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Office of Basic Energy Sciences

Accomplishments

FY 1994

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Major Facilities Construction Highlights

Advanced Photon Source

Semiannual Review of Advanced Photon Source Project (APS)

A Construction Project Management Review of the APS Project was conducted at Argonne National Laboratory on November 15-17, 1994 by the Office of Basic Energy Sciences and the Office of Management. The Review Committee consisted of Mr. James Carney, Construction Management Support Division, Chairman; Robert A. Zich, Acquisition and Assistance Management Division; Office of Basic Energy Sciences' Drs. Albert E. Evans, Frederick A. Koomanoff, William T. Oosterhuis, and Walter M. Polansky, together with eleven peer reviewers from DOE Laboratories. Also present were Mr. Matthew Cole from the Office of Environment, Safety, and Health Technical Support, Dr. Bal Mahajan of the Office of Performance Assessment, and Edward F. Koch from the Office of Field Management. The Committee is pleased to report that the APS Project is meeting budget ($811.9 Million Total Project Cost) and time schedules. Construction of the accelerator should be complete by January 1995. All construction, now mostly office and laboratory space, should be completed by February 1996. Commissioning, now underway, should be complete well in advance of the December 1996 date scheduled for the start of routine operation.

Development of Non-Polluting Process for Cleaning Metal Receives Award by the State of Illinois

The Advanced Photon Source (APS) scientists, engineers, and technicians have combined their efforts and ideas to develop an alternate process for chemically cleaning aluminum-alloy vacuum chamber sections prior to their installation into the APS. The result of their efforts was the elimination of 3,000 gallons of hazardous chemical waste per month and an estimated cost savings for waste removal of $300,000 in the first year. Their new process utilized a combination of an alkaline detergent bath and high-frequency sound waves in lieu of the caustic lye treatment that typically is used for this type of cleaning operation. The used alkaline solution was then easily handled by the Argonne waste-water treatment plant. The staff is now adopting the process to clean other metals used in the APS, such as stainless steel and copper.

Representatives from DOE-Chicago Operations Office/Argonne Area Office (DOE-CH/AAO) and Argonne National Laboratory (ANL) attended the Eight Annual Governor's Pollution Prevention Awards Ceremony in Springfield, Illinois on September 21, 1994. The ceremony was hosted by the Hazardous Waste Research and Information Center within the Illinois Department of Energy and Natural Resources. State Senator John Maitland, on behalf of Governor Edgar, presented a certificate of recognition to ANL for pollution prevention during the past year on the APS, Creig Zook (Acting Director, DOE-CH Laboratory Management Support Division) and John Noonan (ANL/APS) accepted the certificate on behalf of ANL.

"Mini-Review" of the Advanced Photon Source Project was Held at Argonne National Laboratory

A "Mini-Review" of the Advanced Photon Source (APS) Project was held at Argonne National Laboratory on September 7, 1994. The purpose of the review was to examine the operating expenses (the R&D and commissioning) for the APS project, to check on the progress of the construction, and to set up the Semi-Annual Review which will take place in November 15-17, 1994.

The project continues to make extremely good progress. The storage ring assembly is expected to be complete by the end of calendar 1994, so that commissioning of the APS storage ring can begin in January 1995.

The R&D to develop innovative ways to generate, handle and utilize these very intense X-ray beams has gone well. As a result of the R&D, orders for several insertion devices have been placed and the first of these has been delivered and successfully tested. The HASYLAB in Germany has purchased an undulator (magnetic insertion device) designed by APS and manufactured by STI Optronics. This is an example of the transfer of technical information to a small U.S. business, and export of a manufactured product. This undulator will be tested at APS on their automated magnet measuring device.

Beamline front-ends and insertion devices will be provided to users by the APS, which will reduce the cost for instrumenting each beamline by a considerable amount to each of the Collaborating Access Teams (CATs). High heat load optical elements have been devised by the APS staff and several orders based on APS prototypes have been placed. An innovative, Ice-Based Thermal Storage System is being developed for chilled water to reduce the operating costs for the APS.

APS has instituted a "Safety Partnering Program" and has invited safety people from DuPont to review and advise ANL on its safety program. Several of the CATs are close to putting beamline instrumentation on the experimental floor.

Advanced Photon Source Users Meeting

The Sixth Users Meeting for the Advanced Photon Source will be held May 15-16, 1994, at Argonne National Laboratory. Users from Collaborating Access Teams and general users will receive an update on the progress of the Advanced Photon Source and will exchange ideas and designs for beamline instrumentation to better exploit the unique properties of the Advanced Photon Source. The Advanced Photon Source is now installing the Storage Ring components with the goal of finishing the installation to begin commissioning of the Storage Ring by January 1, 1995. William T. Oosterhuis will be attending this meeting from the Division of Materials Sciences/Office of Basic Energy Sciences.

Semi-Annual Review of the Advanced Photon Source Project

A Department of Energy Review Committee met at Argonne National Laboratory on April 12-14, 1994, for its Semi-Annual Review of the Advanced Photon Source. The Department of Energy Review Committee included six people from Energy Research, three from the Argonne Area Office, and nine consultants from various DOE laboratories. The Advanced Photon Source personnel presented overviews on the status of the construction project with regard to cost, schedule, management, technical systems, and Environment, Safety and Health. No major concerns were found. The project continues to make excellent progress with the expectation of completion on time and within budget.

Completion of the Advanced Photon Source Level 1 Milestone: Initiate Injector Synchrotron Commissioning

The injector synchrotron has been installed, individual components have been tested, and an Accelerator Readiness Review has been completed. Authorization to begin commissioning has been granted by the authorizing official (C. Langenfeld, Chicago Operations Office). A beam of 300 million electron volt electrons from the linear accelerator was injected
into the synchrotron on April 21, 1994. Machine physicists are currently working to raise the injection energy of the electron beam to 400 million electron volts before focussing their attention on storing the beam in the booster synchrotron.

Invention at the Advanced Photon Source Recognized by National Award
National Awards Being Presented

Argonne National Laboratory will be receiving the National Pollution Prevention Award for Zero Generation. The text below is taken from the script for the award. The award will be presented by Bill White, the Deputy Secretary.

> The highest measure of source reduction is whether wastes from a process can be designed away to zero. "Zero Generation" is a lofty standard; all the more reason to recognize those that attain it.
>
> The Advanced Photon Source at Argonne National Laboratory requires the use of metal components with a high level of cleanliness. Originally, plans called for extensive use of hazardous solvents for cleaning. Original projections called for the generation of 3,000 gallons of hazardous solutions per month. Waste disposal costs would have been an astounding $300,000 per year. When training, protective equipment, and compliance costs were added, the total could very well have reached $600,000 per year.
>
> Instead, Argonne engineers redesigned the entire process, from component fabrication to cleaning. Now no hazardous waste generation is projected from the process, saving $600,000 per year.

Materials Sciences Program Summary Book for Fiscal Year 1993 Available

One primary mechanism of information transfer and outreach to our customers is the annual publication of research program summary books for each of the five Division of the Office of Basic Energy Sciences. The general wide-spread dissemination of detailed information about all current activities supported by the Basic Energy Sciences program is tremendously useful to those seeking support for their research as well as those who are interested in developing partnerships with the program.

Materials Sciences Programs Fiscal Year 1993 is the most recent annual program summary book for the materials sciences research programs that are funded by the U. S. Department of Energy/Office of Basic Energy Sciences/Division of Materials Sciences. The contents of this multiply indexed 173 page book include program descriptions for 472 research programs including 219 programs at 14 DOE National Laboratories, 242 research grants (237 of which are at universities), and 11 Small Business Innovation Research grants. Five cross-cutting indices identify all 472 programs according to principal investigator(s), materials, techniques, phenomena, and environment. Other contents include a bibliographical listing of 43 publications on select topics, such as scientific workshops that identify materials science research needs and opportunities; descriptive summary and access information on 14 national research user facilities including synchrotron light sources, neutron scattering, electron beam microcharacterization, materials preparation, surface modification, and combustion research; descriptive summary of the DOE Center for Excellence for Synthesis and Processing of Advanced Materials; and an analytical summary of funding levels. Copies are available by calling (301)-903-3427.

Advanced Photon Source Mini Review to be Held

A "mini review" of the Advanced Photon Source Construction Project will be held at Argonne National Laboratory on January 27, 1994. The purpose of this review will be to examine the research and development program and other operating expenses such as commissioning of the facilities. In addition, the mini review will make plans for the next semiannual review to be held in

mid April. DOE/Headquarters will be represented by Dan Lehman, Ron Yourd, Bill Oosterhuis and Walt Polansky and they will be joined by the Advanced Proton Source project manager (Bob Wunderlich) and his staff from the Argonne Area Office.

Safety at the Advanced Photon Source

The Semiannual review of the Advanced Photon Source Construction Project was held on November 2-4, 1993, at Argonne National Laboratory. Dr. Bal Mahajan was invited to attend the review with the goal of:

1) Familiarization of the Offices of Environmental Health with the Advanced Photon Source Project as we go forward from the construction phase to the commissioning and eventual operation of the Advanced Photon Source.

2) To solicit advice as to how Basic Energy Sciences/Advanced Photon Source might become the best it can be in the Environmental Safety and Health area, and in meeting various DOE requirements in Environmental Safety and Health.

A memorandum was received from the Director of the Office of Performance Assessment (Environmental Health) which noted that "a series of effective safety, health, and quality assurance programs including some outstanding proactive practices have been implemented at the Advanced Photon Source. In his (Dr. Mahajan's) opinion, the Advanced Photon Source Director's introduction of the "personal safety assessment" and the "individual safety envelope" qualify as noteworthy practices. "These innovations provide excellent examples of total quality management in the area of hazard communication."

Advanced Photon Source Begins Noteworthy Health and Safety Practice

The management of the Advanced Photon Source at Argonne National Laboratory has instituted a new safety and health initiative whereby each Advanced Photon Source employee will prepare in his own words an individual personal safety assessment or "safety envelope." The safety envelope encompasses the duties of the employee, the potential hazards associated with these duties, the training and experience which the employee has had or needs to deal with these hazards, and the safety practices, documents, and other means of guidance which the worker should follow to protect himself and fellow workers from the hazards. This initiative is cited by the Office of Basic Energy Sciences/Division of Materials Sciences as a noteworthy practice in Environment, Safety, and Health.

Semiannual Review of Advanced Photon Source

A semiannual management review of the Advanced Photon Source (APS) Project was conducted at the Argonne National Laboratory on November 2-4, 1993. The APS Project, a 7-GeV synchrotron radiation facility scheduled for completion in December of 1996, has a total estimated cost of $467 million and a Total Project Cost of $812 million. Conventional construction is over 70% complete. The first technical module, the injection linear accelerator, has been installed and is now undergoing commissioning. The Review Committee consisted of representatives from the Construction Support Division of the Energy Research Office of Management, from the Office of Basic Energy Sciences, and technical experts of DOE facilities. The Committee found the project to be well managed, on schedule, and within budget.

Basic Scientific Advances
Examples of Research Highlights

Destruction of Dioxins in Soil

A recent Environmental Protection Agency reassessment of the health risks of dioxins has concluded that dioxins and related chemicals are a probable cause of cancer in humans. Environmental groups view dioxins as a public health threat and advocate elimination of as many sources as possible. The organization Greenpeace is demanding a moratorium on construction of incinerators that burn chlorinated hydrocarbons. The alternatives to incineration are bioremediation, chemical dehalogenation, and ionizing radiation.

At the University of Notre Dame, Department of Civil Engineering, radiolytic decomposition of dioxins in soil has been researched as the subject of a doctoral dissertation. The studies have concluded that radiolytic destruction of 2,3,7,8-tetrachlorodibenzo-p-dioxin, the most toxic form of dioxin, is both technically and economically feasible. The fundamental basis for the interaction between the radiation and the dioxin molecule and the dioxin's decomposition pathways, involving successive dechlorination, were identified in controlled samples of contaminated soils. The dioxin project, supported by Occidental Petroleum, has made extensive use of the cobalt-60 gamma irradiation sources and analytical instrumentation of the Notre Dame Radiation Laboratory, which is funded by the Office of Basic Energy Sciences/ Division of Chemical Sciences.

Understanding Grain Boundaries in High Temperature Superconductors

A method for understanding grain boundaries in polycrystalline materials was demonstrated by using state-of-the-art transmission electron microscopy in combustion with an extension of an established theoretical analysis. Yimei Zhu and Masaki Suenaga, of Brookhaven National Laboratory, examined grain boundaries in a yttrium-barium-cuprate high temperature superconductor, $YaBa_2Cu_3O_7$, to determine the grain-boundary structure and composition on an atomic scale. A geometrically based theoretical analysis, the constrained coincidence-site method, which is well established for the analysis of the atomic structure of grain boundaries in cubic materials such as copper, was extended to the much more complex structure of the cuprate superconductors. The information derived from the experiments and the theoretical analysis was shown to be crucial in understanding why some grain boundaries, while not others, can transport high currents with no electrical resistance, a characteristic which makes a superconductor technologically useful for magnets, power lines, etc.

Many of the properties of materials, especially electrical and magnetic properties, are strongly influenced by the structure and composition of the boundaries of crystalline grains. Analysis of the structure of grain boundaries provides a fundamental basis for understanding important properties such as strength and electrical conductivity. In recent years, much progress has been made in understanding the detailed atomic structure of grain boundaries in elemental metals such as copper and in simple alloys having cubic crystal structure. However, this has not been possible for materials such as the cuprate superconductors because of their complex structures and the poorly understood nature of interatomic bonding in these materials. This extension of the constrained coincidence-site lattice method to grain boundaries in a complex material opens the way for this method to be used for other technologically useful materials with complex crystal structures.

Fundamental Research in the Geochemistry of Hydrothermal Systems

Juske Horita and David Wesolowski at Oak Ridge National Laboratory have obtained high-precision

measurements of the oxygen and hydrogen isotope fractionation between water and steam at elevated temperatures (25°C to 350°C). The new results can be used to characterize reservoir temperatures of geothermal energy resources and to model water cycles in the atmosphere and at the surface. Horita and Wesolowski calibrated model expressions for temperature variations between liquid and vapor water isotopes with published data and the new high-precision, high-temperature results. Their work helps in determining geothermal reservoir sources and temperatures from collected water and steam samples because their model is less sensitive to inherent sampling problems including partial condensation of steam.

The research was supported by the Office of Basic Energy Sciences/ Geosciences Research Program, in conjunction with DOE's Office of Energy Efficiency and Renewable Energy and the Postdoctoral Research Associates Program.

Basic Research in Rheology and Multiphase Flow Helps Maintain Productivity of Gas Wells

One of the fundamental engineering research projects supported by the Office of Basic Energy Sciences/Engineering Research Program and carried out jointly by the Massachusetts Institute of Technology (MIT), Sandia National Laboratory (SNL), and Los Alamos National Laboratory (LANL) addresses the behavior of very dense suspensions. The results of the effort are now used by natural gas well operators to reduce the cost of gas recovery. So-called proppant, i.e., the porous substance used to keep open the cracks in the rocks through which gas flows from the underground reservoir to the surface, must be immobilized. Without modification the usual proppant, such as sand, tends to flow out from the rock cracks, dragged by the gas outflow causing the cracks to close and thereby shutting off the gas flow. Better understanding of this multiphase flow, together with the results of the MIT-SNL-LANL research have led to the use of special fibers which immobilize the proppant, but do not inhibit the gas flow.

Induced Seismicity Near the Lacq Gas Field, Southwestern France

With joint support from the U.S. Geological Survey and the Office of Basic Energy Sciences/Geosciences Research Program, Paul Segall of Stanford University and colleagues A. Mossop of Stanford and J.-R. Grasso of Grenoble's Laboratoire de Geophysique Interne et Tectonophysique, Observatoire de Grenoble, have investigated the causes of hundreds of shallow low-magnitude earthquakes that have occurred near the Lacq deep gas field of southwestern France. The field is the major natural gas producing field in France. Using a model for poroelastic stressing associated with volumetric contraction caused by gas production, Segall and colleagues show that the predicted displacements and stress fields of the Lacq region compare well with measured subsidence and hypocenter distributions. These results suggest that very small stress changes (0.1 MPa or less within the rock), which correspond to gas reservoir pressure drops of only 30 MPa, were capable of triggering earthquakes at the Lacq field. Segall et al.'s poroelastic model can also be used to constrain the magnitudes of regional deviatoric stresses from known reservoir pressure changes, which are important in predictions of likelihood of failure in the earth's crust.

How Applications Derive from Basic Research, as Seen Through Glass

The following account illustrates the serendipity of science for one research area at Oak Ridge National Laboratory (ORNL), and how we cannot completely direct how science develops. Research that began with waste remediation has resulted in new optical glasses and associated devices developed by different ORNL groups involved in different aspects of photonics research.

Several years ago, while researching methods for encapsulating and disposing of nuclear waste in glass, Solid State Division at ORNL found that the chemical durability of lead phosphate glass could

be significantly increased by adding certain elements to it. Adding iron, for example, produced a stable, easy to make - although inky black - glass that bound readily to nuclear waste elements. These properties appeared to be a custom fit for nuclear waste disposal; however, nuclear policymakers pursued other directions and the ORNL phosphate glass has not, as yet, made the technological short list of materials for radioactive waste disposal.

Despite that turn of events, Solid State researchers Lynn Boatner and Brain Sales believed that they have a potential useful material. "We asked ourselves if there were other elements that would increase the chemical durability of lead phosphate glass without turning it black." They found that adding either indium or scandium to the glass instead of iron produced a clear, colorless, stable glass. The researchers then experimented with lead-iron phosphate glasses to which they added alkali elements, and with the help of Christina Sanchez, a graduate student, they were able to produce glasses with thermal expansion coefficients almost identical to certain important metals like stainless steel and aluminum. These developments allowed them to fabricate a variety of glass-to-metal seals.

Another property, however, caught Engineering Technology Division researcher Steve Allison's attention: the lead-indium phosphate glass has a very high index of refraction. This property means that a glass fiber, for example, can collect light from a much broader angle than conventional glass, making it a potentially useful material for light sensors, amplifiers, laser applications, and imaging light guides. The light rays striking the end of the fiber from wide angles are collected along with light from directly in front, an effect that could have illumination applications as well as light sensing and amplification. Indium glass lenses also exhibit another useful property: unlike conventional glass lenses that become brown and opaque when exposed to radiation over time, i.e., the lead-indium phosphate glass is radiation resistant. For example, ORNL's indium glass was successfully used by researchers at Lawrence Livermore National Laboratory who operated the first lasers based on the radioactive element promethium.

Boatner and Sales pointed to recent efforts to bring photonics-related research together as a multidisciplinary ORNL strength, declaring the work with single crystals and doped glasses a good fit for this endeavor. "See what happens when you get materials people together with people who know applications." Boatner said, referring to Allison's quest to put this promising new material to use. Some of those uses, include fiber-optic gyroscopes, optical time-delay components, medical lasers, and special lenses for semiconducting laser diodes. Several companies have recently expressed an interest in cooperative research and development agreements.

Suppression of Radiation Damage of Ceramics for Fusion Applications

Scientists at Los Alamos National Laboratory, funded by the Office of Basic Energy Sciences, have demonstrated that proper selection of the stoichiometry (chemical balance) of an electrical insulating compound can lead to greater resistance to radiation-induced physical changes. This phenomenon has important applications for ceramic components in fusion reactors. Specifically, spinel is a candidate insulating materials for lightly-shielded magnetic coils and radio-frequency heating system windows in fusion reactors. Stoichiometric spinel has the atomic composition of $MgAl_2O_4$, meaning that there are four oxygen atoms for every two aluminum atoms and one magnesium atom. By adding extra aluminum and oxygen atoms, this compound becomes non-stoichiometric and also more resistant to radiation damage in the fusion reactor. Radiation-induced amorphorization (glassy phase) is undesirable because it changes the materials size and shape, and alters its needed electrical and optical properties. Materials that are resistant to radiation-induced amorphorization are expected to have much longer service lifetimes in fusion reactors.

Caffeine Production by Supercritical Carbon Dioxide Extraction Process

Research at the Oak Ridge National Laboratory supported by the Office of Basic Energy Sciences, Division of Chemical Sciences, has demonstrated the technical feasibility of the supercritical carbon dioxide extraction process for the production of caffeine from Brazilian guarana seeds. There is a substantial global demand for caffeine to be utilized in food and pharmaceutical products, and the Brazilian guarana seed has the highest caffeine content of any known natural product. Previous work had explored caffeine recovery from guarana seeds with conventional liquid extraction using the chlorinated hydrocarbon methylene chloride. However, extraction with supercritical carbon dioxide offers substantial health, safety, and environmental advantages. This work has generated fundamental data on the thermodynamics and kinetics of the extraction and has generalized these data into useful engineering models.

Geologic Generation of Hydrocarbons Under Investigation

Dr. Jeffrey Seewald of Woods Hole Oceanographic Institution, with support from the Office of Basic Energy Sciences/Geosciences Program and the National Science Foundation, has performed experiments to test models for hydrocarbon production in geologic environments (Nature, vol. 370, p. 285, 1994; see also Price's related commentary, ibid., p. 253). Contrary to the standard model for oil and gas generation, involving thermolytic decomposition of organic matter (kerogen) under mainly closed-system conditions, Seewald's results support a growing body of evidence for reaction of circulating water and (inorganic) rock with kerogen to form hydrocarbons. In laboratory experiments at temperatures as low as 325°C, inorganically buffered aqueous assemblages of ethene and ethane metastably equilibrate in less than one month. Seewald's experiments demonstrate a possible reactive link between inorganic and organic constituents of oil and gas-producing sedimentary basins: reactions among water and iron-bearing minerals in a heated sedimentary basin participate in controlling the oxidation and reduction of organic matter to form oil and gas. Further, although kinetic barriers can prevent the entire system from equilibrating even during geologic timescales, local and metastable equilibrium among water, organic phases and inorganic minerals is reached within days. As noted by Price, these results are consistent with recent calculations of metastable equilibria by Basic Energy Sciences/Geosciences supported researchers Helgeson and Shock, at the University of California at Berkeley and Washington University, respectively (Geochim. Cosmochim. Acta, 57, p. 3295; 1993).

Micromechanical Devices Made from Single-Crystal Diamond

Scientists at the Oak Ridge National Laboratory have, for the first time, produced freestanding single-crystal diamond microstructures. The success resulted from the combining of two novel experimental techniques. First, an ion implantation technique was used to lift-off a thin diamond film. Then, the appropriate microstructure was engraved from the diamond film with a focused excimer laser. A variety of microstructures are possible. The most practical is a twelve tooth gear, approximately 400 micrometers in diameter and 13 micrometers thick. Similar microstructures, made from silicon, have been used in tiny electrostatic motors which can be used in microrobotic applications. Many properties of diamond make it even more attractive for such micromechanical applications. Diamond micromotors could operate at higher rpm and should last much longer than similar silicon devices. In addition, diamond micromachines could be used in much harsher environments. The work has been supported by the Office of Basic Energy Sciences, Division of Materials Sciences.

Origin of Natural Gas May Involve Natural Catalysts

Professor Frank Mango (Rice University), supported by the Office of Basic Energy Sciences/

Geosciences Program, has obtained experimental data supporting the concept that naturally occurring catalysts in sedimentary source are important in the conversion of kerogen to natural gas (methane). The prevailing model for the origin of natural gas is thermolytic decomposition of kerogen even though the pyrolysis does not yield the naturally observed methane fraction. With coworkers at Rice University and Exxon Production Research, Dr. Mango demonstrated that an appropriate methane concentration could be produced in the presence of the source rock, but not in its absence, under geologically reasonable pressure and temperature conditions. The specific constitution of the natural catalyst has not been determined but is the subject of active current research. The results, while still controversial, have been reported in Nature (368, p356, 1994) and highlighted in the April 11, 1994, issue of Chemical and Engineering News (p. 4-5). As the authors note in the Nature paper, "Our results verify the existence of an alternative, catalytic pathway to natural gas. If it proves to be significant, it could alter the way in which we view the generation and distribution of oil and gas in the Earth."

New Equation of State Provides Broader and More Accurate Predictions of Engineering Properties of Fluids

Investigators supported by the Office of Basic Energy Sciences/Division of Chemical Sciences at the Oak Ridge National Laboratory, as part of their development of molecular-based models for supercritical extraction, have developed a generalized quartic equation of state for the calculation of a variety of thermodynamic properties of fluids. The chemical, petroleum, and other industries make extensive use of equations of state for process design and development calculations. This new equation is substantially more accurate and of relative simplicity compared to the more narrowly-scoped cubic equations of state currently popular in industry. The Oak Ridge group recognized that the cubic equations were based on a fundamentally incorrect molecular model for the repulsive part of molecular interactions and that a quartic equation offered a much more accurate model.

Synthesis of Semibuckminsterfullerene - A "Buckybowl"

Professor Peter Rabideau and his team of organic chemists at the Louisiana State University report the first synthesis of a semibuckminsterfullerene, a $C_{30}H_{12}$ compound, in his study of bowl-shaped hydrocarbons whose carbon frameworks represent some portion of the soccer-ball-shaped carbon compound, buckminsterfullerene, or "buckyball". This work is supported by the Office of Basic Energy Sciences' Division of Chemical Sciences, and was reported in the ER News (August 1994) and Chemical and Engineering News (August 29, 1994). This "buckybowl", one of several possible configurations, contains two 5-carbon rings and eight 6-carbon rings which force a bowl-shaped conformation having a 2.70 Angstrom depth. This curvature is significantly greater than that of the $C_{20}H_{10}$ compound, corannulene bowl, reported by Professor L. T. Scott, and which has a depth of 0.89 Angstrom. The chemistry of these very unusual compounds, including their ability to complex metal ions, is just beginning to be explored.

Stanford Synchrotron Radiation Laboratory (SSRL) Completes Highly Successful Experimental Run

August 17, 1994, marked the end of 28.5 weeks of experimental running on SSRL's 22 stations. The run was the most successful ever with an overall delivery of 89% of the scheduled user shifts (a 5% improvement in delivery from the previous year). Experimenters from 167 institutions performed 203 experiments. Approximately 560 researchers came to the facility to actually participate in these experiments.

The improvements to the radiation storage ring (SPEAR) orbit, as part of the global feedback system program, were particularly noticeable to users. The standard deviation of beam movement (both planes) in the last half of the run was 80 microns. This is a significant improvement from last year

when the movement was 400 microns in the horizontal and 200 microns in the vertical.

The next experimental run is scheduled to begin December 5, 1994.

Structure and Chemistry of Electronic Ceramic Interfaces Revealed

For the first time, researchers at Oak Ridge National Laboratory have determined concurrent atomic and chemical structure of electroceramic interfaces. The atomic structure of grain boundaries in electroceramics such as $SrTiO_3$ govern a variety of macroscopic electrical properties including their technologically important nonlinear I-V characteristics. An understanding of the relationship between the atomic structure and the electrical properties of the individual grain boundaries requires an atomic scale investigation of both the composition and chemical bonding at the boundaries. This was achieved by the team at Oak Ridge by applying atomic-resolution Z-contrast imaging to examine specific atoms in the interface in combination with atomic resolution electron energy loss spectroscopy which reveals chemical bonding characteristics. These structural studies, when correlated with electrical characterization, will now enable the relationship between grain-boundary structure and physical properties in electroceramic materials to be determined.

New Method "Fingerprints" Oil Samples

Los Alamos National Laboratory researchers John Musgrave, David Janecky, C. Drew Tait, supported by the Office of Basic Energy Sciences/Division of Engineering and Geosciences, and collaborator R. Carey (Scientific Instrument Co.), have developed a new technique useful for identifying oil sources from micro-liter samples. The instrumentation they developed for obtaining synchronously-scanned luminescence spectra from microscopic samples greatly facilitates analysis of organic compounds from single oil-bearing fluid inclusions. Other micro-analytic methods are complicated by rock matrix interference or degradation during sample preparation and analyses. Fine-scale variations in type and concentration of various organic markers in trapped oil can be used to evaluate migration and maturation of oil within producing fields, "fingerprint" oil sources, and characterize oil degradation and cementation processes within hydrocarbon reservoirs.

Combination of Techniques Leads to Super Sensitive Analysis

Research at the Oak Ridge National Laboratory supported by the Office of Basic Energy Sciences/Division of Chemical Sciences has developed a unique combination of two diverse analytical techniques that has demonstrated major increases in sensitivity for the monitoring and characterization of environmentally and biologically important metals. The already high sensitivity and versatility of inductively-coupled plasma mass spectrometry (ICP-MS) has been further improved by using electrochemical stripping analysis (ESA) to preconcentrate metal ions from solutions containing trace amounts of metal ions. Commercial instrumentation for inductively-coupled plasma mass spectrometry is used for the analysis of trace metals with detection limits for direct analysis in the 1-100 parts per trillion range. The electrochemical stripping analysis technique preconcentrates metals by 100-1000-fold. For example, the detection limits for the metal thallium are now in the 10 parts per quadrillion range. Further advances are anticipated as the method is optimized, and similar success is expected for the other metals of interest such as lead, cadmium, zinc, and copper.

Improved Diamond Films Grow from Buckyball Process

Articles in the July 29, 1994, issue of Science, the July 30, 1994, New Scientist, and the August 15, 1994, issue of Business Week highlight a new discovery at the Argonne National Laboratory in which diamond films are grown using fullerene (commonly referred to as buckyball) precursors in an argon microwave plasma without the addition of hydrogen or oxygen. Growth rates with this new technique

are at least four times faster than the traditional methods. If the technique can be scaled up, it promises to lower the cost of diamond films by as much as 75 percent. The combination of outstanding physical properties of diamond, i.e., its exceptional hardness, thermal conductivity, electrical resistance, chemical inertness, optical transmittance, electrical carrier mobility, dielectric breakdown strength, etc., has led to a worldwide effort to optimize thin-film growth of diamond. The Science article projects the market for diamond films to soar to $4.5 billion by the year 2000. The Argonne scientists, Dieter Gruen and Alan Krauss, are supported by the Materials Sciences Division for the basic science studies and by the Advanced Energy Projects Division to optimize the microwave deposition parameters. Negotiations are underway with two electronic companies to develop new uses of diamond films, e.g., to absorb heat from computer chips or serve as coatings for computer hard drives.

Combustion Processes Can Now be Measured by New Technique

A new method for monitoring combustion intermediates has been developed by scientists at the Combustion Research Facility (CRF), Sandia National Laboratories, California, with support from the Chemical Sciences Division of the Office of Basic Energy Sciences. The exciting feature of this method is that it is, in effect, self calibrating. The use of spectroscopy to measure species concentrations in solution or the gas phase has been used for decades and is based on measuring the spectral response of the species at known concentrations and thereafter determining its concentration from measurements of its spectral response. This is fine for stable species where test samples of known concentrations can be prepared. It cannot be done, however, for the unstable intermediates characteristic of combustion. These unstable intermediates are critically important for determining the properties of combustion systems. Such well-known phenomena as engine knock and NO_x emissions result from the chemistry of unstable intermediates. Models for designing new combustion systems must be able to predict the behavior of the unstable intermediates and techniques have been sought for their measurement in combustion systems for years.

The new technique developed at the CRF is based on a combination of two independent measurements. Both measurements are spectroscopic, but each method has a different dependence on the species concentration and on its controlling spectroscopic parameter, the so-called line strength. From the two spectral responses, two functions of two unknowns, the needed line strength can be determined and used for simpler, single technique measurements. This duplex technique will allow more widespread and accurate measurements to be made for the characterization of combustion systems. The method has recently been reported in the June 17 issue of *Science* and was highlighted in that issue's "This Week in Science" column.

Solvent Reorientation Sheds Light on Solar Energy Conversion

The conversion of solar energy into useful energy forms is scientifically complex and technologically difficult. While the final form of an efficient conversion device or system has not been defined, possible forms include solid state photovoltaics, coated semiconductor electrodes, as well as other homogeneous and heterogeneous systems. However, studies of homogeneous solutions provide much information which can be applied to the ultimate construction of heterogeneous systems.

For example, the interpretation of transient electronic processes in solution including electron transfer requires an understanding of the molecular dynamics of solvents where the reorientation (relaxation) of the solvent around nascent charges defines the completion of a charge transfer process. In recent optical studies, performed by Dwayne Miller at the University of Rochester, in the femtosecond (10^{-15}s) to picosecond (10^{-12}s) time frame it has been shown that, at least in water, different types of molecular motions can be identified that provide a microscopic picture of solvent reorientation. It appears that relaxation is determined largely by hindered translational motion rather than

intermolecular molecular vibrational action. Such seemingly esoteric information will, undoubtedly, prove useful in the future for development of efficient solar conversion devices.

Environmentally Benign and Energy Efficient, Photoassisted Chemical Syntheses Discovered

A new technique has been developed for selective conversion of small abundant hydrocarbons to industrially important intermediates using red and near-infrared light. The environmentally friendly photochemical reaction pathways were discovered by Heinz Frei and coworkers at Lawrence Berkeley Laboratory, with support from the Office of Basic Energy Sciences/Division of Chemical Sciences. The reactions take place inside the pores of inert solid, honeycomb materials known as zeolites, at room temperature. The walls of the zeolite cages stabilize tightly held pairs (charge transfer complexes) of hydrocarbon and oxygen molecules, allowing the photochemical reactions to be driven by inexpensive low-energy infrared photons from a conventional tungsten lamp, instead of ultraviolet light most often used in photochemistry. The infrared photochemical reactions are more selective, producing chemicals such as acrolein from propylene, and benzaldehyde from toluene, without unwanted side reactions which necessitate distillations or release of carbon dioxide, the major contributor to the greenhouse effect. The research has generated inquiries for more information from major chemical companies.

Mechanism for Sulfur-Induced Corrosion Elucidated

Dr. Jeffrey Kelber, University of North Texas, Denton, Texas, whose research is funded by the Division of Materials Sciences, Office of Basic Energy Sciences, has obtained further results which yield significant new insights on the mechanisms of sulfur-induced corrosion in the power plant environment. A major cause of corrosion and materials failure in power plants is sulfur contamination which can arise from ubiquitous environmental sulfur or from internal impurities in the material. Sulfur contamination degrades the stability and protective nature of the oxide overlayer, causing catastrophic failure. Such failure translates into several billion dollars a year in materials replacement costs in electric power plants.

The precise microstructural mechanism which leads to the destabilization of the oxide layer is the subject of Dr. Kelber's research. By growing oxide overlayers (scales) on pure iron polycrystalline samples possessing a single monolayer of sulfur and under rigorously controlled ultrahigh vacuum conditions, Dr. Kelber is able to conclusively demonstrate that sulfur-oxygen bonds and the formation of sulfur dioxide is connected to the sulfur-induced instability of oxide scales. These experiments disprove previous claims that sulfur-sulfur clusters were the primary species present a the interface. Future studies will focus on the prevention of such corrosion via appropriate modifications to the chemistry of the metal/oxide interface. This basic materials science research underpins Dr. Kelber's current applied research program with the Electric Power Research Institute (EPRI).

Synchrotron Radiation Used to Study Mineral Surface

Investigators at Argonne National Laboratories and Northwestern University have applied a new technique to study mineral surface reactions. This technique takes advantage of the high x-ray flux provided by synchrotron radiation to image locations of impurity atoms by analyzing reflectivity and fluorescence yield from x-ray standing waves generated inside near-perfect single crystals of calcite ($CaCO_3$). Trace amounts of Pb that dissolved in calcite from dilute aqueous Pb-solutions have been interpreted to be 2/3 distributed in substituted, undisplaced Ca positions on the crystal surface, with the remaining 1/3 disordered. The replacement of trace amounts of Pb for Ca without generating more than localized lattice strain is unexpected in view of its much greater size. In the future, applications of this approach will be applied to in-situ observations of sorption on the calcite-liquid interface, using the higher x-ray fluxes generated at the European Synchrotron Research Facility and

the Advanced Photon Source facility.

This study provides the first direct observations of the process of Pb uptake by calcite, the major constituent of limestone. Understanding the rate and mechanisms for trace metal sorption and desorption on calcite surfaces is fundamental information for assessing the effectiveness of local trapping, or release, of heavy metal contaminants in groundwater.

The research was jointly supported by the National Science Foundation, the National Institutes of Health and the Geosciences Research Program in the Office of Basic Energy Sciences. X-ray standing wave experiments were performed at the National Synchrotron Light Source, Brookhaven National Laboratory, an Office of Basic Energy Sciences-supported facility.

"Molecular Velcro" Polymers Offer Rational Design of High-Strength Polymer Composites

In a paper accepted for publication in Science, Anna Balazs and collaborators at the University of Pittsburgh, Miriam Rafailovich and collaborators at the State University of New York at Stony Brook, together with scientists at Bellcore in Red Bank, New Jersey, and at Exxon Research and Engineering Company, describe the successful design of graft copolymers that act as "molecular velcro" dramatically improving the mechanical properties of polymer composite material and significantly increasing the variety of materials that can be used for multiphase and multicomponent composite materials. This industry-university collaboration involves theoreticians at the University of Pittsburgh whose predictions were confirmed by the Stony Brook-industry collaboration.

Desirable polymer properties are commercially achieved by blending or alloying different polymeric components. The actual fabrication of polymer blends poses significant challenges. Most polymers are immiscible and, thus, the components separate into phases with distinct, macroscopic domains. In order to enhance the structural integrity and mechanical properties of the resulting material, copolymer "compatibilizers" are added to the mixture. These copolymers localize at the interface between the immiscible polymers, lower the interfacial tension, and disperse the incompatible polymers into smaller domains. Consequently, the degree of adhesion between the phase-separated regions and the mechanical properties of the material are significantly enhanced. The new results, presented in the Science paper, allow the rational design of the copolymer side chains such that they interlock across the polymer/polymer interface and effectively fasten to two phase-separated regions, hence, the reference to molecular velcro. These results are particularly important because the interlocking parts of the polymer can be formed from a broad class of polymers and the copolymers can be easily and inexpensively synthesized. Thus, the new design prescription greatly increases the variety of copolymers that can be used for enhancing the structural integrity and mechanical properties of polymer composites.

Charge Transfer System Yields Six New Organic Superconductors with Critical Temperature Approaching a Record High

Argonne scientists have discovered a fascinating new family of organic charge-transfer salts that is the first in a decade to yield multiple superconducting phases in one system. These salts have the chemical formula $(ET)_2M(CF_3)_4.(TCE)_x$, where ET is the organic electron-donor molecule, $M(CF_3)_4^-$ is a discrete TCE inorganic anion in which M represents Cu^{+3} or Ag^{+3}, and TCE is a solvent molecule. To date, six new ambient-pressure superconducting phases of these sale have been identified in a period of a few months, increasing the total number of ambient pressure organic superconductors by 25%. The superconducting transition temperatures (T_c) of these phases are 4.0 and 9.2 K for the $Cu(CF_3)_4^-$ salts and 2.4, 5.0, 9.4, and 11.1 K for the $Ag(CF_3)_4^-$ salts. The discovery of an increasing number of new organic superconductors, and the achievement of continual increases in the maximum T_c of these materials in little more than a decade of research, indicate that

superconductivity in organic compounds is a widespread phenomenon, is capable of achieving T_c's considerably above the present low temperatures, and is a rather fast-paced growth area of basic research. Furthermore, the similarities in the superconducting properties of the organic and high-T_c ceramic oxide superconductors, such as the layered nature of their crystallographic structures, small superconducting coherence lengths, and competing metallic and insulating electronic ground states, suggest the eventual attainment of comparably high T_c's in both classes of materials. An important feature of these new superconducting salts is the incorporation of solvent molecule in the crystal lattice. This renders the salts soluble in organic solvents, which offers possibilities for the formation of thin films and polymer compositions. Finally, this new family of organic superconductors is the first with T_c greater than 10 K to contain a discrete, rather than polymeric, anion. Polymeric anion species are formed by self-assembly in solution, which is an uncontrollable process, thereby precluding the rational synthesis of new superconducting salts. Thus, this discovery of a new family of organic superconductors with $T_c > 10$ K, and based on discrete anions that can be synthesized rationally, opens the frontiers for the synthesis of much higher T_c organic superconductors.

A New Method for Monitoring Combustion Intermediates

A New Method for Monitoring Combustion Intermediates has been developed by scientists at the Combustion Research Facility (CRF), Sandia National Laboratories, California, with support from the Office of Basic Energy Sciences. The exciting feature of this method is that it is, in effect, self calibrating. The use of spectroscopy to measure the concentrations in solution or the gas phase has been used for decades and is based on measuring the spectral response of a species at known concentrations and thereafter determining its concentration from measurements of its spectral response. This is fine for stable species where test samples of known concentrations can be prepared. It cannot be done, however, for the unstable intermediates characteristic of combustion. These unstable intermediates are critically important for determining the properties of combustion systems. Such well-known phenomena as engine knock and NO_x emissions result from the chemistry of unstable intermediates. Models for designing new combustion systems must be able to predict the behavior of the unstable intermediates and techniques have been sought for their measurement in combustion systems for years. The new technique developed at the Combustion Research Facility is based on a combination of two independent measurements. Both measurements are spectroscopic, but each method has a different dependence on the species concentration and on its controlling spectroscopic parameter, the so-called line strength. From the two spectral responses, the two functions of two unknowns, the needed line strength can be determined and used for simpler, single technique measurements. This duplex technique will allow more widespread and accurate measurements to be made for the characterization of combustion systems. The method has recently been reported in the June 17 issue of *Science* and was highlighted in that issue's "This Week in Science" column.

Microearthquake Clusters: Probes for Investigating Fault Zone Dynamics

Analysis of microearthquake clusters from the San Andreas Fault zone near Parkfield, California, by Lawrence Berkeley Laboratory seismologists Nadeau, et al. (Bull. Seismol. Soc. Amer., 84:2, 147-163, April 1994), indicates their utility in monitoring the earthquake nucleation zone for possible precursory changes in physical properties that could signal an upcoming large-magnitude event. The Parkfield segment of the San Andreas Fault zone includes the north-south transition from locked to creeping behavior that spans the currently aseismic hypocenter for the major 1966 event (magnitude 6.6), and may provide a critical test of proposed large-earthquake nucleation models.

Analysis of events from repeated earthquake clusters over the past 37 years, with advanced inversion techniques that provide precise comparisons in source mechanisms and stress conditions, reveals no major change in nucleation-zone properties. Several potentially key properties that should

be monitored, however, include: clustering as the principal mode of small-magnitude seismicity; en-echelon geometry of events within clusters; and elevated pore-fluid pressures near the M 6.6 hypocenter High Vp/Vs ratios, generally interpreted as indicating elevated fluid content, have been located at depths below 5 km in the vicinity of the 1966 epicenter by precise inversion of microearthquake travel times. (However, it is not yet known precisely how high pore-fluid content controls rupturing.)

The research was jointly supported by the National Science Foundation, the U.S. Geological Survey, and the Geosciences Research Program of the Office of Basic Energy Sciences.

New Technique Developed for the Separation of Neutral Organic Molecules

Capillary Zone Electrophoresis (CZE) has become a hot research topic for scientists interested in analytical separations. The technique involves filling a capillary tube with a suitable electrolyte solution and applying a large voltage between the ends of the capillary. Sample ions are introduced into the capillary and move at different rates toward the electrode of opposite charge and are separated. A limitation to the technique has been that it is not generally applicable to neutral molecules that cannot form ions. A variant on CZE called "micelle electrokinetic chromatography" is one answer to separating neutral molecules. However, the use of this technique is restricted by the necessity of using a predominantly aqueous electrolyte and by a rather limited elution window.

Dr. J. S. Fritz and Dr. Youchun Shi at Ames Laboratory have overcome this limitation with an approach that they believe will prove superior to micelle electrokinetic chromatography for the important task of separating and determining non-ionic organic substances. They discovered that by adding a suitable quaternary ammonium salt to the electrolyte and operating in a water-organic solvent containing 40-50% acetonitrile, highly efficient separations are obtained for neutral organic molecules. One class of molecules that can be separated and identified by this new technique are the polycyclic aromatic hydrocarbons, the so called PAHs, many of which have been shown to be powerful cancer-causing agents. The investigators believe the technique will prove to be much more broadly applicable and will offer many new possibilities for more general analytical separations.

Extremely Active Catalysts Now Possible Via New Syntheses of Nanophase Particles

Discrete nanometer-sized particles have received intense scrutiny for their applications in manufacturing catalysts, semiconductors, and non-linear optical materials. This is due to their unique characteristics which are attributable to the effects very small crystalline sizes have on properties such as reactivity and band gaps. However, the lack of suitable synthetic methodologies has hampered research since only microgram and milligram quantities of nanometer-sized particles have been available.

Research funded by the Chemical Sciences Division of the Office of Basic Energy Sciences at Pacific Northwest Laboratories, in supercritical fluids and reverse micelles (supported since the early 1980's), has now provided routes to useful quantities of nanophase particles. Two new particle synthesis techniques have been discovered. They are called the Modified Reverse Micelle (MRM) and Rapid Thermal Decomposition of precursors in Solutions (RTDS) methods. U.S. Patents are pending on both. Each has been used to generate extremely active iron-based coal liquefaction catalysts that are now being used by the DOE's Office of Fossil Energy in their coal liquefaction program.

The Modified Reverse Micelle (MRM) process exploits nanometer-sized water droplets, that act as small "reactors", to limit growth and agglomeration of metal or metal oxide catalytic particles and kilogram quantities of 5-20 nanometer-diameter particles have been made. In the Rapid Thermal

Decomposition of precursors in Solutions (RTDS) process, precursor material is dissolved in water and rapid hydrothermal reactions in a near critical point environment, with extremely fast quenching, limits the particle growth to ultrasmall sizes. The catalytic performance of the materials produced far exceeds that of larger catalyst particles produced by conventional means. Rapid Thermal Decomposition of precursors in Solutions technology was recognized by a Research & Development 100 Award as one of the top 100 inventions in 1993.

These methods can be applied to the generation of a wide range of nanophase materials, powders and composites, and research underway is studying nucleation and growth, multilayered quantum dots and catalysis by these extremely small crystallites.

Dating Young Surfaces Using Cosmogenic He and Ne

Reliable ages for volcanic eruptions during Quaternary time are often difficult to obtain because they are too old for traditional ^{14}C methods and too young for K/Ar dating. The cosmogenic ^{3}He dating method can be used to reliably date rocks erupted during this time period, which is important to geologists establishing the volcanic eruption frequencies or modeling the thermal history of a magma chamber to evaluate a geothermal resource.

A study, being performed by Drs. Poths, Laughlin, Healey, Reneau and Woldegabriel of the Los Alamos National Laboratory, and funded by the Office of Basic Energy Sciences/Geosciences Program, will determine the accuracy and reproducibility of surface exposure dating, using cosmogenic He and Ne. The samples used in this work are from volcanic fields that have been mapped and the deposits dated by ^{14}C, ^{40}Ar-^{39}Ar, U-series disequilibrium, and paleomagnetic secular variation techniques. The area chosen for this specific study is the Zuni-Bandera volcanic field, site of the youngest volcanism in New Mexico.

Cosmogenic ^{3}He surface-exposure dates for three different basalts flows are reproducible, and for this specific area, provided ages of 57,000 to 3,000 years. These are concordant with ^{14}C and U-series dating of the same flows. $^{4}He/^{40}Ar$ ratios can be used to monitor excess ^{40}Ar when dating very young rock samples.

New Class of Superconducting Thin Films Made Possible by Pulsed Lasers

Scientists at the Oak Ridge National Laboratory, supported by the Office of Basic Energy Sciences/Materials Sciences Division, have used pulsed laser deposition methods to create a new class of materials that may become important for superconducting devices. They consist of alternating layers of $BaCuO_2$ and $SrCuO_2$ put down in a special sequence to give the desired properties. Neither layer is stable or superconducting by itself, but in combination they grow as a single crystal on $SrTiO_3$ to create a new type of superconducting thin film with a transition temperature of about 70K. The work is important because it illustrates the power of pulsed laser deposition to artificially control layering sequences on an atomic scale and opens the possibility of engineering novel classes of materials not accessible by other materials synthesis techniques.

Using Magnetic Resonance Imaging to Simulate Behavior in Porous Media

Understanding horizontal convection patterns in porous media is of considerable importance in energy technology areas, namely oil and gas recovery, geothermal groundwater, including pollutants. Researchers at the Duke University, supported by the Office of Basic Energy Sciences/ Engineering program, have developed a novel technique using magnetic resonance imaging (MRI) to obtain clear pictures of such horizontal convection patterns. For this purpose, Dr. Bob Behringer and his group have used a simulation medium consisting of sphere packing.

They have obtained resolutions of velocity, density, and temperature on a scale which is small compared to the physical pore size of a few millimeters.

A key observation from these studies is that the geometry of the matrix has a strong influence on the pattern selection. Experiments with three different horizontal geometries (circular, rectangular, and hexagonal) show strikingly different behavior. In the first case, where there are regions of regular packing separated by boundaries of high permeability, the convection begins at these boundaries and then for high Rayleigh numbers, the high permeability domains pin the convection pattern. In the other two cases, defects are absent in the interior of the packing, but at the edges the permeability is higher. This gives rise to differing behavior in the two cases.

Basic Research on the Structure of Solutions Leads to Theory of Enhanced Oil Recovery

Research supported by the Office of Basic Energy Sciences, Division of Chemical Sciences, in collaboration with Rice University, on the fundamental properties of supercritical fluid solutions, has led to a significant advance in our understanding of the mechanism of oil well fouling and the development of a theory of enhanced oil recovery. The petroleum reservoir phenomena known as "formation damage", which is the reduction in fluid flow due to blockage, may result from the increased aggregation of the asphaltene component in the near-supercritical fluid petroleum in the low pressure region near the wellbore. Fundamental studies of supercritical fluids have revealed the formation of complex micelle and microemulsion aggregates of the molecules in the solutions and how the variable density and pressure of the solutions affects the aggregation process. This understanding of fluid behavior was the critical link to a better understanding of the aggregation of asphaltene colloids in supercritical fluids. Dissolution of these high molecular weight colloids in a supercritical fluid may relieve the blockage and reestablish material flow. The results of this research have been well-received by scientific staffs of oil companies who have made many suggestions for further research.

Design for Tough Structures

Design for safety and long service life of engineered structures is an important aspect of the Office of Basic Energy Sciences/Engineering Research sponsored fracture mechanics investigation being carried out jointly by researchers at the Idaho National Engineering Laboratory (INEL) and Massachusetts Institute of Technology (MIT). Fracture mechanics attempts to ensure structural integrity by applying measurements obtained from laboratory specimens to real structures. Current design and inspection methods are based on the application of geometry-independent data. Nevertheless, crack tip deformation and fracture resistance are only geometry independent within a limited range of loading and geometric conditions, which ensures similar crack tip constraints. The restrictive nature of these size and geometry requirements is a major limitation of the conventionally used fracture studies.

A major accomplishment of the joint INEL/MIT research has been in the development of tools to obtain fracture toughness as a function of constraint so that extrapolation can be made from the laboratory data to real systems. This research has drawn the attention of designers at the Bettis Atomic Power Laboratory, West Mifflin, PA. The potential benefits to design for performance and safety are enormous.

Transport and Chemical Interactions in Petroleum Reservoirs

In a collaborative project involving researchers supported by the Office of Basic Energy Sciences/Geosciences Research Program at Los Alamos National Laboratory (Drs. Dave Janecky and Dale Spall), Mobil Exploration and Producing U.S. (led by Paul Caldwell), and Petrolite to

evaluate waterflood performance for secondary and tertiary oil recovery, isotopic tracers were injected in 6 well sites in the Salt Creek Field in the Permian Basin of West Texas on March 10-11, 1994. Los Alamos National Laboratory researchers will be tracking the distribution of stable isotopically labeled organic tracers from injector to producer as a function of time in order to characterize the reservoir more completely. Analyses of labeled organic compounds will be used to investigate physico-chemical pathways of injected fluids. Improved reservoir characterization will alleviate costs of water flooding (locally 80-90% of annual production budget) and improve efficiency of more costly CO_2-injection methods.

National Renewable Energy Laboratory Researchers Concentrate Sunlight 50,000 Times

Researchers at the National Renewable Energy Laboratory recently used a lens-like refractive secondary concentrator in their High-Flux Solar Furnace located in Golden, Colorado, to harness the power of 50,000 suns. The secondary concentrator, which was designed and fabricated by the University of Chicago, was based on fundamental principles of nonimaging optics developed by Professor Roland Winston and his colleagues at the University under research supported by the Office of Basic Energy Sciences/Engineering Research Program. The achievement expands the range of potential applications for concentrated sunlight, ranging from solar-pumped lasers to the production of fullerenes. Using concentrated sunlight for power, solar-pumped lasers are more efficient than traditional lasers. Also, highly concentrated sunlight could potentially produce greater quantities of fullerenes than conventional energy sources while reducing costs and energy requirements.

Estimating Atmospheric CO_2 Changes from the Geologic Record

Dr. David Cole, with the Office of Basic Energy Sciences/Geosciences program support at Oak Ridge National Laboratory, and Dr. Curtis Monger at New Mexico State University, published geochemical data and analysis in Nature (April 7, 1994, p533-6) leading to the conclusion that carbon isotope ratios in ancient soils can be used as a proxy for past CO_2 changes in the atmosphere. They determined $^{13}C/^{12}C$ and $^{16}O/^{18}O$ ratios in carbonates from an alluvial fan system in the Chihuahuan desert, New Mexico. They were able to relate the isotopic data to a change in vegetation from grass-dominated to shrub-dominated at about 7000-9000 years ago. This event coincides with a rapid increase in atmospheric CO_2 recorded in Antarctic ice cores and geomorphic evidence for local increase in aridity. The oxygen isotope ratios, which are dependent on temperature and moisture, remained relatively constant while the carbon isotope ratios are interpreted to reflect the change in vegetation accompanying increased atmospheric CO_2 concentration. These results suggest that stable isotope ratios in widespread continental palaeosols may be used to provide critical data to bridge spatial and temporal gaps in atmospheric CO_2 concentration indicated in the recent geologic record. If so, the recent geologic record can be more effectively used in the assessment of global climatic circulation models.

Mechanism for Sulfur-Induced Corrosion of Steel Elucidated

Dr. Jeffrey Kelber, University of North Texas, Denton, Texas, whose research is funded by the Division of Materials Sciences, Office of Basic Energy Sciences, has obtained results which yield significant insight concerning mechanisms of sulfur-induced corrosion of steels in the power plant environment. A major cause of corrosion and materials failure in power plants is sulfur contaminations which can arise from ubiquitous environmental sulfur or from internal impurities in the steel. Sulfur contamination degrades the stability and protective nature of the oxide overlayer, causing catastrophic failure. Such failure translates into several billion dollars a year in materials replacement costs in electric power plants. The precise microstructural mechanism which leads to the destabilization of the oxide layer has never been experimentally verified. By growing oxide

overlayers (scales) on stainless steel surfaces under rigorously controlled ultrahigh vacuum conditions and under various temperatures and levels of contamination, Dr. Kelber is able to demonstrate that a single layer of sulfur introduced at the stainless steel surface before oxide growth causes the disruption of the metal oxide bonding to the metal surface. This research demonstrates that ultra-high vacuum surface science studies can shed new light on the real world problem of sulfur-induced corrosion. Future studies will focus on the prevention of such corrosion via appropriate modifications to the chemistry of the metal/oxide interface. This basic materials science research underpins Dr. Kelber's current applied research program with the Electric Power Research Institute (EPRI).

Definitive Measurements of Elusive Process to Improve Understanding of Plasmas

Protonized hydrogen, H_3^+, is the simplest stable polyatomic molecule and the most abundant molecular ion in any hydrogen plasma. Its reactions play a key role in diverse environments ranging from plasmas to interstellar space. Knowledge of its rates of destruction and formation are critical when modelling plasmas. In collaboration with their Swedish counterparts, scientists at Oak Ridge National Laboratory supported by the Office of Basic Energy Sciences/Chemical Sciences Division have measured the rate of destruction of H_3^+, using a recently constructed ion storage ring at the Manne Siegbahn Institute in Stockholm. The dominant loss mechanism is reaction with electrons to yield neutral molecular and atomic fragments. The process, dissociative recombination, may be studied in a storage ring where the ion merges with a 'cooled' beam of electrons to allow the study of the interaction with energies that are known precisely. Previous measurements showed considerable uncertainty and varied over four orders of magnitude. The new definitive measurements agree with a theoretical calculation and will allow improvements in models designed to account for energy balance in hydrogen plasmas.

High Temperature Creep Crack Growth in Structures

Time dependent behavior of a solid with a crack involves an incubation period followed by a period of crack growth that may lead to catastrophic failure. During the incubation period creep deformation develops in the creep zone emanating from the crack tip until sufficient cumulative damage has occurred to produce crack growth. Power producing equipments experience variable temperature and load histories. They are subjected to loads for some periods of time followed by idle periods when there are no loads or the loads are reversed. Creep fatigue behavior of these structures is quite different from that predicted by elastic/plastic or by constant load creep design analysis. Variable load creep at elevated temperature has not received adequate attention in the past.

Results of recent investigation by Dr. F. W. Brust and his group at the Battelle Columbus Laboratories clearly indicate that the predictions based on either assumption mentioned above would grossly overestimate the service life. Their study reveals three important stages of crack growth: (i) during the unload period the crack opening displacement decreases due to the compressive creep strains which develop at the crack tip; (ii) the creep strain rates in the compressive zone are very large just after the load changes; (iii) after reload the displacement rates increase compared to the rates during the previous loading period. They have found that several currently used global integral parameters are inadequate for estimating crack growth.

New Knowledge in the Search for the Origins of Natural Gas

Professor Frank Mango, supported by the Office of Basic Energy Sciences/Geosciences Program, at Rice University has obtained experimental data supporting the concept that naturally occurring catalysts in sedimentary source are important in the conversion of kerogen to natural gas

(methane). The prevailing model for the origin of natural gas is thermolytic decomposition of kerogen even though the pyrolysis does not yield the observed (in natural gas) methane fraction. With coworkers at Rice and Exxon Production Research, Dr. Mango demonstrated that an appropriate methane concentration could be produced in the presence of the source rock, but not in its absence, under geologically reasonable pressure and temperature conditions. The specific constitution of the natural catalyst has not been determined but is the subject of active current research. The results, while still controversial, have been reported in Nature (368, p356, 1994) and highlighted in the April 11, 1994 issue of Chemical and Engineering News. As the authors note in the Nature paper "Our results verify the existence of an alternative, catalytic pathway to natural gas. If it proves to be significant, it could alter the way in which we view the generation and distribution of oil and gas in the Earth."

Research Yields More Precision for Seismological Testing

Acoustic impedance contrasts at contacts between different underground layers are exploited for nondestructive testing and seismological surveys. Paul Johnson, Thomas Hopson and Tom Shankland of Los Alamos National Laboratory have extended the applicability of ultrasonic waves for interpreting impedance structure to regimes where travel times are relatively long, materials are highly absorbent, or multiple arrivals complicate travel time analyses. By taking advantage of the frequency-dependent phase changes between reference signals and transmitted waves, higher-precision travel times can be measured and additional information about the non-linear propagation through the rock, reflecting cracks and pore fluids can be obtained. The improved precision in reflection seismic surveys is complemented by information on fluid resources available in reservoirs.

Drs. Johnson and Shankland are receiving Office of Basic Energy Sciences support for studies of non-linear elastic phenomena in collaboration with Drs. B. Bonner of Lawrence Livermore National Laboratory, T. McEvilly and L. Myer, Lawrence Berkeley Laboratory.

Predicting Damage in Brittle Materials

Engineering materials like ceramics, concrete, and geologic materials are heterogeneous or disordered. To describe their deformation and failure, these materials are often modelled as homogeneous with effective elastic and plastic properties. But such homogenization does not provide a reasonable description of local deformation and failure. Recent work by Professor Krajcinovic (Arizona State University) supported by the Engineering Research program within the Office of Basic Energy Sciences has provided significant mechanistic understanding of the deformation process in a medium with distributed microvoids.

It is found that critical states exist leading to cooperative evolution of the voids. The behavior near a critical state, i.e., when at least one chain of voids extends from one side of a given material volume to another side, is analyzed using percolation theory and it is found that different void configurations lead to different percolation thresholds. This implies that the percolation threshold cannot be described by effective stiffness properties. Rather, it is necessary to introduce a damage tensor in order to describe evolution of voids. A study of the relation between an arbitrary void distribution and the damage tensor provides the means necessary to accurately characterize this evolution. This study is significant for predicting the failure of brittle materials.

3-Dimensional Periodic Table?

Two Division of Materials Sciences grantees from Virginia Commonwealth University have proposed a scheme to design clusters of atoms (2 to 1,000) atoms) which can be assembled to

synthesize a new class of materials, as reported in a paper submitted to Physical Review B.. This design enables the construction of a 3-dimensional periodic table, where the size and composition of clusters define the third dimension. Using sophisticated quantum theory, Puru Jena and Shiv Khanna have designed two different kinds of clusters that retain their pristine structure and chemical identity even after they are allowed to assemble. One class of these clusters is chemically inert while the other has strong ionic character. These researchers have shown that clusters of metallic elements can be assembled to form semiconductor or insulator materials. Since the size and composition of clusters can be varied without limit, the design of the "cluster elements" can give rise to a vast source of new materials with properties that are yet unknown. The new materials are synthesized from clusters as building blocks and offer the potential or redefining the frontiers of materials science and technology in the next century.

Recent Advances in Electromagnetic Imaging of Subsurface Reservoirs

Electromagnetic (EM) methods offer the potential for obtaining high resolution images of subsurface electrical properties. The images of conductivity (and/or permittivity) provide information on reservoir heterogeneity and fluid distribution which can be used to estimate reservoir properties such as porosity, fluid saturation, fracture distribution and orientation. The methods are applicable in enhanced oil recovery, environmental restoration and geothermal energy development. The Office of Basic Energy Sciences/Geosciences Research program has sponsored research at Sandia leading to new cross-well imaging schemes which are not limited to small contrasts in properties which involve full forward modeling and are computationally time consuming and expensive. Recent advances at Lawrence Berkeley Laboratory extended application of the previously used first Born approximation method to an iterative approach which is also more efficient computationally. Now conductivity contrasts as great as 10:1 can be dealt with in the cross-hole environment. Further, it is now clear that frequency dependence of image quality can be used to obtain information on both general geometry and details of conductivity.

These studies provide new ways to efficiently image subsurface electrical properties which convey information of direct importance in oil and gas recovery, movement of environmental contaminants, and assessment of geothermal reservoirs.

New Method Developed for Forming Aluminum Nearly as Strong as Steel

A new and improved method has been developed for forming aluminum layers with strengths approaching those of high strength steels. By using a high-energy pulsed laser to alternately evaporate material from aluminum and aluminum oxide targets, J. A. Knapp, D. M. Follstaedt, S. M. Myers, R. J. Bourcier, and M. T. Dugger of Sandia National Laboratories, New Mexico, have developed a method for depositing a layer of aluminum metal containing a dispersion of nanosized (i.e., circa 1 billionth of a meter) aluminum oxide grains. The microstructure obtained is very similar to one that Sandia previously synthesized by using ion implantation of atomic oxygen into aluminum. Measurements of the microhardness of the earlier material yielded flow stresses indicative of strengths greatly exceeding those of modern aerospace aluminum alloys and approaching those of high strength steels. The key to the properties of these materials is the dispersion of hard precipitates so that they are very close together and block the plastic deformations from spreading through the metal matrix. This work is part of a program on Energetic Particle Synthesis supported through the Office of Basic Energy Sciences/Division of Materials Sciences.

While the use of ion implantation is limited by the high cost and availability of sources of high-energy ions and by the limited penetration of ions into the metal, pulse laser deposition is a new approach which has major advantages over ion implantation. The process is potentially more

widely available, gives complete control of composition versus depth, can be used for deposition on arbitrary substrates to any thickness, and is scalable to larger areas and thicknesses. Pulsed laser deposition for forming nanodispersion-hardened aluminum layers could have a very significant impact on the application of aluminum alloys to engineering problems. The flexibility and scalability of the pulsed laser technique is expected to enable applications for these layers which would be unattainable through ion implantation.

Probe Developed to Study Catalytic Reactions at High Pressures

A new type of nuclear magnetic resonance (NMR) probe has been developed by researchers at the Pacific Northwest Laboratory that measures previously difficult to observe reaction processes at high pressures. This new method will have many important applications. For instance, reactions that occur in important commercial high pressure catalytic reactions can now be investigated.

The new method uses an inexpensive and safe high-temperature, high- pressure vessel fitting within existing 5 and 10 mm NMR probes and overcomes the technical difficulties encountered in prior efforts to detect these reaction processes. The elegantly simple probe should enable widespread, convenient high-pressure NMR investigations by many others in the research community. The NMR probe is being nominated for a R&D 100 Award and a patent is pending on the design.

Future work by these researchers, who are supported by the Office of Basic Energy Sciences/Division of Chemical Sciences, will involve studies of catalytically important metal complexes under high pressures, to better understand ligand exchange and addition reactions which are fundamental to homogeneous and heterogeneous catalysts in solution, and C-H bond activation in high pressure methane reactions.

Neutron Irradiation Study Explains the Radiation-Resistance of Magnesium Aluminum Oxide Ceramics

An explanation for the radiation-resistance of magnesium aluminum oxide ceramics has been provided by the Neutron Irradiation Induced Metastable Structures program at Los Alamos National Laboratory. Since magnesium aluminum oxide is a radiation-resistant material and does not conduct electricity, it is a candidate material for fusion reactor components such as radiofrequency windows. As part of a program on the effects of neutron irradiation on materials, sponsored by the Office of Basic Energy Sciences/Division of Materials Sciences, K. E. Sickafus and A. C. Larson of Los Alamos National Laboratory, in conjunction with G. W. Hollenberg and F. A. Garner of Pacific Northwest Laboratory, and R. C. Bradt of the University of Nevada-Reno, carried out a neutron irradiation study of magnesium aluminum oxide to understand the basis for its radiation resistance.

Magnesium aluminum oxide occurs in a crystalline form called spinel. An understanding of its radiation resistance is needed for the development of new ceramics with similarly advantageous properties. In the spinel structure the magnesium ions are surrounded by four oxygen ions and the aluminum ions are surrounded by six oxygen ions. When neutrons scatter off atoms in the spinel structure, the magnesium and aluminum ions which are smaller than the oxygen ions may be displaced into spaces in the crystal structure which are energetically less favorable and normally unoccupied; termed interstitial sites. In addition, magnesium and aluminum ions which are displaced momentarily into interstitial sites may jump into vacant sites left by other displaced ions. From the measurements conducted at Los Alamos on neutron-irradiated samples, it is estimated that at least 15 percent of the magnesium ions were replaced by aluminum ions, while

50 percent of the aluminum ions were replaced by magnesium ions. Thus, an important mechanism in establishing the stability of spinel appears to be its ability to disorder its two types of metal ions. This also suggests that other radiation-resistant ceramics may be found among multicomponent oxides which accommodate disorder between their different component metal ions.

Properties of a Replacement for Ozone Depleting Refrigerants are Made Available

New equations for the viscosity and thermal conductivity of refrigerant R134a, (1,1,1,2-tetrafluoroethane), which is considered to be an environmentally acceptable alternative to the now commonly used, but ozone depleting refrigerant R12 (dichlorodifluoromethane), has been successfully developed by Jan Sengers at the University of Maryland and coworkers in collaboration with scientists at the University of Stuttgart. Jan Sengers is a researcher supported by Basic Energy Sciences/ Division of Chemical Sciences. The equations, which are valid over a wide range of pressures and temperatures, are based on the theoretical analysis of available experimental data sets which had considerable inconsistencies between data sets. The theoretical analysis took into account observed enhancements in the thermal conductivity in the critical region which are represented by Senger's crossover model for transport properties in the critical region that extends around the vapor-liquid critical point.

The tables of the transport properties produced by this project will be included in the IEA Annex 18 for R134a, which means that the tables will effectively become a new international standard for the refrigeration industry.

Highly Efficient Semiconductor Lasers Developed

Research on advanced light-emitting semiconductor materials at Sandia National Laboratories/Albuquerque has resulted for the first time in a semiconductor crystal which performs as a highly efficient laser. The semiconductor crystal was grown with atomic precision by molecular beam epitaxy, a technique which enabled hundreds of layers of compound semiconductor materials to be grown layer-by-layer of the crystalline lattice. The Sandia group then etched periodic microscopic cells (approximately one tenth the thickness of a human hair) into the crystal. When the crystal was energized, it lased with high efficiency and emitted a narrow, well-controlled beam. Most striking was the observation that, in contrast to conventional semiconductor lasers, input power required to achieve lasing did not increase as larger areas of the crystal were energized. This showed that a large crystal emitted amplified light more efficiently than conventional semiconductor lasers.

Soot - Its Formation and Health Effects

Articles in the popular press, including the New York Times, reported that several studies have concluded that tens of thousands of deaths are caused in the United States each year by the inhalation of soot particles. As might be expected, most affected are children with respiratory problems, asthmatics of all ages, and seniors with illnesses such as emphysema. In response to these studies, the Environmental Protection Agency is in the process of revising regulations on emission standards for airborne particulates. Research programs of the Division of Chemical Sciences of the Office of Basic Energy Sciences have for some years been aimed at understanding pollutant formation in combustion with an emphasis on soot. With a knowledge of key steps in the formation of soot, strategies for its mitigation may be developed while maintaining energy efficiency and resource conservation. Recent advances in this research area include a new mechanism for the formation of soot in hydrocarbon systems.

Basic Research in Atomic Physics Establishes a Niche in Glow Discharge Fabrication

Scientists at Sandia Laboratories in Albuquerque, supported by the Office of Basic Energy Sciences/Division of Chemical Sciences, have reported a major advance in changing glow discharge physics from a "black art" to a science. Non-reproducible results have been common in glow discharge systems. A broad effort to understand the problems of the deposition of materials on substrates used in fabrication of microstructures led to the adoption of a standardized apparatus that allowed an intercomparison of experimental results between laboratories. Most recently, it was found that non-reproducibility was caused by virtual electronic circuit components. The virtual components affect the electric and magnetic fields in the low temperature plasma in an unknown manner. The result is the formation of 'non-desirable' chemical species that, in turn, produce microstructures different from those expected. By monitoring the various species formed in the plasma and interpreting the relevant physical processes, techniques were developed to ensure reproducibility. The implications of this development were demonstrated in pilot projects and the economic value to the industry is underscored by Sematech's interest in this work.

Newly Discovered Silicon Surface Layer Affects Mineral-Fluid Interactions

The rates and pathways by which mineral surfaces interact with fluids remains a difficult problem. Geochemists have long been struggling with the apparent discrepancy between (1) the high rates and apparently traditional dissolution mechanisms by which minerals dissolve in the laboratory, and (2) the much slower rates and often different products which form in nature.

Recent research by scientists at The Universities of California and Wisconsin and Sandia National Laboratories indicates that reactive silicon layer forms on mineral surfaces undergoing dissolution. This surface layer can undergo spontaneous reaction to generate previously unsuspected intermediates. These regions can also become nuclei for incipient crystallization and do not require the presence of silicon in solution as was previously thought.

These results have far-reaching implications in the fields of (1) soil formation and reactions, (2) the reactivity of minerals and soils and their capacity to sorb contaminant and immobilize toxic compounds, as well as (3) the reactivity and specific interaction of minerals with biotic tissue and its potential for pathogenesis. In a review of the research published in Nature, it is commented that "Casey and his coworkers may well find that they have started a flood of new geochemical research".

New Lacing Process Discovered

A new lacing process involving the collisional neutralization of an atomic positive ion by a negative ion has been reported by a grantee supported by the Office of Basic Energy Sciences/Division of Chemical Sciences. In the experiment, singly charged positive ions of aluminum ablated from a metal surface were neutralized by negative atomic hydrogen ions produced in situ. The neutralization collisions produced neutral aluminum atoms in an excited state whose population was inverted with respect to the ground state and that, by stimulated emission to the ground state, lead to laser action at 369.2 nanometers. The complete interpretation of the result was greatly assisted by discussions the grantee held with fellow Chemical Sciences grantees brought together for the Atomic Physics Program "Contractors Workshop" held on October 15 and 16, 1993. These workshops are a management tool long used by each Program in the Division. The potential for development of a competitive laser using this new process remains to be explored.

Buckyballs Used to Grow Diamond Films

A research team at Argonne National Laboratory has recently achieved the deposition of diamond films on silicon wafers, using buckyball microwave plasmas to collisionally dissociate the C_{60} buckyballs into primarily C_2 and C_{58} fragments and deposit the C_2 on the surface while the C_{58} fragments rebound away from the surface. It is thought that the C_2 fragments insert directly into the C-H bonds terminating at the diamond surface, eliminating chemical reaction sequences otherwise occurring at the surface with methane or other hydrogen-containing precursor carbon sources for diamond film deposition. The research demonstrates both a relatively high production of C_2 over other fragment carbon stoichiometries and a ready deposition of these C_2 fragments to produce diamond films at a rate approximately six times higher than is observed with more commonly used methods involving gas mixtures. A first report of these achievements will be published in the Journal of Applied Physics (in press) by the Principal Investigator, Dr. Dieter M. Gruen, and his collaborators. Further characterization and optimization of this diamond film production process will be investigated. This research is supported by the Office of Basic Energy Sciences/Division of Advanced Energy Projects.

Carbon-free Buckyballs Reported

The November 5, 1993, issue of Science contains the first report of a carbon-free material with the "buckyball" structure. Professor John Corbett of the Ames Laboratory at Iowa State University and a graduate student, Slavi Sevov, report the synthesis and structure of a family of compounds composed of nearly round cages of either 70 or 74 atoms of the element indium. Unlike the normally hollow carbon buckyball, the indium material contains three successively smaller structures: a cage of sodium atoms, a smaller cage of indium atoms, and a single central atom of either nickel, palladium or platinum. The structure cannot exist without the internal cages.

Scientists first mass-produced carbon buckyballs in 1990. That advance touched off a cascade of interest in buckyballs for their potential uses in medicine, superconductivity, lubrication, and a number of other fields. The new indium buckyballs degrade upon exposure to small amounts of oxygen or water and appear to be poor conductors of electricity. Research is continuing. Professor Corbett's research is supported by the Office of Basic Energy Sciences/Division of Materials Sciences.

Fracture Dynamics Found to be Similar for Different Materials

Studies by Professor H. Swinney and his group at the University of Texas at Austin supported by the Office of Basic Energy Sciences/ Engineering Research Program on Complex Spatiotemporal Patterns in Nonequilibrium Systems reveal a universal behavior of rapid fracture in two very different material plates. Oscillatory instability of the tip of a crack beyond a threshold velocity, v_c, is a generic feature of fracture in brittle materials. Recent experiments on the dynamics of rapidly moving cracks in two different brittle amorphous materials, PMMA and soda-lime glass, show similar quantitative as well as qualitative fracture behavior. In particular, it is found that v_c is the same in both materials. These results suggest that there is a universal aspect to the velocity-dependent fracture energy.

Innovative Methane-C_2 Conversion Process Doubles Yield

Basic research referenced in Chemical and Engineering News (October 11, 1993) by investigators from the University of Minnesota supported by the Office of Basic Energy Sciences/Division of Chemical Sciences, has lead to the development of a new process which produces C_2 products (i.e., molecules with two carbon atoms such as ethylene) from the catalytic oxidative coupling of

methane. Industrial researchers have been focusing on this problem for a number of years and the results to date have demonstrated a conversion rate of less than 25%. The research of Carr and Aris which was predicated on basic studies involving a simulated countercurrent moving-bed chromatographic reactor have demonstrated conversion rates of greater than 60%.

This process was described in **Science** (**262**,221,(1993)) and involves the rapid separation of oxygen, methane, and C_2 products which prevents the further oxidation of the desired product. Another advantage is the shifting of the chemical equilibrium through separation which drives the creation of product in equilibrium-limited cases. The process entails a countercurrent moving-bed reactor in which the catalyst flows slowly downward against a countercurrent stream of inert carrier gas. Methane is injected midway in the column and flow rates are adjusted such that weakly adsorbed species (e.g., ethylene) move upward with the carrier gas and the more strongly adsorbed species (i.e., carbon dioxide) move downward with the solid catalyst. Conditions employed currently use samarium oxide (Sm_2O_3) as the catalyst at 1000 K. This research effort could have a broad impact in the petroleum and chemicals industry.

New Technique Helps Predict Surface Chemistry

The propensity of an exposed mineral surface to absorb contaminants contributes significantly to the mobility of waste products in soils. Accurate models of subsurface transport phenomena require descriptions of the interactions between exposed mineral surfaces and waste materials. The complexity of surface interactions has until recently forced theoreticians to deal only with ideal, smooth crystal surfaces. While such calculations could provide some insight into chemistry at surfaces, it was expected that imperfections on real surfaces may play a more significant role. Now, Maureen McCarthy at the Pacific Northwest Laboratory, supported by the Chemical Sciences Division of the Office of Basic Energy Sciences, in collaboration with groups in Italy and Great Britain have implemented a new computer code called 'EMBED' to predict the chemistry at imperfections on oxide mineral surfaces. The test case that has been modeled was that of the chemical binding of water to clean and stepped surfaces of magnesium oxide. The binding of water to the magnesium oxide surface was discovered to be three times stronger at a surface defect site than on the face. Scientists have long believed that much of the interesting surface chemistry takes place at surface defect sites, but now with modern computational capabilities, these ideas can be tested against more rigorous theory. The work is being performed as part of the program at the Pacific Northwest Laboratory to characterize environmental processes relevant to the Hanford site cleanup efforts and was made possible by the high speed numerical capabilities and core/disk memory provided by the supercomputers at the National Energy Research Supercomputer Center.

Transparent Silicon Carbide of High Quality Synthesized

Dr. A. Zangvil of the Materials Research Laboratory at the University of Illinois has established the conditions for the synthesis of high-quality, transparent bulk silicon carbide (SiC) in a hot-wall chemical vapor deposition chamber. This work was supported by the Office of Basic Energy Sciences/Division of Materials Sciences and was carried out in collaboration with Dr. J. Goela of Morton Advanced Materials. The results of this work will be presented at the International Conference on Silicon Carbide and Related Materials to be held at Howard University, Washington, D.C., from November 1-3, 1993. A paper, entitled "Microstructure of Transparent Silicon Carbide from CVD," has been submitted for publication.

Bulk silicon carbide is typically opaque. Dr. Zangvil has shown that transparent silicon carbide can be grown under favorable conditions of temperature, pressure, reactant gas composition, and flow rate, and that this silicon carbide has a high degree of crystalline perfection with only a few

dislocations observable by high-resolution electron microscopy. Silicon carbide grown under slightly less favorable conditions was translucent and was observed to have a large number of twinned crystals. Opaque silicon carbide obtained under unfavorable conditions had grains containing many stacking faults. Since twin boundaries and stacking faults scatter light, it is necessary to grow silicon carbide under conditions which avoid these defective structures. Silicon carbide has potential use as a high-temperature semiconductor, however its possible use is limited by imperfections such as those which Dr. Zangvil has found possible to control or eliminate in this study.

Volcanic Eruption Volume is Related to Neodymium Isotopic Composition

Research published in Nature by Department of Energy-sponsored investigators at Lawrence Berkeley Laboratory (Chen, Chang-Hwa, D.J. DePaolo, A. Nakada, and Y.N. Shieh) have established a relation between the volume of lava erupted and the neodymium isotopic composition of the lava. The proposed explanation of this observation is that rapid recharge of mantle material leaves little time for the assimilation of crustal material and produces large volumes of mantlelike lavas. This is the first predictive tool for magmatic eruption based on the chemistry of lavas and extends and confirms the volume composition pattern found in the western United States. With this answer to the question "How much magma is stored in the volcano?" and previous isotopic indicators of "How long is the magma stored?", Earth scientists are verging on a predictive mechanistic model of volcanic eruption.

X-Ray Scattering Studies of Holmium Reveal New Magnetic Behavior

Scientists from Brookhaven National Laboratory (supported by the Division of Materials Sciences) have performed high-resolution X-ray and neutron scattering studies of the correlations associated with magnetic ordering in the spiral antiferromagnet holmium. The main result is that within 2 centigrade degrees above the critical temperature, the magnetic fluctuations exhibit two length scales. This is the first observation of critical magnetic scattering by X-ray diffraction. The scientists believe that multiple-lengthscale critical phenomena are more common in magnetic systems than was previously realized, and have begun high-resolution studies of other rare earth and transition element magnets. A central feature of our understanding of second order phase transformations is the appearance near the transition temperature of large scale, coherent fluctuations. As the temperature approaches the critical temperature, the average size of the fluctuating domains (the correlation length) diverges.

The experimental results contradict the predictions of the conventional theory of second order phase transformations, in which only a single-length scale is expected. The two domains differ in their extent by nearly a factor of ten at the temperatures for which they overlap. In addition, the slopes of the temperature-dependent lines differ by a factor of two. These surprising results are reminiscent of the two-component line-shapes observed for the cubic-to-tetragonal structural transitions of the perovskites, and may be related to the famous "central-peak" problem. In the perovskites, it is believed that a random distribution of defects offers a nucleation site for the formation of the second kind of fluctuation, although this is still controversial. A very intriguing possibility is that the second component in these experiments is related to the surface.

New Techniques Developed for Determining DNA Adducts

Basic research by investigators from the University of Wyoming supported by the Office of Basic Energy Sciences, Division of Chemical Sciences, has resulted in the development of a new technique which could be important for precancer diagnostics. The technique understudy, solid-matrix luminescence, was found to be a fast and facile analytical method for determining the four

stereoisomeric tetrols, which are products from benzo[a]pyrene-DNA adducts. A tetrol is the oxygenated metabolite of polynuclear aromatic hydrocarbons formed in the body. Tetrols are important in cancer research. Their distribution and amounts can be used as a means of human molecular dosimetry. This new technique involves the use of solid-matrix luminescence at room temperature, which proves to be a very sensitive technique for these and other organic compounds. The advantage of this technique is the ease and sensitivity with which the tetrols can be detected and their photophysical parameters can be determined. These parameters can then be used to characterize and quantitate the four stereoisomeric tetrols. This new technique could prove useful in the Department of Energy's continuing efforts in health effects and environmental monitoring.

A New Material Architecture Discovered which Selects Photons

The September 25, 1993, issue of Science News highlights the recent accomplishments of a research team at the Ames Laboratory who have designed and fabricated a new class of materials that have proven to be useful as filters in electronic circuits and may lead to the development of highly efficient lasers. Calculations by the team suggested that an array of dielectric spheres in a special geometry having the same symmetry as the atoms in a diamond, the diamond lattice, would prevent photons from propagating in any direction in the structure. The team then concluded that structures having the required geometry could be built by stacking long slender rods in a particular criss-cross fashion. The initial experiments were done by stacking aluminum oxide rods to form a material with a "photonic" band gap centered at 13 gigahertz where the device applications would be a filter in microwave circuits. By "tuning" the structure using different sized rods and spacings, the band gap has been pushed successfully to frequency gaps near 400 gigahertz.

The goal is to move into the infrared and optical region of the electromagnetic spectrum where laser devices would be the logical application. The concept of using periodic arrays of dielectrics opens a whole new field in which simple geometric structures can be used to produce both tailored materials and devices with controlled optical properties.

Scientific Awards and Recognition

Laboratory Scientists Elected to Fellowship by the American Vacuum Society

Three laboratory scientists, whose research is supported by the Office of Basic Energy Sciences/Division of Materials Sciences, were among those honored for having been elected to Fellowship at the National Symposium of the American Vacuum Society, October 24-28, 1994, in Denver, Colorado. The American Vacuum Society is a scientific organization with over 5,000 members whose interests are in the problems and applications of high-vacuum technology (e.g., material coatings, surface science, plasma science, and electronic materials). Members are elected to fellowship to honor those who have "made sustained and outstanding scientific and technical contributions in those areas of interest to the American Vacuum Society," and it is a prestigious membership level bestowed to a select few by the Trustees of the Society. The three laboratory scientists so honored were Charles S. Fadley, Lawrence Berkeley Laboratory, for "leading the technique of photoelection diffraction from a laboratory curiosity to a powerful and widely utilized surface structural probe;" Jack E. Houston, Sandia National Laboratories, New Mexico, for "his many outstanding contributions to surface science, including the recent invention, development and application of the Interfacial Force Microscopy;" and Michael Van Hove, Lawrence Berkeley Laboratory, for "the development of powerful theoretical methods to determine

complex surface structures with electron diffraction, with application to a wide variety of surface structures, especially of catalytic relevance."

Engineering Research Grantees Honored

Two of the current grant holders from the Office of Basic Energy Sciences/Engineering Research Program have been honored at last week's winter annual meeting of the American Society of Mechanical Engineers.

The Fluids Engineering Award was presented to Professor Graham Wallis (Dartmouth College) for extensive research in the field of two-phase flow and for writings on the extension of potential flow theory to two-phase flow. Besides its didactic value, the results of the research have application when, say, bubbly flows are rapidly accelerated, e.g., in a loss-of-coolant incident.

The G. L. Larson Memorial Award went to Professor S. Torquato (Princeton University) for outstanding achievement in mechanical engineering within ten to twenty years following graduation. His contribution is in the area of micromechanics of heterogeneous materials, notably the relationships between transport coefficients in porous media, with applications to gas/oil exploration, and environmental restoration.

Chemical Sciences Researcher Receives International Recognition

Professor Neil Bartlett of the Chemical Sciences Division at the Lawrence Berkeley Laboratory and the University of California, Berkeley, has received two awards of international recognition for his research advancements which have had a major impact in the field of inorganic chemistry.

Professor Bartlett was awarded the Bonner Chemiepreis from Friedrich Wilhelms Universitat, Bonn, Germany, and an Honorary Doctor of Laws degree from Simon Fraser University in British Columbia. His research has been funded by the Office of Basic Energy Sciences/Division of Chemical Sciences.

Young Materials Sciences' Grantee Receives Award

Marjorie Olmstead, an Associate Professor of Physics at the University of Washington, Seattle, and holder of a research grant from the Office of Basic Energy Sciences/Division of Materials Sciences, received the Peter Mark Memorial Award from the American Vacuum Society during its National Symposium, October 24-28, 1994, in Denver, Colorado. The American Vacuum Society is a scientific organization with over 5,000 members whose interests are in the problems and applications of high-vacuum technology (e.g., material coatings, surface science, plasma science, and electronic materials). The Mark Award was established by the Society in 1979 in memory of Peter Mark, Princeton University, who served as the Editor of the Society's Journal of Vacuum Science and Technology from 1975 until his death in 1979. The award is presented annually to a young scientist or engineer (35 years of age or under) for outstanding theoretical or experimental work in a field of interest to the American Vacuum Society. Olmstead received her award for "elucidating the nature of semiconductor surfaces and the heteroepitaxial growth of insulating materials on these surfaces." Olmstead received her B.A. from Swarthmore College in 1979 with a physics major, with an M.A. being granted in 1982 and a Ph.D. in 1985 by the University of California at Berkeley.

Combustion Research Advances Reported in Science News

In a recent issue of Science News (Vol. 146, p 164) the research conducted at the Combustion

Research Laboratory (CRF), Sandia National Laboratories, California, by Dr. Jacqueline Chen on combustion modeling was described. Dr. Chen, one of several scientists at the Combustion Research Laboratory who are supported by the Chemical Sciences Division of the Office of Basic Energy Sciences, is engaged in research to characterize the fundamental interactions between fluid mechanics and chemistry in turbulent combustion. To this end, Dr. Chen uses direct numerical simulation to solve the Navier-Stokes equations for fluid dynamics. The major challenge is in determining how to reduce the complex chemistry to computationally tractable proportions without losing important features of the chemistry. Current computer models for combustion emphasize either fluid dynamics or chemistry, but for accurate prediction of the performance of combustion devices, the interaction between the two must be dealt with in detail. This is particularly important for predicting the emissions of trace species from combustion processes. Science News is published weekly by Science Service, a nonprofit corporation with the mission of increasing public understanding of science and scientific literacy among members of underrepresented groups.

Geological Society of America Awards to BES Supported Researchers

Two Office of Basic Energy Sciences-supported researchers garnered awards at the recent annual meeting of the Geological Society of America in Seattle, October 24-27. David Walker, of Lamont-Doherty Earth Observatory at Columbia University was awarded the Arthur L. Day Medal for outstanding contributions to geosciences research. B. Charlotte Schreiber, of City College of New York, Queens, was awarded the Outstanding Educator Award by the Association for Women Geoscientists.

Walker's BES-supported research on thermal diffusion processes in silicate melts provides fundamental data important for predictions of transport properties of geologically common fluids. His recent laboratory measurements of the temperature variation of solubility of selected sulfate and their hydrate species have been made to aid in the interpretation of results from preliminary thermal migration experiments to measure diffusion in response to chemical and thermal gradients. Schreiber's BES-supported research focussed on the study of biological markers in evaporite sedimentary rocks as a means of determining whether or not the organic matter deposited in selected marine and estuarine/continental deposits provides a good source for oil generation in ancient as well as recent sediments. She retired from City College of New York last fall.

Prize Awarded to Graduate Student Supported by the Division of Chemical Sciences

One of the three recipients of the 1994 Rao Prize is a graduate student supported by the Office of Basic Energy Sciences/Division of Chemical Sciences. The Rao Prize was established in 1991 to acknowledge first time speakers. The three best talks by students presented at the previous annual International Symposium on Molecular Spectroscopy receive this award. The prize was created by a group of spectroscopists who, as graduate students, benefited from the emphasis on graduate student participation at the symposium and was named in honor of K. Narahari Rao of the Ohio State University who for over a quarter of a century was the organizer of the symposium. One of the three winners this year, Jonathan Paul O'Brien, is supported by a grant administered by the Division of Chemical Sciences to his research professor at Massachusetts Institute of Technology. The title of Mr. O'Brien's prize winning talk was "Molecular Dynamics in Acetylene: Effective Hamiltonian Models and Optical Intermediate States for Dispersed Fluorescence Spectra." This work has been supported by the Office of Basic Energy Sciences as part of a broad effort to understand the chemistry of molecules in highly energetic states characteristic of the combustion environment. This is the second time that a student from this same research group under this same grant has been awarded the Rao Prize. The previous winner, Stephani Solina, received her award in 1992 and was one of the first three recipients of the prize.

Materials Grantee to Receive 1995 Educator Award

Professor William D. Nix, the Lee Otterson Chair of Engineering at Stanford University and a long-time grantee of the Office of Basic Energy Sciences of DOE, has been selected to receive the 1995 Educator Award from The Minerals, Metals and Materials Society (TMS). The award is given each year to "an individual who has made outstanding contributions to education in metallurgical engineering and/or materials science and engineering." The award will be presented to Professor Nix at the annual meeting of the society to be held in Las Vegas in February of 1995. Professor Nix has had a long and productive relation with DOE. His first research contract was obtained from the Division of Materials Sciences of the Atomic Energy Commission in 1965, when he was just starting his academic career. Since that time, he has trained a total of 58 Ph.D. students in materials science, 22 of whom were supported by grants from DOE and the predecessor agencies. His former students have taken leadership roles in industry, government and academia. This record of accomplishment was the primary basis for his being selected for this honor.

Professor Nix and his graduate students are presently studying the mechanical properties and reliability of thin film "high tech" devices that are so important in the success of Silicon Valley. Their research has contributed directly to the economic strength and technological competitiveness of several U.S. corporations.

Richard LeSar Named an Associated Western Universities DOE Laboratory Distinguished Lecturer

Dr. Richard LeSar of Los Alamos National Laboratory was awarded an Associated Western Universities DOE Laboratory Distinguished Lectureship for the 1994-95 academic year. The Lectureship recognizes Dr. LeSar's accomplishments as a distinguished laboratory scientist and provides a forum for discussing scientific interests and exchanging ideas with faculty and students. The Lectureship program offers the opportunity for a Lecturer to visit up to five universities during the academic year. Sixty-one universities belong to the Lectureship program. Dr. LeSar is the principal investigator for a Basic Energy Sciences/Division of Materials Sciences new initiative program on Unified Theory of Evolving Microstructures.

Investigator Supported by Chemical Sciences Wins Prestigious Award in Surface Science

Professor John T. Yates of the University of Pittsburgh, Chemical Sciences Division investigator, will receive the 1994 Medard W. Welch Award on Wednesday evening, October 26, 1994, at the awards assembly of the 41st National Symposium of the American Vacuum Society in Denver. The award, given annually for outstanding accomplishments in surface/vacuum science over the prior ten-year period, recognizes Dr. Yates for his "development and use of modern measurement methods to provide insights into the behavior of chemisorbed species on metal and semiconductor surfaces." Professor Yates, the R.K. Mellon Professor of Chemistry and Director of the Surface Science Center at the University of Pittsburgh, is one of the world leaders in the field of surface science and catalysis.

Plastics: "The Go-Betweens"

An article with the above title was published in the October 1, 1994, issue of the Economist, in the Science and Technology section. The research involves the successful design of copolymer compatibilisers that act as "molecular velcro" significantly improving the mechanical properties of polymer composite material. This discovery increases the variety while decreasing the cost of materials that can be used for multi-phase and multi-component composite materials, e.g., recycled plastics. This research was supported by the Division of Materials Science and involves an industry-university collaboration which includes polymer theoreticians at the University of

Pittsburgh whose predictions were confirmed in joint experiments by scientists from the State University of New York, Stony Brook, from Bellcore in Red Bank, New Jersey, and from the Exxon Research and Engineering Company in Annandale, New Jersey. The article ends with the following statement "Dr. (Anna) Balazs (the University of Pittsburgh theoretician) has been collaborating with Exxon, a well-heeled oil company, so the technique may soon find an industrial application."

Scientific American Discusses SQUIDs

The August 1994 issue of Scientific American features an article that describes recent advances in the design and new uses for SQUIDs, short for superconducting quantum interference devices. The author, John Clarke of the Lawrence Berkeley Laboratory (LBL) and the Department of Physics of the University of California at Berkeley, has been supported for many years by the Materials Sciences Division for his work on superconductivity and SQUIDs. The SQUID, which picks up minute changes in magnetic field, is the most sensitive detector of any kind available to scientists. Only inherent quantum effects set its limit. The LBL work, involving a Cooperative Research and Development Agreement with Conductus, Inc., uses high temperature superconducting material that allows the SQUID to operate at liquid nitrogen temperature (77 kelvins or -196 degrees Celsius). As such, these newer SQUIDS will be simpler to use and more widely applicable than those built from conventional super-conductors, which function only at temperatures near absolute zero. Such SQUIDs are being used in medical diagnosis to measure magnetic field gradients that can pinpoint the location of the lesion in the brain generating the condition called focal epilepsy, or can provide detailed location of the source of cardiac arrhythmia (erratic heartbeat). Other uses include geophysical surveying-recording subtle variations in the magnetic field in the earth to locate a source of geothermal energy below the surface.

Nobel Prize for Physics

The 1994 Nobel Prize for Physics was awarded today to Cliff Shull and Herb Brockhouse for their 'pioneering work in neutron scattering.' Dr. Shull, recently retired from Massachusetts Institute of Technology (MIT), was employed as a scientist at Oak Ridge National Laboratory with support from the Atomic Energy Commission from 1946 through 1955 when he went to MIT. He carried out many of the very first experiments using neutron beams during his tenure at ORNL using the graphite reactor. In particular, his experiments with Ernie Wollan at Oak Ridge on elastic scattering of neutrons from solids opened up a new field whereby the structures of many condensed matter phases could be studied using neutrons. Elastic scattering is the process in which a neutron has just as much energy after being scattered as it had before the scattering process. Because neutrons possess a magnetic moment, Dr. Shull was able to measure the structure of magnetic moments in solids using neutron beams, and in a classic experiment, was able to demonstrate for the first time in the late 1940's, the existence of the antiferromagnetic phase in certain materials. At MIT, Dr. Shull continued to do research with neutron beams, including some very innovative experiments on neutron interferometry. He was supported by the Division of Materials Sciences/Office of Basic Energy Sciences until his retirement from MIT. One of his Ph.D. students was David Moncton, currently the Director for the Advanced Photon Source at Argonne National Laboratory.

Dr. Brockhouse, a Canadian, was cited for his work in inelastic scattering which was carried out at the Chalk River Laboratory in Canada. Inelastic neutron scattering, in which the neutron looses energy to the solid that scatters it, has led to the study of many of the excitations of crystalline lattices (phonons) and magnetic systems (magnons).

The Graphite Reactor was one of the first research reactors and provided neutron beams with an

intensity of 10^{12} neutrons per second. The Advanced Neutron Source would provide a beam 1000 to 10,000 times more intense for the study of many problems in condensed matter that have been impossible to address because of the lower intensity of existing sources.

Argonne Scientist Receives Zavoisky Award

Dr. James R. Norris, a Senior Chemist in the Chemistry Division of Argonne National Laboratory and supported by the Office of Basic Energy Sciences/Division of Chemical Sciences, is the recipient of the Zavoisky Award which was presented in August 1994 at the 27th Congress on Magnetic Resonance held in Kazan, Russia. The award is given in recognition of an outstanding contribution to the development of the electron paramagnetic resonance technique and marks the 50th anniversary of the discovery of electron paramagnetic resonance spectroscopy by E. K. Zavoisky in Kazan in 1944. The award is sponsored by the Russian Academy of Sciences, Kazan State University, the Tartarsan Academy of Sciences and the publisher, Springer-Verlag.

Distinguished Chemist Receives Humboldt Research Award

Distinguished Scientist Georges Guiochon, a chemist at the University of Tennessee, Knoxville, who also holds a joint appointment with the Oak Ridge National Laboratory, was recently honored with a Senior Humboldt Research Award. Professor Guiochon has made significant contributions in preparative chromatography, especially for optical isomers, which are increasingly important because of their selective chemistry. Dr. Guiochon is the third University of Tennessee, Knoxville, Distinguished Scientist to receive the prestigious award. The other prior recipients are Dr. Bernhard Wunderlich (chemist) and Dr. Ward Plummer (solid state physicist). Dr. Guiochon is supported by the Office of Basic Energy Sciences/Division of Chemical Sciences.

Depletion of Ozone Revisited

The depletion of ozone through the chemistry associated with chlorofluorocarbons (CFC's) is the subject of a feature article in the August 15, 1994 issue of Chemical and Engineering News, a weekly publication of the American Chemical Society. The article was written by Professors F. Sherwood Rowland and Mario Molina who provide a historical perspective of their initial scientific findings and subsequent investigations that led to both legislative and international action dealing with the environmental impact of stratospheric ozone depletion by CFC's.
Noted in the preface to the article is the following: "Although Rowland's own research at the time concentrated on radiochemistry, in 1973 he asked his sponsor, the basic sciences program of the U. S. Atomic Energy Commission (AEC), for permission to probe the atmospheric fate of CFC compounds. AEC agreed, although such a "blue sky" research proposal had no obvious value to the agency." This work exemplifies a promulgation of the Office of Science and Technology Policy (OSTP) document "Science in the National Interest" where it is noted that, "Vibrant scientific disciplines are best guaranteed by the initiatives of talented investigators and in turn provide the strongest and most enduring foundation for science in the national interest."(emphasis added) Professor Rowland's research has been supported by the Chemical Sciences Division of the Office of Basic Energy Sciences (and its predecessors since 1965).

Six Scientists Receive Awards from the American Chemical Society

Scientists supported by the Office of Basic Energy Sciences have been named to receive several prestigious awards from the American Chemical Society that recognize expertise and technical leadership in the chemical sciences. Professor John M. Prausnitz of the University of California will receive the Award in Petroleum Chemistry; Professor Georges Belfort, Rensselaer Polytechnic Institute will receive the Award in Separations Science and Technology; Professor W. Henry

Weinberg of the University of California, Santa Barbara, will receive the Arthur W. Adamson Award for Distinguished Service in the Advancement of Surface Chemistry; Professor Angelica M. Stacy of the University of California will receive the Francis P. Garvan-John M. Olin Medal that recognizes her work in solid state studies of advanced materials and high temperature superconductivity; and Professor Mark Barteau of the University of Delaware will be awarded the Ipatieff Prize for his work in chemical catalysis. The American Chemical Society will honor Professor Richard E. Smalley of Rice University with the Harrison Howe Award that recognizes Smalley's work in chemical physics.

Chemical Sciences Investigator to Write for Encyclopedia of Physics

Dr. David Styris of the Pacific Northwest Laboratory has been invited to contribute three chapters for the new Encyclopedia of Physics to be published by Macmillan Publishing Company. This four-volume set will consist of 900 entries covering the many disciplines of physics. The intended audience is comprised of high school and college students, teachers, professors, and other professionals working in the field of physics. Dr. Styris' chapters will be on Thermal Radiation, Radiant Energy, and Heat Transfer - subjects that are fundamental to any understanding of many high temperature physical processes. His expertise in these areas is a direct consequence of his work on high temperature surface chemistry conducted over the last 15 years under the support of the Division of Chemical Sciences of the Office of Basic Energy Sciences.

Ames Laboratory Professor Honored for Research in Metal Casting

Professor Rohit Trivedi of the Ames Laboratory will be presented with the prestigious Bruce Chalmers Award of the Minerals, Metals, and Materials Society at their next annual meeting in Las Vegas, Nevada, on February 14, 1995. The Society's Citation to Professor Trivedi is for

> "his seminal contributions to the science of solidification by the application of sophisticated mathematical analysis coupled with a deep physical insight to dendritic and cellular growth of solids from the liquid phase."

The most common commercial forms of solidification processing for metals and alloys are casting and welding. It is of paramount importance to the classical metals industries: aluminum, steel, copper, etc. It has now taken on a heightened significance because new and emerging solidification technologies will lead to waste minimization, less environmentally undesirable effluence, more precise achievement of final product shape and dimensions, less machining, and reduced cost. Technological improvements in solidification processing are an attractive route to more environmentally benign and economically competitive manufacture.

Two Basic Energy Sciences Researchers Appointed Los Alamos National Laboratory Fellows

Basic Energy Sciences researchers, Ricardo Schwarz and Greg Swift, were appointed Los Alamos National Laboratory Fellows in June 1994 by Director Sig Hecker. Each year Laboratory staff are called to nominate their peers to be Laboratory Fellows. A review committee representing the scientific disciplines at Los Alamos evaluates the nominations and recommends to the Director candidates they judge as deserving of this highly prestigious honor. Less than 2 percent of the entire technical staff are so honored.

Laboratory Fellows are recognized for sustained outstanding scientific or technical contributions. Ricardo Schwarz was recognized for his development of solid state amorphization of metallic alloys and creative use of mechanical alloying to the synthesis of new materials. Greg Swift was recognized for his development of the fundamental principles of thermoacoustic refrigeration, implementation of these principles in working devices, and the transfer of these new thermoacoustic technologies to industry.

The research by Schwarz and Swift has been supported for several years by the Division of Materials Sciences in the Office of Basic Energy Sciences.

Professor Brent Adams Receives Two Very Prestigious International Awards

Professor Brent Adams of Brigham Young University, who has just accepted a permanent position at Carnegie-Mellon University, is the recipient of two very prestigious international awards in the area of materials science. These were the 1994 Henry Marion Howe Medal from ASM International for the best paper published in 1993 in Metallurgical and Materials Transactions and the 1995 Champion Mathewson Medal from the Metals, Minerals and Materials Society based on a series of related papers published over the past three years in the same journal. These works studied the detailed misorientation distribution of polycrystalline metals and related the statistics to texture and high-temperature fracture. These papers were a direct result of support by the Metal and Ceramics Branch of the Office of Basic Energy Sciences/ Division of Materials Sciences. This topic is of critical importance to both manufacturing technology and to the safety of high-temperature energy conversion systems.

Professor David Seidman Receives a Max-Planck Research Prize

Professor David Seidman, a materials scientist from Northwestern University, has been awarded a Max-Planck Research Prize from the Alexander von Humbolt-Stiftung and the Max-Planck Gesellshaft. In receiving the prize Professor Seidman was cited for outstanding lifetime achievement in materials science. Seidman, jointly nominated with the late Professor Peter Haasen of the University of Goettingen, is currently performing experimental research and simulations of processes that occur at internal interfaces on an atomic scale. The prize provides for cooperative research between Professor Seidman and a German scientist. Seidman's current research at the Northwestern University in the area of structure and composition at material interfaces has been supported by the Division of Materials Sciences/Office of Basic Energy Sciences; his prior research in the areas of point defects, diffusion and radiation damage was funded for many years at Cornell University.

Accomplished Graduate Joins Staff at Oak Ridge National Laboratory

Ms. Anna Swan, a recent recipient of a Ph.D. in physics from Boston University, has joined the research staff of the Solid State Division at Oak Ridge National Laboratory as a Eugene P. Wigner Fellow. Ms. Swan's thesis research at Boston University was in the field of experimental surface physics, and it was supported by DOE's Office of Basic Energy Sciences/Division of Materials Sciences. For her thesis research, Ms. Swan was awarded both the Nottingham Prize and the Traum Award, which are the major two awards given in the United States to recognize outstanding original research in surface science performed by an individual while still a graduate student. The Nottingham Prize (given in memory of Professor Wayne B. Nottingham of the Massachusetts Institute of Technology) was presented to Ms. Swan in June 1993 at the annual Physical Electronics Conference, while the Traum Award (given in memory of Morton M. Traum of the American Telephone and Telegraph Bell Laboratories) was presented at the American

Vacuum Society National Symposium in November 1993. These awards are bestowed yearly and Ms. Swan is the first graduate student ever to have received both of these prestigious awards.

Materials Sciences-Supported Student Wins Professional Society Award

Jong-Shing Bow, an Office of Basic Energy Sciences/Division of Materials Sciences-supported graduate student under Professor R. W. Carpenter at Arizona State University, has been selected as the Presidential Scholar for 1994 by the Microscopy Society of America. This award carries a monetary value of approximately $2,000 in addition to the prestige associated with it. It is in recognition of Mr. Bow's Materials Sciences-funded electron-beam microcharacterization research on thin film semiconductor contacts, where a defect free interface structure and a precise localized chemical composition are required to achieve the desired electronic characteristics. Mr. Bow's scientific conclusions relate to critical issues in the total quality manufacture of semiconductor devices.

Chemist Receives Award at American Chemical Society National Conference

Dr. Ed Yeung, Professor of Chemistry, Iowa State University and Director of Environmental Sciences at Ames Laboratory, recently won the 1994 American Chemical Society Fisher Award, the highest honor in analytical chemistry. Professor Yeung's research is supported by the Office of Basic Energy Sciences/Division of Chemical Sciences. The award recognizes Yeung's research on novel detection schemes in capillary electrophoresis for the study of red blood cells for "markers", which are indicators of mutative changes in their chemical content. The combination of capillary electrophoresis separation and laser fluorescence detection achieves extraordinary results; namely, the ability to pass the intracellular components, one at a time, across a laser beam for measurement and identification. The award includes a $5000 honorarium. It is sponsored by the Fisher Scientific Company and was established to recognize and encourage outstanding contributions to the science of analytical chemistry, pure and applied, carried out in the United States and Canada.

National Academy of Sciences Elects New Members

Membership in the Academy of Sciences is an honor that is given to very few scientists. Last week the members of the National Academy of Sciences elected nine women and 51 men to membership in the Academy. Several newly elected members receive support for their research from the Office of Basic Energy Sciences/Chemical Sciences Division. The new members and their affiliations are: Professor Marye Anne Fox, University of Texas, Austin; Professor Thomas J. Meyer, University of North Carolina at Chapel Hill; and Professor Sung-Hou Kim, a Division Director at Lawrence Berkeley Laboratory.

National Center for Electron Microscopy Selects Visiting Scientist Awards

Three customers of the National Center for Electron Microscopy at the Lawrence Berkeley Laboratory have been selected by the Center's Steering Committee as recipients of Visiting Scientist Awards. They are Professor Daniel Callahan from Rice University, who will study internal processes during deformation using the 1.5 million electron-volt High Voltage Microscope, Professor Richard Spontak from the University of North Carolina, who will examine the microstructure of polymers and ceramic oxides with the Atomic Resolution Microscope, and graduate student Lynn McInnes from the University of Washington, who will characterize aerosol samples as part of an environmental study. All three are scheduled to spend an extended research visit at the Berkeley User Facility.

Division of Energy Biosciences Awardees

At the recent annual meeting of the National Academy of Sciences, three researchers either currently or previously supported by the Office of Basic Energy Sciences/Energy Biosciences Division were honored. These include:

Dr. Sharon R. Long of Stanford University was inducted into the National Academy. In addition, in April, Dr. Long was given a Howard Hughes Medical Institute investigator award in recognition of her innovative research. (Currently supported by the Division of Energy Biosciences).

Dr. Joanne Chory of the Scripps Research Institute was awarded the National Academy of Sciences Award for initiatives in research by a young investigator. (Currently supported by the Division of Energy Biosciences).

Dr. Beth Gantt of the University of Maryland was given the Gilbert Morgan Smith Medal for her research in Algal Photosynthesis that had been supported by the Division of Energy Biosciences.

New Smithsonian Exhibit Features Basic Energy Sciences Member

The newly opened exhibit, "Science in American Life," at the National Museum of American History features Chemical Sciences Division staff member, Joseph V. Martinez, as one in a panel of six scientists. The exhibit opened on April 27, and will be on display indefinitely. It stresses Diversity in its presentations and includes hands on chemistry demonstrations, a mock-up of the Manhattan Project nuclear reactor, a control console from the Hanford facility credited with production of plutonium, a photo pictorial of a teaching science laboratory at the Hampton Institute, an Historical Black College and University (HBCU), a reproduction of a 1950's household that illustrates the introduction of plastics in consumer products and one of the magnets fabricated to be incorporated in the Super Conducting Super Collider. The exhibit was made possible with a $5.3 million contribution from the American Chemical Society.

Basic Energy Sciences Grantees Receive Welding Award

Pennsylvania State University researchers T. DebRoy and K. Mundra recently received the 1994 McKay-Helm award of the American Welding Society. The award is presented for the best contribution to the advancement of knowledge in welding of steels, as represented in articles published in the American Welding Journal. Their award-winning paper, "Toward Understanding Alloying Element Vaporization During Laser Beam Welding of Stainless Steels," was supported by the Division of Materials Sciences, Office of Basic Energy Sciences. The award is named after James C. McKay, President of Teledyne McKay for over thirty years, and David F. Helm who occupied the McKay chair in welding metallurgy at the Mellon Institute in Pittsburgh from 1934 to 1973.

The market value of welded components in the United States is estimated to be about $300 billion per year. Welds are used extensively in a wide variety of industries, such as energy, transportation, aerospace, construction, infrastructure, etc. Steel constitutes about 70 percent of the total welded products. Defects in welds lead to poor weld performance which can lead to catastrophic failure with costly system down-time and damage to properties and lives. Our welding research is concerned with weld quality, safety, and reliability.

Harry Drickhamer Receives Honors from the Russian Academy of Sciences

Professor Harry Drickhamer has been awarded an honorary degree "D. Honoris Causia" by the Russian Academy of Sciences. This award is based on his many years of high-pressure research, all of which was funded by the Office of Basic Energy Sciences/Materials Sciences at the Frederick Seitz Materials Research Laboratory at the University of Illinois. Professor Drickhamer also is a recipient of the Presidential National Medal of Science.

Materials Sciences Grantee Wins the National Science Foundation National Young Investigator Award

An Office of Basic Energy Sciences/Materials Sciences Division grantee Assistant Professor, Vinayak P. Dravid earned his doctorate from Lehigh University in 1990. His DOE grant research was started on September 1, 1993. It is concerned with issues that relate to varistors and grain boundary layer capacitors. Professor Dravid has now been awarded a National Science Foundation National Young Investigator award.

Peter Schultz, Lawrence Berkeley Laboratory, Named Hughes Institute Investigator

Professor Peter Schultz, principal investigator at the Lawrence Berkeley Laboratory and Professor of Chemistry at the University of California at Berkeley, has been appointed Howard Hughes Medical Institute Investigator. The Hughes Institute, the largest private philanthropy in the country announced the names of 44 new investigators April 6, 1994, bringing the national total of institute biomedical investigators to 274. These scientists have their full salary paid by the Institute, and receive funds for research, new equipment, and renovated facilities. They are expected to spend 75 percent of their time doing research, with the rest devoted to teaching and other activities.

Schultz is known for his research in the use of molecular biology to synthesize novel compounds and materials and for the development of catalytic antibodies-substances that accelerate very specific chemical reactions. This research has been supported jointly by the Basic Energy Sciences/Divisions of Materials Sciences and Energy Biosciences. Among his many honors, Schultz is the youngest person ever elected to the National Academy of Sciences (in 1993 at the age of 36).

James Livingston Elected to National Academy of Engineering

Professor James D. Livingston of the Massachusetts Institute of Technology has been elected to membership in the National Academy of Engineering. He is well known for his Basic Energy Sciences/Materials Sciences supported investigations concerning the mechanisms of deformation of intermetallic compounds with complex crystal structures, and the brittle fracture behavior of this technologically important class of materials. The key barrier that is presently inhibiting the more widespread use of these intermetallic compounds in structural applications is their brittle fracture behavior, which may not be intrinsic. Such intermetallic compounds have an enormous range of potential applications that could lead to improved performance and safety, such as for fossil-fuel energy production; light-weight, fuel-efficient vehicles; secondary steam power and a variety of turbine applications. Professor Livingston's pioneering work is significant for the understanding that he has achieved concerning the parameters that govern this brittleness.

Materials Sciences Researchers Sweep Los Alamos Fellows Prize

Two Division of Materials Sciences researchers, John Petrovic and Greg Swift, recently received the 1993 Los Alamos National Laboratory Fellows Prize. Through an annual competition, the Los

Alamos Fellows recognize one or more individuals for their outstanding contributions to their respective research fields. Each researcher received $3,000 and presented a Laboratory colloquium on his award-winning work.

Petrovic was selected for his work in the development of a new class of materials called high-temperature structural silicides that are strong, lightweight, oxidation resistant and can withstand extreme conditions. One academic colleague commented, "it is rare in our field that the results of a single individual can cause a virtual revolution. However, this is certainly the case with respect to John Petrovic's pioneering work..." Swift was recognized for his contributions to heat pump science and engineering. He is primarily responsible for the conceptualization and development of thermoacoustics as a new means of refrigeration, producing extremely cold temperatures using sound vibrations to initiate the cooling system. Both researchers hold patents on their work and are actively involved in industrial programs to transfer these technologies to the U.S. marketplace.

Cohen Awarded Lilienfeld Prize

Marvin Cohen of the Lawrence Berkeley Laboratory has been awarded the 1994 Julius E. Lilienfeld Prize. The Lilienfeld Prize was established in 1988 in memory of Julius Edgar Lilienfeld, to recognize outstanding contributions to physics by an individual who has also demonstrated exceptional skills in lecturing to diverse audiences. The citation reads:

> "for his development and application of new theoretical techniques that have dramatically enriched our understanding of the properties of crystalline solids and provided the impetus for the experimental discovery of new properties and materials. Also for his outstanding ability to communicate to diverse audiences his deep insights into physical phenomena and his keen enthusiasm for the process of scientific discovery."

Cohen received his Ph.D. from the University of Chicago in 1963 and joined the technical staff at AT&T Bell Laboratories. He left in 1965 to become a senior scientist at the Lawrence Berkeley Laboratory where he has been supported by the Office of Basic Energy Sciences. He is also a faculty member of the University of California, Berkeley, where he is presently a professor physics. Cohen is also a past recipient of the American Physical Society's Oliver E. Buckley Prize.

Science News Features Materials Sciences Studies on How Diamonds Grow

A leading article entitled "A Material World" in the February issue of Science News featured microanalytical studies of diamond films performed by David A. Muller and Professor John Silcox of Cornell University with support from the Division of Materials Sciences/Office of Basic Energy Sciences. Diamond films are being developed for a wide variety of technical applications but exactly how the diamonds nucleate is not known. The work of Muller and Silcox using a scanning transmission electron microscope and electron energy loss spectroscopy reveals subtleties of carbon bonding at the interface between the diamond film and the silicon substrate on which the film is grown.

Basic Energy Sciences Member Receives Excellence Award

Joseph V. Martinez, a member of the Office of Basic Energy Sciences/Division of Chemical Sciences, became a recipient of the first award presented by the National Alliance of Research Centers of Excellence (NARCE) in its six-year history. The citation reads: "For many years of strong training which have positively impacted the nation, including minority institutions." The award was presented during the sixth in the series of NARCE conferences held on March 17-18 and hosted by the Center for Theoretical Studies of Physical Systems (CTPS) of Clark-Atlanta

University. The Center for Theoretical Studies of Physical Systems is one of several such centers supported by the National Science Foundation. The concept that led to establishing the centers was published by Dr. Martinez in 1975. Besides Clark-Atlanta, other members of the National Alliance of Research Centers of Excellence are Alabama A&M University (nonlinear optics and materials), City College of New York (structures and interfaces), Hampton University (high energy and nuclear physics), Howard University (materials sciences), Meharry Medical College (molecular biology), University of Puerto Rico/Mayaguez (topical and Caribbean research), and University of Texas/El Paso (materials sciences). Each center is built around the research specialty indicated.

Three Ceramics Researchers to be Inducted as Fellows of the American Ceramic Society

Three ceramics researchers that are funded by the Office of Basic Energy Sciences/Division of Materials Sciences are to be inducted as Fellows by the American Ceramic Society on April 26, 1994, at the Annual Meeting of the Society in Indianapolis. They are Dr. Rowland M. Cannon of the Lawrence Berkeley Laboratory, Professor Thomas O. Mason of Northwestern University, and Professor Dinesh K. Shetty of the University of Utah.

Schmidt Elected to National Academy of Engineering

Lanny D. Schmidt, Professor of Chemical Engineering and Materials Sciences at the University of Minnesota was elected to the National Academy of Engineering (February, 1994). Membership in the Academy is the highest professional distinction for an American engineer. Schmidt's research at Minnesota is supported by the Office of Basic Energy Sciences/Chemical Sciences Division.

Basic Energy Sciences Staff Member Named as a Fellow of the American Physical Society

Fellowship in the American Physical Society (APS) is a great honor. This year, Joseph V. Martinez of the Office of Basic Energy Sciences/Chemical Sciences Division has been elected by the Forum on Physics and Society as a Fellow of the American Physical Society. The citation reads "For his national leadership in minority education, his active encouragement of young minority scientists, and his development of the atomic physics program at the Department of Energy."

Engineering Research Program Grantees Elected to National Academy of Engineering

Two grantees of the Office of Basic Energy Sciences/Engineering Research Program have been honored by an election to the National Academy of Engineering. They are Steven Davis at Northwestern University and Richard Lahey at Rensselaer Polytechnic Institute. In both cases they are recognized for their contributions to engineering through research funded in part by the DOE Engineering Research Program. The election to the National Academy of Engineering is a high honor and national recognition of the electees' contributions. This most recent action continues the past decade's record of one or two grantees being elected every year to the National Academy. Hence, it is a more or less direct measure of the over-all quality of the sponsoring program as viewed by the U.S. engineering community.

1994 American Society of Photobiology Research Award

Dr. John Hearst of the Lawrence Berkeley Laboratory, partially funded through the Office of Basic Energy Sciences/Energy Biosciences program, recently received the 1994 American Society of Photobiology Research Award for his work on the biochemistry of photosynthesis.

Corrosion Researcher Honored with Uhlig Award of the Electrochemical Society

Dr. Hugh Isaacs of Brookhaven National Laboratory has been honored with the H. H. Uhlig Award of the Electrochemical Society for his research on corrosion. Dr. Isaacs is well known for his studies of localized corrosion using a scanning reference electrode to locate, monitor, and observe actively corroding sites on metal surfaces, and his previous research on that subject spawned a Cooperative Research and Development Agreement with Basic Aircraft Industries, Inc. More recently, his research has been concerned with the use of synchrotron X-ray methods for the in situ study of corrosion, and investigations of the composition of salt layers and occluded solution, the role of chromium and chromates, and the growth and dissolution of passive layers on iron and aluminum alloys. The annual economic cost of corrosion damage in the U.S. is estimated as 4.25 percent of the Gross National Product according to a recent Panel Report by the National Academy of Engineering.

Geosciences Researcher Elected to the National Academy of Engineering

John Bredehoeft, research geologist, U.S. Geological Survey (USGS), Menlo Park, was elected to the National Academy of Engineering for "fundamental and applied contributions to subsurface fluid engineering and science concerning water management, nuclear waste disposal, and seismic hazards" (announced February 7, 1994). The Geosciences research program supports this research through funding a University of Utah graduate student working with Dr. Bredehoeft at Menlo Park. He is a former member of the Basic Energy Sciences Advisory Committee. His currently funded project is testing the hypothesis that kerogen conversion to oil causes the anomalously high pore pressures distinctive of the Uinta basin and necessary for oil migration (and ultimately exploitation) in water-wet geologic materials. Establishing a causal relationship would thus aid efforts to identify and develop new oil and gas reserves. This research project is an application to the oil and gas industry of his previous hydrologic research using numerical simulations of two-phase fluid flow extended to oil plus water in a hydrocarbon reservoir.

Grantee to Receive Townes Award from the Optical Society

Professor Joseph H. Eberly of the University of Rochester who is supported by the Office of Basic Energy Sciences/Division of Chemical Sciences' Atomic Physics Program is the 1994 recipient of the Townes Award given by the Optical Society of America. Professor Eberly is cited for his outstanding contributions to theoretical optical physics and in particular to coherent pulse propagation and superradiance, atomic radiation theory, cavity quantum electrodynamics and intense field phenomena. It is the latter work that is supported by DOE and concerns the interactions of high intensity lasers with atoms. The award was established in 1981, in honor of 1964 American Nobel Lauerate, Charles H. Townes, the inventor of the maser. It is presented annually for outstanding contributions in the field of quantum electronics. The award consists of a medal, a scroll and a $1,000 honorarium and will be presented to Professor Eberly in May at the annual Conference on Lasers and Electro-Optics to be held in Anaheim, California. The Society has requested that public announcement of this award be delayed until May 1.

Three Investigators will become Fellows of the American Physical Society

Three investigators funded by the Office of Basic Energy Sciences/Division of Materials Sciences will be installed as Fellows by the American Physical Society at the Society's Division of Material Physics annual meeting in Pittsburgh on March 22, 1994. They are Professor Michael H. Aziz of Harvard University, Professor Didier R. de Fontaine of Lawrence Berkeley Laboratory, and Dr. Cullie J. Sparks of Oak Ridge National Laboratory.

Economist Features Office of Basic Energy Sciences-Funded Research

The lead Science and Technology article for the February 12, 1994, issue of the Economist featured the Office of Basic Energy Sciences/Division of Materials Sciences' work on metallic glasses by Professor William Johnson of California Institute of Technology. The large international circulation (534,000 copies weekly) of the Economist provides prompt news of world-wide business, financial and technical developments to an influential readership. The Economist article noted that the materials produced by Professor Johnson's research, are twice as strong and half as dense as the best steel, resistant to wear and corrosion, hard yet ductile, and so smooth - "it slides across a surface as if it were Teflon." The article also notes that there is a strong commercial interest in metallic glasses, and that the Japanese also have a team of scientists investigating similar materials. The Division of Materials Science provided enhanced funding to Professor Johnson to help exploit the strong commercial potential of these new metallic glasses and further encourage his already significant industrial interactions.

Materials Sciences Investigators Receive Metallurgical Society Honors

Division of Materials Sciences-funded investigator, Dr. Chain T. Liu of Oak Ridge National Laboratory, was installed as a Fellow of the Metallurgical Society on March 1, 1994. The highest honor bestowed by The Metallurgical Society, the rank of Fellow recognizes an individual for a lifetime of outstanding contributions to the practice of metallurgical and materials science and technology. Awarded for life, the rank of Fellow may be held by no more than 100 living individuals. Dr. Liu's citation is "For major contributions to the field of alloy design and the development of greatly improved intermetallic alloys." Dr. Liu has authored more than 190 technical papers and reports as well as 16 U.S. patents. He has received a number of honors, including awards from the National Aeronautics and Space Administration and DOE for contributions to the development of special structural alloys for space applications.

Materials Sciences grantee, Professor Ole J. Kleppa of Northwestern University was presented with The Metallurgical Society's Sir William Hume-Rothery Award on March 1, and was invited to present the 1994 Hume-Rothery Memorial Lecture. The title of Professor Kleppa's lecture was "Systematic Aspects of the High-Temperature Thermochemistry of Binary Alloys and Related Compounds" and it featured some aspects of Kleppa's pioneering DOE funded work concerning modern high-temperature reaction calorimetry and its application to a wide range of binary alloy systems and related compounds. The Sir William Hume-Rothery Award honors a scientific leader for exceptional scholarly contributions to the science of alloys.

Division of Materials Sciences-funded welding science investigator Dr. Stan A. David of Oak Ridge National Laboratory, was presented with The Metallurgical Society's Champion H. Mathewson Award on February 28. The award citation notes a series of papers published by Dr. David on the subject of welding and microstructures.

Westinghouse Finalist Supported by Division of Materials Sciences

Ms. Shimin Zheng, a student at the Townsend Harris High School/Queens College in New York City, is one of the 40 finalists in the 53rd Westinghouse Science Talent Search. Ms. Zheng conducted her research project in the laboratories of Professor Miriam Rafailovich at Queens College, City University of New York. Her research project, supported by the Office of Basic Energy Sciences/Division of Materials Sciences, is entitled "Nanoscale Patterning of Silica with Block Copolymers." Ms. Zheng will present her work at the March meeting of the American Physical Society and a paper describing the work (with Ms. Zheng as lead author and with collaborators from Bellcore in New Jersey, the State University of New York at Stony Brook, and

McGill University) has been submitted to Applied Physics Letters for publication. Ms. Zheng will visit Washington, D.C. during the period of March 9-14, 1994, as a guest of the Westinghouse Competition Committee. During this time she will present a poster of her project in the hall of the National Academy of Sciences.

Two years ago Professor Rafailovich mentored another Westinghouse Finalist, again on a project supported by the Division of Materials Sciences.

Multiple Honors to Professor Joseph E. Greene

Professor Joseph E. Greene of the University of Illinois has been elected to the Governing Board of the American Institute of Physics and, separately, as a Fellow of the American Vacuum Society. His Office of Basic Energy Sciences/Division of Materials Sciences-funded research has recently lead to the design of a new metastable alloy $Ti_{0.8}Al_{0.2}N$ which is a much better diffusion barrier in silicon-based semiconductor devices than presently used titanium nitride, and also possesses the required electrical properties for such applications. This alloy also possesses excellent high temperature wear and oxidation resistance. Amongst Professor Greene's on-going industrial interactions are joint experiments on the use of this new metastable alloy, and other joint experiments with Atlantic Telephone & Telegraph, and consulting arrangements with Gilette to develop new wear and abrasion resistant ceramic coatings on steel.

Six Investigators Funded by Materials Sciences Win Alexander Von Humboldt Awards

The Alexander von Humboldt Foundation announced the names of newly selected awardees for support to conduct research at universities in Germany for a duration of not less than one year, as follows:

Professor Walter G. Klemperer of the University of Illinois, for Senior American Scientists in Chemistry

Professor Robert Averback of the University of Illinois, for Senior American Scientists in Engineering

Professor Vaclav Vitek of the University of Pennsylvania, for Senior American Scientists in Engineering

Dr. Man Yoo of Oak Ridge National Laboratory, for Senior American Scientists in Engineering

Amongst scientists selected to receive funding for a German postdoctoral researcher were:

Professor J. William Morris of Lawrence Berkeley Laboratory

Professor William C. Johnson of California Institute of Technology

Engineering Researcher Earns Welding Award

Dr. H. Smartt, Idaho National Engineering Laboratory (INEL), has been awarded the A. F. Davis Silver Medal Award by the American Welding Society. The award is for a paper in Welding Journal during the previous calendar year that is judged to be the best contribution to progress in welding. The award-meriting paper was entitled "A Model for Heat and Mass Input Control in Gas Metal Arc Welding." It describes the results of the research on the fundamental aspects of the welding process for independently controlling heat and mass input to the weld. The research is

sponsored by the Office of Basic Energy Sciences/Engineering Research Program and is a part of a joint project between INEL and the Massachusetts Institute of Technology.

Geoscientist Receives High Honor

Dr. Thomas J. Shankland of Los Alamos National Laboratory has been elected to Fellowship in the American Geophysical Union (AGU). Fellowship in AGU is essentially membership in a "one in a thousand" honorary group, being limited to 0.1% of the total membership of AGU. Dr. Shankland will be honored for his continuing and major geophysical contributions toward understanding electrical and thermal properties of the earth's deep interior. He has been supported in this research area by the Geosciences program for more than a decade.

Materials Sciences Researcher Receives a Senior U.S. Scientist Award from the Alexander Von Humboldt Foundation

In recognition of his past accomplishments in research and teaching, Dr. Eicke R. Weber (Lawrence Berkeley Laboratory) has received an Alexander Von Humboldt Senior U.S. Scientist Award. Dr. Weber has made extensive studies of the relationship between the synthesis and processing of artificially structured semiconductors and the properties of these materials that result from structural and electronic imperfections. Improved understanding of these materials is important for the design of advanced photovoltaic energy conversion devices and for a variety of sensors used in energy conversion processes. The prestigious Von Humboldt Award entitles Dr. Weber to stay at an institution of his choice for a period of up to 12 months, and he has decided to spend the Spring 1994 Semester at the newly founded Max Planck Institute for Microstructural Physics in Halle, Germany.

Lawrence Berkeley Laboratory Researcher Receives 1994 Lawrence Award

Professor Robert Bergman of the Chemical Sciences Division at Lawrence Berkeley Laboratory has been selected to receive a 1994 Lawrence Award at a Department of Energy (Forrestal) ceremony and reception to be held on February 14, 1994. This citation recognizes his many outstanding contributions in the fields of catalysis, synthesis, and reaction mechanisms of organic and transition metal organometallic compounds. Professor Bergman is supported by the Office of Basic Energy Sciences/Chemical Sciences Division.

Geosciences Researcher to Give Distinguished Lecture at International Conference

John Rundle has been selected to give one of two Association Plenary Lectures at the 27th General Assembly of the International Association of Seismology and Physics of the Earth's Interior. The meeting will be held at Victoria University of Wellington, New Zealand, January 10-21, 1994. His lecture will be entitled "Statistical Mechanics of Earthquakes."

He has been supported by the Office of Basic Energy Sciences/Geosciences Research Program since 1980 at Sandia National Laboratories (Albuquerque), and at Lawrence Livermore National Laboratory. He joined the University of Colorado faculty in October 1993. He has served as Chair of the National Academy of Sciences/National Research Council Committee on Geodesy and is active in research on large-scale deformation of the Earth's crust.

Corrosion Scientist Honored

The United States is losing roughly 4-5 percent of its Gross National Product every year due to materials' corrosion with subsequential safety and environmental costs that may be even higher.

The understanding and prevention of corrosion therefore is an economic necessity of national importance. The Office of Basic Energy Sciences is funding research projects that are specifically designed to address and solve this problem. The Office of Basic Energy Sciences-funded Professor Digby D. Macdonald, Pennsylvania State University, was honored for his corrosion research by being invited to present the "6th W. B. Lewis Memorial Lecture" at the University of New Brunswick, Canada on November 4, 1993. His lecture entitled "Research on Determinism in the Science and Study of Corrosion," was based on work funded by the Office of Basic Energy Sciences/Division of Materials Sciences.

Humbolt and Feodor-Lynen Awards Presented to Office of Basic Energy Sciences-supported Researchers

The Alexander von Humbolt Foundation in Bonn, Germany, has awarded three Office of Basic Energy Sciences-supported American Scientists the prestigious Humbolt Award for senior scientists. These were Walter Klemperer (University of Illinois), Jack Norton (Colorado State University), and Lanny Schmidt (University of Minnesota). The recipients receive research awards of up to 120,000 DM and spend up to one year carrying out research in Germany.

In addition to the senior scientist awards the foundation also selects outstanding young scientists for long-term collaborative awards. Among those selected was BES-supported researcher Rinaldo Poli from the University of Maryland.

The selection of distinguished American Scientists to have German post-doctoral students study with them was also announced. The recipients of these students from the Feodor-Lynen program included BES-sponsored researchers Robert Madix (Stanford University), William Miller, Neil Bartlett and Kenneth Raymond all from LBL.

Cullie Sparks of Oak Ridge National Laboratory has been Named a Fellow of the American Physical Society

Cullie Sparks of Oak Ridge National Laboratory has been named a Fellow of the American Physical Society. He was cited as follows:

> "For his contributions to the development of X-ray optics, monochromators, and anomalous resonance scattering that have advanced synchrotron radiation studies of local atomic arrangements and displacements in crystals."

The announcement will be published in the March issue of the American Physical Society News. Cullie Sparks and his research has been sponsored by the Office of Basic Energy Sciences/Division of Materials Sciences for many years.

Chemical Sciences Program Manager Elected an American Physical Society Fellow

Dr. Joseph V. Martinez, Manager of the Atomic Physics Program of the Office of Basic Energy Sciences/Division of Chemical Sciences, was recently notified that he has been elected a Fellow of the American Physical Society. In conferring Fellowship, Martinez was cited: "For his national leadership in minority education, his active encouragement of young minority scientists, and his development of the atomic physics program at the Department of Energy." The Society, with a membership of 43,720, annually elevates less than one-half percent of its membership to Fellow status. Currently 4,312 have been accorded the honor.

Dr. Alan Bishop of Los Alamos National Laboratory Awarded the 1993 E.O. Lawrence Award

Dr. Alan Bishop of Los Alamos National Laboratory has been awarded the 1993 E.O. Lawrence Award in Materials Sciences. Dr. Bishop's work on conducting polymers, change and spin-density wave materials and synthetic metals was cited as well as his extensive participation in synthesis-characterization-modeling teams of chemists, physicists, and biophysicists. This research has been supported since the early 1980's by the Office of Basic Energy Sciences/Division of Materials Sciences.

American Chemical Society Adamson Award to Gabor A. Somorjai of Lawrence Berkeley Laboratory

The American Chemical Society has announced that the 1994 Arthur W. Adamson Award for Distinguished Service in the Advancement of Surface Chemistry will be awarded to Gabor A Somorjai, Materials Sciences Division, Lawrence Berkeley Laboratory and Professor of Chemistry at the University of California at Berkeley. The award, which consists of $5,000, a gold medal, a bronze replica of the gold medal, and a certificate, is sponsored by Occidental Petroleum Company and will be presented at the National meeting of the American Chemical Society in San Diego, California in April, 1994.

Professor Somorjai's research leading to this award has involved the structure and surface chemistry of molecules adsorbed on metal surfaces. This research forms a basic component of the science of catalysis, tribology, the growth of well-ordered materials and other industrially important processes. Professor Somorjai's research has been supported by the Office of Basic Energy Sciences/Division of Materials Sciences for many years.

Geosciences Researcher at Idaho National Engineering Laboratory Named Distinguished Lecturer

Dr. Jonathan Epstein, a Basic Energy Sciences-supported researcher in Geomechanics at the Idaho National Engineering Laboratory, has been named a Distinguished Lecturer for the 1993-1994 academic year by the Associated Western Universities. He is one of two lecturers from the Idaho National Engineering Laboratory and one of nine named by Associated Western Universities. Distinguished Lecturers will visit as many as four Associated Western Universities institutions during the year to present seminars and describe research opportunities at their laboratories. The program is sponsored by the Department of Energy's Office of University and Science Education Programs and is administered by Associated Western Universities.

Chemist Donald Cram Receives the National Medal of Science

Nobel Prize winning scientist, Donald J. Cram of UCLA, received the National Medal of Science at a White House ceremony on Thursday, September 30, 1993. Professor Cram is credited, with partial support from the Office of Basic Energy Sciences/Division of Chemical Sciences, with the discovery of a new means of binding metals to chemical complexes. This work led to the development of crown ethers and other ring-shaped molecules which are highly selective in binding metal ions. This work opened an entire area of metal complexation research which is now contributing to the removal of actinides and other fission products from high level radioactive wastes, as well as other applications, such as the separation of medical isotopes for cancer treatment.

Technology Transfer Activities

Integration with U.S. Industry

Thermoacoustic Natural Gas Liquefier

The Thermoacoustic Program at Los Alamos National Laboratory continues to stimulate industrial interest in the applications of acoustic cooling. The Program, under Gregory Swift, produced the technology underlying the first no-moving-parts cryogenic refrigerator (U. S. Patent No. 4,953,366, September 4, 1990) already the subject of considerable commercial interest, and the subject of a joint Los Alamos National Laboratory-National Institutes of Standards and Technology-Tektronix collaboration. Now the group is proposing a thermoacoustic natural-gas liquefier (TANGL) which would be maintenance-free, inexpensive, portable and environmentally benign. It could, for example, enable economic recovery of natural gas from wells too remote to justify construction of a pipeline. It could also provide a means to recover gas from offshore sites, methane from bio-wastes, natural gas entrained in petroleum and to liquefy locally natural gas for a variety of purposes. The first TANGL is expected to liquefy 70% of its throughput by burning the remaining 30% as fuel. Further research is expected to improve this efficiency. A Cooperative Research and Development Agreement, was executed on April 21, 1994, with Cryenco, Inc. to investigate the system.

Commercialization of Magnetic Flux Imaging System Developed at Argonne

We reported on March 24, 1994, that a new magnetic flux imaging microscopy had been developed by researchers (G. Crabtree, et., and) at Argonne National Laboratory under support from the Division of Materials Sciences/Office of Basic Energy Sciences. This microscope provides the capability to observe how an external magnetic field penetrates a superconductor, how the current is distributed in a superconductor, how magnetic flux vortices break loose (flux lattice melting) when the critical current is exceeded, and the observation of inhomogeneities which pin the magnetic flux in a superconductor. With this device, one can see the movement of magnetic flux under changing conditions such as the applied field or the current. A videotape has now been produced to show these effects. A California company, Phase Metrics, is now manufacturing and selling this instrument, which was exhibited at the March 1994 Meeting of the American Physical Society in Pittsburgh.

Industrial Researcher Praises Materials Sciences Workshop

Dr. John Rabolt, senior scientist at the IBM Almaden Research Center in San Jose, California, has written a letter to the Division of Materials Sciences praising the results of a DOE workshop on Thin Organic Films held in 1986. Dr. Rabolt writes "that was clearly ahead of its time in the sense that it included academic, industrial and government participants. As one of the participants from industry, I recall many frank discussions on important areas for emphasis and continuous debate on other directions which should be abandoned. What emerged was a blueprint of opportunities and challenges for research in organic thin films which was subsequently published in the journal LAGMUIR in 1987. Recently, I consulted Citation Index and was pleased to find that this article has received upwards of 300 citations since it was published!!" Dr. Rabolt goes on to say that he has incorporated the workshop recommendations into his vision of research areas that will benefit IBM. He adds, "I am convinced that the workshop report has influenced a generation of surface and interface scientists to explore new areas, take risks and push the state-of-the-art in analytical instrumental methods."

This workshop was the product of the Council of Materials Sciences, a diverse working group of experts drawn from Materials Sciences customers and stakeholders. The next meeting of the Council will be on December 15-16, 1994. Dr. Rabolt asks that the Council consider convening "a group to assess the progress made and to again play the role of visionaries and chart a course for organic thin films that will take us into the 21st century."

Measurements of Carbon Black Structure Support U.S. Tire Company

Research by Los Alamos National Laboratory scientist Dr. Rex Hjelm on the structure of carbon black using small-angle neutron scattering is contributing to the U.S. tire industry and to improved energy efficiency in automobiles. Dr. Hjelm presented his work at the 146th meeting of the Rubber Division of the American Chemical Society. Michel Gerspacher and Charles O'Farrell of Sid Richardson Carbon Co. said, "we are convinced that the studies you have directed at the Los Alamos Neutron Scattering Center have dramatically improved the understanding of carbon black - a strategic materials for the tire industry in this country." Carbon black is embedded in the rubber of automobiles tires to improve efficiency, durability, and toughness. The form and structure of carbon black in reinforced rubber relates directly to understanding how carbon black improves the mechanical properties of tires. Even a small improvement in properties such as tire heating would reduce gas consumption in automobiles and result in substantial economic benefit. The Los Alamos studies show that carbon black forms an aggregate-elastomer network. The outer surface of the aggregate is smooth and relates to the binding of polymer to the carbon black. The network formed is important in understanding the mechanical properties of the manufactured materials. This research is supported by the Division of Materials Sciences in the Office of Basic Energy Sciences.

Combustion Research Facility Licenses Technique for Characterizing Ultrashort Laser Pulses

Scientists supported by Basic Energy Sciences' Division of Chemical Sciences have developed a new technique for characterizing ultrashort laser pulses at the Combustion Research Laboratory (CRF) of Sandia National Laboratories, California. This technique will soon become a commercial product. The device was developed to enhance our ability to measure events in molecules taking place over extremely short time intervals on the order of one ten trillionth of a second (10^{-13} s). Such very fast time scales are characteristic of the time in which a normal vibrational motion in a molecule becomes a dissociation path (i.e., the breaking apart of a molecule). Characterizing how this occurs can lead to better models for predicting the temperature and pressure dependence of chemical reactions which in turn can lead to better models for combustion. Lasers capable of

producing pulses of light lasting less than 10^{-13} s appeared to be the ideal tool for studying chemical dynamics, but without being able to characterize the phases and intensities of the radiation in the pulse, it would be impossible to characterize the molecular dynamics the pulse was being used to probe. In contrast to continuous lasers which exhibit extremely uniform frequencies, short laser pulses are made up of a wide spectrum of light *simply because the pulses are short*! And obviously, one cannot use shorter pulses to characterize something which is producing the shortest pulses of light known.

Working in collaboration with scientists at Los Alamos National Laboratory, the Combustion Research Facility scientists developed a technique which they have called Frequency-Resolved Optical Gating (FROG). They discovered that the mathematical relationship between the spectrogram of the pulse and the frequencies and phases of the waves making up the pulse was identical to a problem in image science that had been already been solved. Because of possible applications ranging beyond chemical dynamics to semiconductor characterization and various optics problems, commercial interest in the device was generated. As a result of the technology transfer efforts of the Sandia scientists and the Sandia Technology Transfer office, FROG will soon be a commercial product. The Department of Energy has recently granted a license to sell FROG devices to Clark Instrumentation, Inc., an innovative ultrafast-laser company.

Light-Weight Materials Being Pursued for Automotive Applications

Ames Laboratory has been selected by the United States Automotive Materials Partnership (USAMP)/Advanced Metals Division to participate in the development of low-cost powder metallurgy technology to produce particle reinforced aluminum components of low weight for the new generation automobiles. In this four-year effort Dr. Iver Anderson, from the Metallurgy and Ceramics Program at Ames Laboratory, in collaboration with Oak Ridge National Laboratory, the National Institute of Standards and Technology, several universities, and commercial suppliers, will provide several powder mixtures and participate in the development of press and sinter processes eventually used to produce automobile parts for automobile engines. The technology used by Ames Laboratory is based on basic research funded by the Office of Basic Energy Sciences/ Division of Materials Sciences. The automobile parts developed will be evaluated by Chrysler, Ford, and General Motors in actual tests. The USAMP/Advanced Metals Division has predicted a number of significant improvements of present day engines if this new technology is introduced. Other beneficial applications should then follow.

New Column in "High-T_c Update" Provided Forum for Applications of Superconductivity

Ever since the discovery of high temperature superconductors in 1986, the Office of Basic Energy Sciences/Division of Materials Sciences has supported a newsletter called "High-T_c Update" at the Ames Laboratory. This newsletter dessminates all of the latest research results on high temperature superconductors and has received acclaim from around the world for this outstanding service.

Since March 1, 1994, "High-T_c Update" has begun a monthly "Technology News" column that discusses progress in manufacturing, product development, and technology transfer issues in the high-T_c superconductivity field. The new column gives a flavor of some of the work that various superconductivity industries are pursuing. The aim is to broaden the scope and readership of "High-T_c Update," and reinforce to the public that all the basic research is beginning to lead to some practical applications. The managers and presidents of several companies that are currently pursuing development of high-T_c products, are very happy to send information about their work and pleased to have a forum for international exchange of information regarding technology

transfer aspects of the high-T_c superconductivity field. It makes a significant contribution to technology transfer in superconductivity.

Basic Research "Spins Off" Advanced Research Reactors for Semiconductor Materials Growth

Concepts developed through BES research at Sandia National Laboratories over the last decade have matured into new technology being embraced by the U. S. semiconductor industry. Sandia has delivered a prototype of its "Rotating-Disk" Chemical Vapor Deposition Reactor to SEMATECH, and a $3.9 million Cooperative Research and Development Agreement (CRADA) is underway with EMCORE, Inc., of New Jersey to further commercialize large scale designs for compound semiconductor materials growth. In a letter to Sandia, Norman E. Schumaker Chairman and CEO of EMCORE gives "several explicit examples of the benefit of this work to our success." His letter continues "with the analysis performed by your staff and the discussions with my EMCORE engineers, we were able to improve our process conditions within two runs to meet and exceed a customer's requirements. This simple interaction allowed us to: (1) successfully complete a contract specification which had been difficult to achieve, and (2) to convince a potential customer of the merits of our equipment. In business, time is money and Sandia's responsiveness has helped us greatly in our market.

The "Rotating-Disk" Reactor was originally developed by Sandia to study and develop models of the complex chemistry of chemical vapor deposition processes under well characterized conditions. Sandia's demonstrated expertise in modeling of these processes has led to a significant number of subsequent programs funded by DOE Defense Programs and DARPA to work with industry in advancing the development of chemical vapor deposition reactors. One such program with SEMATECH led to the development of the scaled-up 6-inch diameter reactor that was recently shipped to SEMATECH for use in their process development programs. Additional CRADAs have been negotiated directly with U.S. industry, for example with Hewlett-Packard, Motorola, Texas Instruments and EMCORE to assist in transferring these scientific design methods to industry. These CRADAs are funded by the Assistant Secretary for Defense Programs.

SEMATCH Companies Explore the Use of Synchrotron Light Sources

On August 29, 1994, Bill Oosterhuis, Division of Materials Sciences/Office of Basic Energy Sciences, participated in a meeting with representatives of the SEMATECH Companies in Santa Clara, California, the Stanford Synchrotron Radiation Laboratory (SSRL), and the Advanced Light Source (ALS). The purpose of the meeting was to explore the use of synchrotron radiation in innovative ways which might be of use to the semiconductor industry.

There are two different techniques. The first is Total Reflection X-ray Fluorescence which can identify minute quantities of impurities on the surfaces of wafers. The brightness and tunability of the X-ray beams from SSRL and ALS make it possible to detect quantities as small as 10^8 atoms per cm^2, the atomic identity of the impurity, and the chemical environment of the impurity. (There are about 10^{15} atoms/cm^2 on a silicon wafer surface, so this technique can detect impurities at a concentration of less than one part per billion surface atoms.) The other technique, which is evolving, is called micro-XANES spectroscopy, in which photoelectrons resulting from the tunable X-ray beam can map out the chemical distribution of atoms on or near the surface, and thus identify separate structures of silicon, silicon dioxide, aluminum, etc. as might be found on a semiconductor chip. Both of these techniques could become quite useful in problem solving in semiconductor chip manufacturing as the dimensions of the structures get smaller and smaller - approaching 0.1 micron in width.

The participants from the SEMATECH companies are quite interested in the possible use of these techniques for making use of the photon beams from SSRL and ALS through the analytical services provided by Charles Evans & Associates. The Office of Basic Energy Sciences is interested in helping develop these new technologies to be of service to the semiconductor industry. SEMATECH and Charles Evans & Associates are accustomed to Advanced Research Projects Agency, which often provided them with funding to establish new instruments. Such a practice would be difficult with current Basic Energy Sciences resources, but other avenues will be explored.

Ames Laboratory Materials Preparation Center Solves Industrial Welding Problem

The Materials Preparation Center at Ames Laboratory through its Iowa Company Assistance Program provides a technology information and advise to Iowa companies. Through the program, the laboratory offers up to 40 hours or $2,500 assistance to Iowa companies. Recently, a team from the Center solved a problem of faulty welds which was plaguing Wayne Engineering Company, a garbage truck manufacturer in Cedar Falls. Through metallurgical analyses of welds and a visit to the production line, the team showed that the company was not getting full welds and advised the company on how to improve its welding process.

The Materials Preparation Center is funded through the Division of Materials Sciences of the Office of Basic Energy Sciences. The Division also supports fundamental studies of solidification of metals at Ames. The Iowa Company Assistance Program is carried out through funds provided by the state of Iowa.

Method Developed for the Early Detection of Weathering of Paint

Research that originated at the Oak Ridge National Laboratory and supported by the Basic Energy Sciences Division of Chemical Sciences has demonstrated the technical feasibility of the early detection and characterization of the weathering process that takes place in paints and polymer coatings. Current methods of analysis of this process, such as scanning electron microscopy, normally require a year or more as the paint film cracks, blisters, and peels, destroying the sample in the process. The research on the new, nondestructive, method, supported in part by a Cooperative Research and Development Agreement (CRADA) with the Masonite Corporation, uses positron spectroscopy to probe the changes in the polymers and pigments that make up the paint by analyzing the Doppler broadening of the annihilation radiation resulting from the positron-electron interaction. Results indicated that the weathering decreases the free volume contents of the film. The effects of only one week of weathering could clearly be detected. This work was done in collaboration with the Department of Applied Sciences of the Brookhaven National Laboratory.

Engineering Research Project Draws Industrial Interest

A significant portion of the Office of Basic Energy Sciences/Engineering Research Program is devoted to the diagnostics and control of the plasma processing of materials. One of our principal investigators (Professor E. Pfender, University of Minnesota) has reported that as a result of the basic research supported by us, The Engineering Research Program has received sizable contracts from Westinghouse, DuPont and Alcatel for the utilization of his results in industrial processes (e.g., diamond deposition and plasma synthesis of materials).

User Facilities Important for Contamination-Free Manufacturing

Bill Oosterhuis, Division of Materials Sciences, participated in a workshop hosted by SEMATECH

on August 29, 1994, in Santa Clara, California, in which analytical laboratory managers discussed the need for analytical services using DOE synchrotron radiation facilities - primarily the Stanford Synchrotron Radiation Laboratory and the Advanced Light Source. The brightness and intensity of the X-ray beams from these sources enables the observation of minute quantities (femtograms per square micron) of impurities on circuitry of submicron dimensions, which will form the basis for the next generation of microchips. The ability to observe and analyze these impurities is crucial to the efficient manufacturing of these devices and to a competitive edge for the semiconductor industry. This is of direct importance to the National Electronics Manufacturing Initiative (NEMI) under consideration by the Administration. The workshop was requested by INTEL and Hewlett-Packard.

Research on Lift-Force Contributes to an Industrial Process

The Office of Basic Energy Sciences/Engineering Research Program has supported a fundamental research project at the Clarkson University dealing with lift and drag forces acting on droplets and particles in turbulent flows. The theoretical results of J. M. McLaughlin's research have been validated by experiments and numerical simulation. The results of this work have come to the attention of the DuPont Corporation, a leading producer of titanium oxide powder, used in paint and food industries. DuPont engineers believe that McLaughlin's work will "offer a unique insight into the fundamental turbulence dynamics that influence a number of unresolved process questions." In particular, that insight is expected to help improve DuPont's process technology, and hence maintain their global competitive advantage. DuPont is now providing some additional support for the work at Clarkson University focussing on the flow geometry reflecting the actual industrial process.

Atlantic Telephone & Telegraph Evaluating Devices Developed at Oak Ridge National Laboratory

Atlantic Telephone & Telegraph is evaluating thin-film optical waveguide devices developed by a research team headed by R. A. McKee of the Oak Ridge National Laboratory Metals and Ceramics Division. With the support of the U.S. Air Force, DOE Office of Energy Efficiency and Renewable Energy, and Office of Basic Energy Sciences/Materials Sciences Division, the team developed and patented a method for using molecular-beam-epitaxy growth technologies to fabricate thin-film ferroelectric optical devices including waveguides. These optical-quality waveguide structures can be integrated directly on silicon, which is a very important feature for future applications.

Announcement of University-Industry Grant Program Generates High Interest

The Office of Basic Energy Sciences is widely disseminating information on its initiation of a collaborative university-industry grant program for Fiscal Year 1995. The announcement of intent and how to satisfy the requirements of the new program appeared in various trade publications, such as Chemical & Engineering News and the MRS Bulletin, and word has been spread at scientific and technical meetings, workshops and conferences. To date, over 160 requests for additional information about the program from interested researchers have been answered. In addition to generating more high quality university-industry grant proposals, it is hoped that the tremendous interest generated by the announcement will inform more organizations and investigators about Basic Energy Sciences program activities and their importance to industrial competitiveness.

Representatives of the General Electric Company Discuss Making Sapphires

On Monday, July 18, 1994, Division of Materials Sciences staff will meet with three representatives

from the General Electric Company, Central Research and Development, from 9:30 to 11:00 a.m. regarding a recently reported discovery by General Electric of a process for conversion of polycrystalline alumina to its single crystal form, sapphire. Charles Sorrell of Energy Efficiency/Advanced Industrial Concepts has been invited to join the discussion. The Lamps Division of the General Electric Company recently reported an observation of the conversion of polycrystalline alumina to sapphire. However, neither the basic mechanisms by which the process occurs nor the optimized processing conditions are known at present.

Coordination Visit of Office of Basic Energy Sciences Staffer to Du Pont Central Research and Development

Dr. F. Dee Stevenson, Office of Basic Energy Sciences/Chemical Sciences Division, was invited to visit Du Pont Central Research and Development in Wilmington, Delaware, to discuss industrial basic research needs, current avenues by which research results from DOE supported universities and laboratories are utilized by industry, and ways to more effectively partner in the R&D enterprise. The invitation came as a result of interactions at several previous meetings with Dr. Leo Manzer, who is the Director of the Du Pont Corporate Catalysis Center, including the Council for Chemical Research conference on "Frontiers in Catalysis," the National Institute of Science and Technology Advanced Technology Program Meeting in Gaithersburg, and the participation of Drs. David Dixon and George Coulston of Du Pont at the Ninth Department of Energy's Basic Energy Sciences' Heterogeneous Catalysis and Surface Chemistry Meeting held this past May. Du Pont is active in collaborations with Basic Energy Sciences researchers at the Department of Energy labs and in academe.

This was a very productive visit which confirmed that big companies, such as Du Pont, value the basic research efforts of Government agencies (National Science Foundation and the Department of Energy's Basic Energy Sciences) and have reservations about the current trends to make basic research contributions more "relevant" to industry by promoting applied research. They, themselves, are focusing on more foundational research, like that which launched Du Pont in the 1920's. They also expressed doubts about "linear" models of technology transfer. They expressed concern about the limited expertise from the chemical industries on the Galvin Committee. They welcome the opportunity to participate in "shaping the future."

Big Three Auto Manufacturers Meet with the Department of Energy and the National Science Foundation

Department of Energy and National Science Foundation Representatives met on June 9, 1994, in Dearborn, Michigan, with representatives from the Big Three auto manufacturers to discuss plans for a workshop on basic research needs associated with the Partnership for the New Generation of Vehicles (PNGV). Discussions on such a workshop have been ongoing between Department of Energy and USCAR and between National Science Foundation and representatives of the Big Three for nearly a year. Progress has increased now that the government and industrial partners have been organized under the PNGV. Representing the government partners were the Office of Basic Energy Sciences and the Office of Energy Efficiency and Renewable Energy, Lawrence Berkeley Laboratory, Sandia National Laboratories, the National Science Foundation's Division of Materials Research and the Princeton Materials Institute. Representing industry were USCAR and research directors from Ford, General Motors, and Chrysler. In all, about two dozen individuals participated in a lively two hour discussion about the scope, intent, and agenda of the workshop. The next step will be for industry to prepare a prioritized list of barriers to technology development for consideration by the Department of Energy and the National Science Foundation in early August. The purpose of the workshop is to bring together technologists and scientists from universities and government laboratories, who have heretofore had little occasion to interact

directly, for the purpose of identifying research themes to guide the Federal basic research effort in the coming years. The proceedings of the workshop will be published by an appropriate professional journal to gain the widest dissemination of the workshop's findings and recommendations.

Important Medical Applications Spin Off Engineering Research

The Office of Basic Energy Sciences/Engineering Research Program supports studies of the properties of small bubbles of gas that are acted upon by a sound field in the surrounding liquid. At the University of California, Los Angeles, the properties of small bubbles are studied by Professor S. Putterman, because they can concentrate the sound energy by over twelve orders of magnitude to make picosecond flashes of UV light.

Medical researchers have become interested in these bubbles because their huge interaction with the sound field should make them ideal contrast agents for ultrasonic imaging. The idea is to inject such bubbles into arteries and then carry out the ultrasonic radiology. Gas bubbles trapped in a sound field go to a steady state radius of about 4 microns due to some mass flow process between the bubble and surrounding fluid which is not yet fully understood. It is important to realize that 4 microns is smaller than the diameter of red blood cells, so such bubbles are able to pass through membranes.

An obvious medical problem is that air in arteries can create embolisms. From this completely independent perspective, Professor Feinstein, University of Chicago Medical School, realized that if the trapped bubbles could be encapsulated then this would be a very desirable product. He achieved this effect by merely adding egg white to the water which contains the bubbles. The egg white is then cooked by the sound field to create an albumen-covered bubble of air. This product was sold to Molecular Biotechnologies, Inc., and is known as "Albunex". Although various proprietary issues are still to be resolved, this product will revolutionize medical ultrasonic imaging.

Further, J. D'Arrigo, formerly of the University of Connecticut Health Center, and R. H. Simon, University of Connecticut Health Center, find that when, in addition to albumen, the microbubbles are coated with a monolayer of cholesterol esters, they preferentially accumulate at tumor sites! The numerous potentials for diagnostic and treatment techniques are being aggressively pursued.

Natural Gas Recovery is Another Aim of Thermoacoustic Cooling Technology

The Thermal Physics Program at Los Alamos National Laboratory (LANL) continues to stimulate industrial interest in the applications of thermoacoustic cooling. The BES-supported program, under Gregory Swift, produced the technology underlying the first no-moving-parts cryogenic refrigerator (U. S. Patent No. 4,953,366, September 4, 1990) already the subject of considerable commercial interest, and the subject of a joint LANL-National Institutes of Standards and Technology-Tektronix collaboration.

Now the group is proposing a thermoacoustic natural-gas liquefier which would be maintenance-free, inexpensive, portable and environmentally benign. It could, for example, enable economic recovery of natural gas from wells too remote to justify construction of a pipeline. It could also provide a means to recover gas from offshore sites, methane from bio-wastes, natural gas entrained in petroleum and to locally liquefy natural gas for a variety of purposes. The first thermoacoustic natural-gas liquefier is expected to liquefy 70 percent of its throughput by burning the remaining 30 percent as fuel. Further research is expected to improve this efficiency. A Cooperative Research and Development Agreement, supported by LANL's Laboratory Director's

Research and Development funds, was executed on April 21, 1994, with Cryenco, Inc. to investigate the system.

An Industrialist's Perception of a Cooperative Research and Development Agreement from Basic Energy Sciences/Materials Sciences

Dr. Peter R. Bridenbaugh is Executive Vice President for Science, Technology, Engineering, Environment, Safety, and Health for Alcoa (nee Aluminum Corporation of America). The following paragraph is taken verbatim from an invited address that he presented at the University of California at Santa Barbara earlier this year:

> "We are engaged with governmental laboratories in several Cooperative Research and Development Agreements. The one I believe looks most like a prototype is our work with Sandia-Livermore on microstructural modeling. Here, we are taking some very sophisticated modeling know-how and parallel computing software developed by the government labs and combining it with our own materials physics work to develop software capable of predicting second-phase nucleation in aluminum alloys. The ability to integrate Sandia's rate-theory model and supportive atomic-level simulation tools with our knowledge of precipitation and related physical phenomena will extend Alcoa's advantage in microstructural modelling and simulation. This represents the opportunity we are looking for in this kind of joint work."

Industrial Applications Grow from Research on Intermetallics

Recent and continuing advances in new intermetallic alloys now make their commercial application attractive to service temperatures as high as 1000 degrees Celsius in a variety of fossil energy, transportation and gas turbine applications. Their use will continue to lead to improved fuel economies and minimize pollution control expenses. The increasing industrial acceptance of intermetallic alloys was spawned by Basic Energy Sciences/Materials Sciences research, and DOE supported research at Oak Ridge National Laboratory has lead to license agreements with Armada Corp., Valley Todeco, Ametek, Cummins Engine Co., Metallamics, Hoskins, Armco, Cummins Engine Co., and Harrison Alloys.

Thirty-two of the 175 papers to be presented at the Third International Conference on High Temperature Intermetallics, May 16-19, 1994, in San Diego, California, will portray research supported by the Office of Basic Energy Sciences/Division of Materials Sciences. Some of the other work to be reported at this Conference was supported by DOE/Fossil Energy and DOE/Energy Efficiency and Renewable Resources which also support some of the same laboratories and investigators. Office of Basic Energy Sciences/Division of Materials Sciences will be represented at this Conference by Dr. Michael E. Kassner who will chair a session on Strengthening and Dr. John N. Mundy.

Magnetic Flux Imaging System Developed at Argonne Commercialized

A new magnetic flux imaging microscope has been developed by researchers (G. Crabtree, et. al.) at Argonne National Laboratory under support from the Office of Basic Energy Sciences/Division of Materials Sciences. This microscope provides the capability to observe how an external magnetic field penetrates a superconductor, how the current is distributed in a superconductor, how magnetic flux vortices break loose (flux lattice melting) when the critical current is exceeded, and how inhomogeneities cause pinning of magnetic flux in a superconductor. With this device, one can see the movement of magnetic flux under changing conditions such as the applied field or the current. A videotape has been produced to show these

effects. A California company, Phase Metrics, is now manufacturing and selling this instrument, which was exhibited at the March meeting of the American Physical Society in Pittsburgh.

Start-Up Company Exhibits its Superconductivity Products

Shortly after the discovery of high-temperature superconductivity, in which copper-oxide materials were identified which became superconductors at or above liquid nitrogen temperatures ($77 Kelvin), a small start-up company was formed to develop and market products which exploit superconductivity. This company, Conductus, has developed a variety of products which can measure very small changes in magnetic field - such as those needed for geological exploration, or magnetocardiograms - the magnetic analogy of an electrocardiogram to measure heartbeat. Conductus has benefited from a great deal of input from the Office of Basic Energy Sciences/ Division of Materials Sciences-supported research in superconductivity devices at LBL over the years, and is now bringing a number of new products to the marketplace. These products were exhibited at the March meeting of the American Physical Society in Pittsburgh.

Industry Requests License on Brookhaven National Laboratory Patent

Research supported by the Office of Basic Energy Sciences/Division of Chemical Sciences, at the Brookhaven National Laboratory led to a patent in 1988 on a hydrogen gas storage system employing the suspension of the solid metal hydride formers as a slurry in an inert solvent which can reversibly adsorb and desorb hydrogen. The Partnerships Limited, Inc. company in Lawrenceville, New Jersey, has applied for a nonexclusive license to investigate the commercial applicability of hydride slurries as a hydrogen storage medium to provide hydrogen fuel in the private sector. The company has requested a Small Business Innovation Research grant from DOE.

Collaborations between Industry and the Combustion Research Facility Provide a Basis for Low NO_x Burner Design

Working in collaboration with Altex Technologies Corporation, scientists at the Combustion Research Facility (CRF) at Sandia National Laboratories, Livermore, California, have completed fundamental studies of NO_x formation in a bluff-body stabilized methane burner characteristic of many practical industrial burners. The collaborators developed planar multispecies imaging techniques, an area of expertise at the CRF, which they used to characterize turbulent reacting flows. The data from these studies are being used by scientists at MIT to develop and validate turbulent combustion models. Based on this work, Altex has designed two low NO_x industrial burners. The first, for metals processing, reduces typical NO_x emissions for this class of burner by more than 90%. The second, developed for firetube boilers, reduces NO_x by 85%. This work was sponsored by the Office of Basic Energy Sciences Division of Chemical Sciences, the Gas Research Institute and Gaz de France. As such, it demonstrates the technology transfer that can result from a collaboration between scientists from basic and applied research backgrounds working together in a facility designed for that purpose.

Computer Software on Electrochemical Simulations Commercialized

A spin-off commercial software product, "DigiSim", has resulted from a long-term ongoing research effort at Brookhaven National Laboratory on theoretical simulations of electrochemical phenomena. Cyclic voltammetric measurements are performed routinely in electroanalytical chemistry. The DigiSim cyclic voltammetry simulation software can be used to differentiate various possible reaction mechanisms occurring at the electrode by comparison of simulated data to the measured cyclic voltammagrams. The computer software package was a joint venture, involving Stephen

Feldberg, a Senior Scientist at Brookhaven National Laboratory; Manfred Rudolph of Friederich-Schiller University, in Germany; David Reddy, of Radio Logic, Inc.; and Bioanalytical Systems, Inc. Professor Rudolph's contribution was a more efficient computational, finite difference, method. Mr. Reddy is a professional computer programmer. The marketing and distribution of the DigiSim software package is being handled by Bioanalytical Systems, Inc.

Advances in Gas Metal Arc Welding Help Meet OSHA Guidelines

It has been found by industry researchers that noxious fumes produced during welding are due to overheating of the molten metal droplets. Occupational Safety and Health Administration (OSHA) guidelines limit stringently the exposure to such fumes.

Research on pulsed current welding carried out by Professor T. Eagar at Massachusetts Institute of Technology (MIT) has helped John Deere & Company meet OSHA guidelines by reducing fume generation in the welding process by 60-90%. That has saved the manufacture several millions of dollars in fume exhaust equipment while producing high quality welds.

The necessary insight into the process underlying the fume production and potential for mitigation was a result of a long-term research project (joint between MIT & Idaho National Engineering Laboratory) on the basics of welding physics supported by the Office of Basic Energy Sciences/ Engineering Research Program.

IBM Discusses Needs for Making Increased Use of DOE Laboratories

Dr. Robert Rosenberg, Manager for Materials and Processing Science at the International Business Machines (IBM) Thomas J. Watson Research Center in Yorktown Heights, New York met with Bob Gottschall in Germantown on February 24, 1994, to discuss enhancement of the existing interactions between IBM and the private industrial sector in general, and the DOE National Laboratories. Rosenberg's request to Bob of February 22, 1994, stated in part,

> "...I believe most materials industries are becoming very exposed in future product development by lack of fundamental understanding of degradation modes related to processing and use, and the inability to reduce the massive testing and development costs that are predicted. Our thesis is that through fundamental knowledge and modelling, and a new approach to simulation on a mesoscopic scale, industry will eventually be able to design reliability, as well as performance, into the development process. There is great need for the resources residing in National Labs for basic materials studies, modelling and model verification by their sophisticated experimental methods. As you know, industrial labs like ours are no longer able to support the basic sciences and need to develop critical mass by more collaborative means. The DOE/BES program is crucial to this effort. Thanks for the opportunity to chat about our ideas."

Rosenberg and Gottschall discussed many possible avenues of enhanced collaboration between IBM and the DOE Laboratories. One of the more exciting avenues for collaboration that was discussed was the DOE 13 Laboratory Center for Excellence in the Synthesis and Processing of Advanced Materials because this organization provides industrial institutions with a single point of contact to gain coordinated access to all laboratory research efforts in advanced materials. Rosenberg also expressed preliminary interest in the contemplated University-Industry Grant Program under the Division of Materials Sciences.

Importance of Fracture of Weldments to Energy Industries Addressed

The Electric Power Research Institute and the Office of Basic Energy Sciences/Division of Materials Sciences jointly sponsored a Research Assistance Task Force to address the issue of the fracture of weldments and the needs and opportunities to reduce the risk associated with the structural integrity of weldments. The participants were drawn from experts from industry and industrially sponsored institutes, DOE laboratories and academia, and their findings were published in the September 1993 issue of the Welding Journal. This publication noted that welding, inspection and repairs, and weldment-related failures play a critical role in the economics of electric power generating plants, the offshore oil industry, pipelines, etc. Thus, for a 500 megawatt fossil-fueled electric power generating plant, welding represents 10% of the cost of construction of a new plant and 20% of maintenance costs. Failure costs are also high, as evidenced by the facts that (1) To repair a leak in a tube containing a dissimilar metal weldment, the plant would have to be down for two days and the cost of repair would be $1 million, (2) A leak in a header involving a pipe weld would force four days' downtime and a repair cost of $2 million, and (3) The potential cost of a catastrophic failure where there is a loss of life could cost more than $100 million.

The publication presents a summary of industrial weldment problem areas and research needs. The necessity of developing verified models to predict the fracture process (initiation of crack growth, crack growth per se, and crack instability) were emphasized. The necessary capability includes weld mismatch, residual stresses, etc,. as well as some information about limits of applicability. These models provide the basis for predicting fitness-for-service.

This Research Assistance Task Force was organized by Dr. Donald W. Keefer while on assignment from the Idaho National Engineering Laboratory to the Division of Materials Sciences staff.

Industrial Applications of Advanced Geophysical Techniques

ARCO has developed a Deep Well Treatment and Injection Process for the possible disposal of hazardous waste. The approach involved injection of fluids or slurries in the deep subsurface by hydraulically opening or creating fractures, a procedure called hydrofracturing. It is commonly used in the Gas and Oil industry to enhance production levels. ARCO asked researchers at Los Alamos National Laboratory (LANL) and Lawrence Berkeley Laboratory (LBL) to participate in the design and implementation of the $8.1 million field-project based on their expertise, developed under EE/Geothermal and BES/Geosciences support over an extended period of time, in detecting and interpreting microseismic events which accompany the propagation of the hydrofractures. The collaboration continues with ARCO sharing a copy of the data set with LANL investigators. The data set, pertinent to an entirely new geologic environment for the LANL research team, provides a unique opportunity for them to extend their approach. ARCO management provided a letter of appreciation for their efforts.

New Technologies Spawned by Research at the National Synchrotron Light Source

In 1993, there were 4,367 scientists (including 597 industrial scientists from 89 U.S. companies) who conducted X-ray and neutron beam experiments at user facilities supported by the Office of Basic Energy Sciences. These experiments ranged from the determination of crystalline or molecular structures of new catalytic materials to the fabrication of tiny microcircuits using X-ray beams to etch patterns into a polymer coating on a semiconductor wafer. The National Synchrotron Light Source (NSLS) alone, served 3,274 scientists in 1993, of which there were 480 from industry. Industry has provided about $40 million worth of equipment and 300 person-years of labor to implement the beamlines at NSLS. Examples of research accomplishments at the

National Synchrotron Light Source are given below:

1) Soft X-ray Microscopy - a unique probe that provides chemical as well as elemental specificity - is being used by scientists from DuPont and the University of North Carolina to study the processing of polymer blends in order to make improved fibers. The same technique is being used by scientists from IBM, State University of New York-Stony Brook, and Lawrence Berkeley Laboratory to make chemical maps of computer chips so that the geometric definition of conductor, insulator, and semiconductor can be identified in these very tiny circuits and to make sure that they are being manufactured as designed.

2) X-ray Lithography - Computer chips made with x-ray irradiation of polymeric films on semiconductor wafers can have higher resolution and greater density than those made using conventional optical lithography. IBM and more recently, AT&T Bell Laboratories have been developing advanced X-ray lithographic techniques at NSLS to provide the means for manufacturing the next generation of computer chips. More recently, Brookhaven National Laboratory scientists together with scientists from the University of Wisconsin are developing so-called deep lithography for the manufacture of tiny mechanical devices ("micromachines"). This area is growing very rapidly, and is building on much of the research done to develop X-ray lithography for electronic devices.

3) Catalysts - The chemistry of many experimental and commercially employed catalysts is not very well understood, and even a small improvement in efficiency for such large-scale processes can result in big economic gains. Exxon, Mobil, Chevron, DuPont, Dow Chemical, BP America, and Monsanto are among the corporations that have been studying catalyst systems including zeolite, metal colloids and silica-supported metals using neutron and X-ray diffraction and spectroscopy at NSLS and the High Flux Beam Reactor (HFBR) at Brookhaven National Laboratory.

4) Platinum Surfaces - In studies at the NSLS, researchers from Exxon, Brookhaven National Laboratory, Massachusetts Institute of Technology and Oak Ridge National Laboratory have discovered surprising changes in the surfaces of platinum at temperatures far below its melting point. As the platinum crystal surface was heated from about 500°C to 900°C, X-ray probes showed that its flat surface underwent several transitions that its flat surface underwent several transitions of roughening and faceting, or rearrangements of its surface atoms, near its defect sites - the sites where the chemical reactions in catalysis are usually initiated. This finding has important technological implications, because understanding the nature of defect sites is crucial in designing catalysts.

5) Removing Sulfur from Coal to Remedy Pollution - About half of the nation's electricity is produced by the combustion of coal, and coal is used in making steel and chemical feedstocks. The problem is that sulfuric acid is a polluting byproduct of coal conversion that contributes to acid rain. Using X-ray probes at the National Synchrotron Light Source, University of Kentucky researchers, with support from the Electric Power Research Institute, (an industrial consortium) have identified all of the major molecular forms of sulfur in coal. They have also found the percentage of each form of sulfur in coals that constitute most of the nation's coal supply. Thus, industry can now determine which desulfurization methods are most effective for removing the various forms of sulfur from coal, thereby reducing pollution.

6) Lead Levels in Soils - Researchers from DuPont are using X-ray absorption spectroscopy at the NSLS to determine the various types of lead found in contaminated soils. One striking finding is the attraction of lead in soil for sulfur. When the two elements combine, the resulting lead sulfide is highly insoluble, making it extremely unlikely that it would enter the drinking

water supplies. Such research can be used to make decisions concerning public health.

7) Magnetic Materials for Efficient Computers - Researchers from the Naval Research Laboratory are using polarized X-rays at the NSLS to probe the structure of thin magnetic films of terbium iron (TbFe), the mainstay of magneto-optic computer storage devices. Consistent with magnetic theory, the researchers have found a preference of about 10 percent more iron-iron and terbium-terbium bonds than iron-terbium bonds along the direction of the film plane. Because iron terbium films form naturally as a disordered arrangement of atoms, this finding was unexpected. The direction of magnetization can be made to align parallel or perpendicular to the plane of the film, but the perpendicular direction, which is maintained by terbium iron films, permits more efficient data storage for computer devices. Because atomic structure and magnetism directly affect the efficiency of high-density storage devices for computers, such research is essential for the design and fabrication of more powerful information storage devices.

Industry Collaborates on Metal Deformation Research

A nondestructive, on-line methodology has been developed to inspect thin metallic sheets, thus providing information on their formability. This new analysis tool is useful for preventing tearing of deep-drawn parts, such as automobile components and beverage cans. The tearing is caused by the resistance of the metal to deform in certain directions. This Office of Basic Energy Sciences/Division of Materials Sciences research under Dr. R. B. Thompson at the Ames Laboratory has developed an ultrasonic characterization technique for this directionality dependence as developed during hot rolling of large metallic ingots to thin sheets. In collaboration with Westinghouse, it was demonstrated that the parameters which are used to describe this directionality, can be inferred from the directional dependence of the speed of sound. In collaboration with Alcan, the usefulness of sound to quantify the degree of recrystallization of aluminum sheet after hot-rolling was demonstrated. This effort is now being joined by Ford Motor Company, LTV Inc., and others to determine formability parameters using speed of sound measurements. An instrument to measure the speed of sound during the rolling process has been developed.

Discovery of New Catalyst for Natural Gas Conversion

An important catalyst formed from a molybdenum-sulfur cluster contained in a zeolite cage was recently discovered. This catalytic material has resulted in a process at moderate temperature for converting large quantities of methane (natural gas) to longer chain molecules which are much more valuable as a feedstock for many hydrocarbon products. One of the highest priority objectives in catalyst research today is to find an economical way to convert methane to higher hydrocarbons for chemical feedstocks or fuels, or to methanol. The initial work which identified this catalyst was done at Argonne National Laboratory with support funded by the Office of Basic Energy Sciences/Division of Materials Sciences. Related work is ongoing such as development of the optimized catalysts themselves, and the testing for catalytic activity and efficiency with support from the Office of Basic Energy Sciences/Division of Advanced Energy Projects. Research under a Cooperative Research and Development Agreement between Argonne National Laboratory and Amoco is designed to lead to commercialization of an efficient catalyst which will convert methane in a simple one-step process at a moderate temperature. The successful development of such a catalysts could result in a billion dollar business.

Understanding Industrial Processes through Neutron Scattering

The intense neutron beams at the High Flux Isotope Reactor at Oak Ridge National Laboratory provide unsurpassed capabilities for the development of new polymers and the improvement of welding technology. Industry is increasingly turning to blends of existing polymers to avoid difficulties associated with commercializing new polymers. Such polymers blends now account for one-quarter of industrial polymers and $7 billion in annual U.S. sales. Small-angle neutron scattering is the premier technique for investigating blend thermodynamics and phase behavior of polymers. Exxon, IBM, and Allied Corporation are some of the companies which have used neutron facilities at Oak Ridge to develop new polymer blend products. Many industrial processes rely on understanding the behavior of colloid-sized structures, such as those in latex paints and detergent-oils. The high penetrating power of neutrons allows such complex materials to be studied, and companies including Hercules and Eastman Kodak have come to Oak Ridge to determine both the structure and the underlying molecular principles which govern these materials. Residual stresses in materials are the source of structural failures and engineering performance limitations encountered by industry every day. Welding technology alone affects $30 billion in U.S. manufacturing activity each year. Neutrons can penetrate most materials to depths of an inch or more, revealing strains and distortions in a weld which cannot be otherwise determined. Oak Ridge National Laboratory is working with many companies including General Electric and Alcoa to develop and apply neutron residual stress mapping to industrial processes.

Advanced Battery Technology Research and Development Program

Grant applications for the FY 1994 Advanced Battery Technology Research and Development Program were solicited through a public notice in the Federal Register on November 2, 1993, with a due date of January 13, 1994. It is anticipated that new awards totaling approximately $600,000 will be made this fiscal year. In addition, seventeen of the twenty-one projects awarded funding in FY 1993 will receive continuation support in FY 1994 totaling approximately $2.9 million giving a FY 1994 program total of approximately $3.5 million.

Research efforts for projects selected range from one to three years. The objective of the research is to develop new generic battery technology for the non-automotive consumer market with emphasis on improvements in battery size, weight, life, and recharge cycles. Areas of research include battery systems based on lithium, metal hydrides, and other electrochemical systems, as well as research in modeling, diagnostics, and characterization.

Lead-Free Solder Developed

A new lead-free solder alloy has been developed at Ames Laboratory. This environmentally acceptable alloy can replace the presently used tin-lead alloys which face opposition by environmental legislation. For instance, the National Institute of Occupational Safety and Health has recommended a maximum industrial exposure limit of one tenth of one milligram of lead per cubic meter of air. This limit includes all industrial soldering activities.

The new alloy, based on tin, silver, and copper, has an acceptable melting temperature (217 degree Celcius) and has been produced in the form of wire and paste. Final results indicate that it has properties, highly desirable to form a strong joint. Fundamental research, necessary for this alloy's development, was funded by the Office of Basic Energy Sciences/Division of Materials Sciences. Performance tests of the solder in various environments have been started by Allied Signal-Kansas City Division. Feasibility in circuit manufacturing operations are carried out at the Center for Solder Science and Technology at Sandia National Laboratory, Albuquerque.

American Superconductor Corporation Dedicates New Manufacturing Plant; "Superconductivity Week" celebrated in Massachusetts

Massachusetts Governor William F. Weld proclaimed November 29 - December 4, 1993, as "Superconductivity Week" in Massachusetts. His Proclamation noted the Materials Research Society Meeting in Boston featuring the participation of the Secretary of Energy, Hazel R. O'Leary and over 300 major international companies. Governor Weld stated that "...the development of high-temperature superconductors will result in more efficient use of electricity through smaller, more efficient generators, power transmission cables, transformers, and motors, ensuring the competitiveness of United States industries while having a positive effect on the environment...". The Governor's speech also made specific note of the American Superconductor Corporation. The Massachusetts based firm was founded in part on research supported by the Basic Energy Sciences/Division of Materials Sciences with its present Chief Executive Officer Gregory J. Yurek, when Yurek was the principal investigator on a research grant with the Massachusetts Institute of Technology. American Superconductor Corporation is engaged in the development of high-temperature superconducting wire with support from the department's Superconducting Partnership Initiative under the Office of Energy Efficiency and Renewable Energy. A new production facility in Westborough, Massachusetts was dedicated on December 2, 1993.

Masonite Corporation Successfully Collaborates with National Laboratories

Brookhaven National Laboratory and the Oak Ridge National Laboratory provided technical help to Masonite's John M. Coates Technical Center, St. Charles, Illinois, on weathering effects on polymer protective coatings. In the spring of 1993, Dr. James Pfau of Masonite approached Dr. Lester Hulett of Oak Ridge National Laboratory, inquiring whether or not positron spectroscopy could be used to assay weathering effects on paints and varnishes. Hulett decided that the Doppler broadening of positron annihilation radiation would likely be the most appropriate way. However, Oak Ridge National Laboratory was not yet set up to perform the evaluation. Hulett asked Dr. Kelvin Lynn of Brookhaven National Laboratory for help. Lynn quickly responded by making his Doppler broadening spectrometer available. Mr. Scot Wallace, a guest researcher at Oak Ridge National Laboratory, travelled to Brookhaven National Laboratory with the paint samples. Wallace and Dr. Csaba Szeles, a resident expert in Doppler broadening at Brookhaven National Laboratory, worked together on the analyses. The results were very good. Control samples and three sets of polymer coatings, each consisting of a film that had been weathered in the laboratory (xenon arc WeatherOmeter^{R}) for one week, were evaluated. To the unaided eye, the weathered samples could not be distinguished from the controls, but to the positron spectrometer they were distinctly different. The data showed that the ultraviolet light and water spray, to which the samples were subjected, caused free volume changes in the polymer binder of the film.

Masonite is very pleased with the preliminary results. Normally, at least a year of exposure to weathering is necessary in order to assay the durability of their coatings. Positron spectroscopy provides quantitative measures of deterioration after only one week of WeatherOmeter^{R} exposure. Masonite is going to work with the Oak Ridge National Laboratory-Brookhaven National Laboratory team and explore other responsibilities.

The research at Brookhaven is supported by the Office of Basic Energy Sciences/Division of Materials Sciences and at Oak Ridge by the Office of Basic Energy Sciences/Division of Chemical Sciences.

Book Published on Health Effects of Mineral Dusts

The biological processes leading to the development of lung disease by minerals occurs at the mineral-fluid interface. The surface properties of minerals have long been characterized by geochemists but until recently this role has not been fully appreciated by the medical research profession. Recognition of the specific mineral-fluid interactions controlled by the surface properties of minerals represents a major step forward in the evaluation of industrial health and safety. Crossing the barrier between these disciplines is important step for research into the specific cause and interactions responsible for pathogenesis. The field of biofluid-mineral interactions and its relation to mineral-induced pathogenesis is a prime candidate for interdisciplinary research involving mineralogists, health scientists, petrologists, pathologists, geochemists, biochemists and surface process scientists.

Researchers at Los Alamos National Laboratory working with colleagues at the College of Medicine, University of Vermont organized a short course (October 22-24, 1993) through the Mineralogic Society of America on the Health Effect of Mineral Dusts. The 68 attendees represented workers in industrial health and safety, geoscience and medicine. The workshop was sponsored jointly by BES-Geosciences and HER-Health Effects and Life Sciences. The workshop notes are available as a 584-page text and should become a standard reference for workers in this interdisciplinary field.

Breakthrough in Laser Microfabrication

In a spin-off of research supported primarily to study electron-atom scattering, scientists at the National Institute of Standards and Technology supported by the Office of Basic Energy Sciences/Division of Chemical Sciences have developed a laser-based technique to prepare surface chromium structures of less than two hundred nanometers in size on a silicon substrate using atom optics. In the scattering experiments, use is made of lasers to manipulate the atom target and thus minimize the number of unknown parameters. The laser techniques developed for chromium atom targets were found appropriate to focus a beam of atoms onto a silicon substrate resulting in formation of a grating-like pattern. The grating lines are 65 nanometers wide separated by a spacing of 213 nanometers. This preliminary result already competes with the current spacing limitation of 200 nanometers imposed by current lithography technology using ultraviolet light and requires substantially less time to create these structures.

Patent protection for the process has been filed by the National Institute of Standards and Technology (NIST) and the continuing efforts to further develop microfabrication laser-based techniques will be part of a new National Science Foundation-sponsored institute that will provide $1 million a year for five years to a team of scientists from NIST, the Joint Institute of Laboratory Astrophysics, Harvard University and American Telephone and Telegraph.

Workshop Will Identify Basic Research Needs for "New Generation of Motor Vehicles

A planning team met on October 21 with Don Walkowicz, Executive Director, U.S. Consortium on Automotive Research (USCAR) to discuss participation by the automotive industry in the workshop. The planning team consists of Stephen Binkley, Sandia National Laboratories, Donald Grether, Lawrence Berkeley Laboratories, and William Kirchhoff, Office of Basic Energy Sciences. The workshop will identify the basic research needed to remove technology barriers to accomplishing the objectives of the joint government/industry research and development program for the "New Generation of Motor Vehicles." Although the Office of Basic Energy Sciences is sponsoring the workshop, planning for the workshop will be coordinated through the Clean Car Coordinating Committee which was convened by the Office of Energy Efficiency and Renewable

Energy and which consists of representatives from the National Laboratories and the Department of Energy Offices of Energy Efficiency and Renewable Energy, Energy Research, and the Office of the Defense Programs Deputy Science and Technology Advisor. This was the first meeting of the workshop planning team with representatives of USCAR who approved of the concept and timing of the workshop and who promised to encourage participation by the U.S. auto industry. A so-called "Supercar" committee of representatives from Chrysler, Ford, and General Motors is currently being organized to help in the direction of the government/industry program and one of the first agenda items for this committee will be the basic research workshop. The workshop is planned for early spring and will be held in the Detroit vicinity.

Cooperative Research and Development Agreements (CRADAs)

Ames Laboratory Enter Into CRADA for Rapid Prototyping Work

A three-year Cooperative Research and Development Agreement (CRADA) was signed between Micro-Cut and Ames Laboratory. It involves the use of sterolithography to produce molds for mass production of plastic components used in automobiles, electronics, etc. Mold production is a multi-billion dollar industry. The current processes for producing molds are labor intensive and time consuming, and frequently yield molds with a short production life due to the high pressures used during injection molding. Based on basic research funded by Basic Energy Sciences/ Materials Sciences, Drs. Trivedi and Ellis from the Metallurgy and Ceramics Program, Ames Laboratory, have developed and tested alloy deposition and solidification techniques with full microstructural control such that molds can be produced quickly (which is important if the parts have to be redesigned), inexpensively, and with much-improved mechanical properties. Micro-Cut will compare mold components produced by current technology with those using the newly developed processes, and perform a full analysis of the activities necessary to commercialize the improved technology.

1,000th DOE Cooperative Research and Development Agreement Based on Division of Materials Sciences-Supported Research

Elric Saaski found himself and his small company at the center of a U.S. Department of Energy press conference recently in Washington, D.C. They called Saaski because his company, Research International, happened to sign the 1,000th Cooperative Research and Development Agreement (CRADA). This CRADA involves research supported by the Division of Materials Sciences and support from Laboratory technology transfer. The joint-research agreement lets Saaski use miniature battery technology developed by Oak Ridge National Laboratory. Research International is using the lab's "thin-film" lithium batteries to develop a small card-like device that can be clipped onto workers' clothing and warn them of hazardous gases.

Saaski is providing the gas-sensor technology and pairing it with the thin-film batteries, which use a coating five microns thick that is able to store the minute amounts of electricity needed to power the device. "It's easily less than 1/100th as thick as a human hair," he explained, "It's thinner than Saran Wrap." The entire monitoring device, including the gas sensor and all its associated electronics, is about the size and weight of two credit cards. The "Hazard Card" still has a long way to go in the lab before it's ready for release. "The things we're working on you're not going to see for five years," he said.

The eleven-person company is working an several other research projects, all of them involving miniaturized devices. But the Hazard Card is the one that has attracted the most attention, because the Department of Energy CRADA.

Saaski said he could never have afforded to develop the sophisticated battery technology needed for the device on his own. "There's a lot there (in the department's labs) that can find its way rather promptly into the market," said Dr. Martha A. Krebs, Director of the Office of Energy Research.

Electrospray Cooperative Research and Development Agreement (CRADA) with General Mills Corporation Adds Sugar Coating

Oak Ridge National Laboratory (ORNL) and General Mills Corporation of Minneapolis, Minnesota, propose to form a CRADA to develop and test new methods for the use of electric fields in the atomization or spraying of high-viscosity sugar syrups from nozzles. The research to be conducted will enable ORNL to take the lead in the heretofore unexplored science and technology of atomization of high-viscosity fluids using electric fields, while General Mills will have an efficient process for coating cereals with sugar that maximizes product quality and minimizes wastes. If successful, this work could place ORNL in an excellent position to extend this experience toward the programmatic goal of the processing of polymeric materials. This work in the Chemical Technology Division at ORNL is based on fluid spray research supported by the Office of Basic Energy Sciences/Chemical Sciences Division and precipitation studies supported by the Materials Sciences Division.

Research on Separations of Metals from Solution is Subject of a Cooperative Research and Development Agreement (CRADA)

The Argonne National Laboratory and Eichrom Industries, Inc. of Darian, Illinois, propose to form a CRADA to develop and test new methods for the separation and preconcentration of metals from solutions. The studies will address the actinides, selected fission products, and toxic elements from a variety of environmental samples, mixed waste, industrial wastewaters, and contaminated groundwater. This work is based on research supported by the Office of Basic Energy Sciences, Division of Chemical Sciences, in the Chemistry Division of Argonne National Laboratory. Eichrom Industries, Inc. is a spinoff business, fostered by this separations research, that manufactures metal separations media for the treatment of various waste streams.

Combustion Instruments to be Applied to DNA Sequencing

Researchers at the Combustion Research Facility are participating in a Cooperative Research and Development Agreement (CRADA) with industry on instrumentation for Deoxyribonucleotide (DNA) sequencing. The CRADA between Sandia and Beckman Instruments, Inc., will result in the development of laser-based detection systems that will be integrated with capillary electrophoresis and high performance liquid chromatography for new analytical instrumentation with increased sensitivity and selectivity. The initial project in this CRADA will be the instrumentation for DNA sequencing. Of particular importance is the unexpected application of laser diagnostic technology developed for studying combustion to a problem from a wholly unrelated field. Although the basic research for using fluorescence measurements to measure DNA fragments was developed elsewhere, the particular talents at the Combustion Research Facility for applying laser techniques to combustion diagnostics allowed them to apply laser techniques to other measurement problems. The Combustion Research Facility at Sandia is operated by the Office of Basic Energy Sciences. Also participating in this CRADA are scientists from the Chemistry Department at Stanford University.

Supercritical Fluid Research Leads to Cooperative Research and Development Agreement

Research at the Pacific Northwest Laboratory on the fundamental properties of supercritical fluids has led to the signing of a Cooperative Research and Development Agreement between the Department of Energy and the Milliken Company. There are concerns in the textile dyeing process that the solvents used may be detrimental to the environment. Disposal of such waste solvents, in a safe manner and in compliance with existing regulations, poses a significant problem for the manufacturer. Basic studies of the chemical and physical properties of supercritical fluids characterize the ability of these fluids to act as super-solvents for a variety of other chemical compounds. The research collaboration involves helping the Milliken Company develop processes of dyeing fabrics using more environmentally benign solvents, such as supercritical carbon dioxide. If successful, the results of this work could be of considerable benefit to the textile industry in the disposal of hazardous wastes. The supercritical fluids research is supported by the Division of Chemical Sciences, Office of Basic Energy Sciences.

Subject of Manufacture of Optoelectronics of Cooperative Research and Development Agreement with Hewlett Packard

Sandia National Laboratories have entered into a Cooperative Research and Development Agreement with Hewlett Packard to develop advanced manufacturing techniques for optoelectronics. The program includes fundamental materials research as well as packaging technology for light-emitting diodes (LEDs) which are currently the highest volume optoelectronic device being produced in the world. Rapidly growing markets are projected for the next several years. Hewlett Packard is the largest U.S. optoelectronic company and is competing vigorously against Toshiba. LEDs are particularly useful for high reliability, appearance, styling, safety, and low power consumption in automotive and outdoor large display markets. The automotive market for LEDs is now $50 million/year and growing at 35 percent/year. The large outdoor displays have a world-wide market currently at $73 million and growing at 25 percent per year. The Sandia people can make a large impact in this area based on the long history of support from the Office of Basic Energy Sciences/Division of Materials Sciences involving strained-layer superlattices, chemical vapor deposition, molecular beam epitaxy, electronic bond structure modelling and laser controls.

The Hewlett Packard people have enthusiastically endorsed this collaboration with statements such as "the collaboration between Hewlett Packard and Sandia is now as tightly coupled as collaborations between the HP divisions"; "The CRADA enabled Hewlett Packard to identify whether the performance of a particular device was limited by fundamental materials properties or by manufacturing problems - and hence how to invest its future effort to increase device performance"; and, "The CRADA is enabling Hewlett Packard to find solutions to problems and to develop understanding of the underlying mechanisms so that new products can hit the market problem-free."

Cooperative Research and Development Agreements Result from Chemical Vapor Deposition Science Capabilities Developed Under the Office of Basic Energy Sciences/Division of Materials Sciences Program

Sandia National Laboratories has recently kicked-off two major new Cooperative Research and Development Agreement programs on metal-organic chemical vapor deposition technology based on advances and capabilities developed over the past decade under the Office of Basic Energy Sciences/ Materials Science funded Chemical Vapor Deposition Sciences project. Both of the Defense Programs funded Technology Transfer Initiative Cooperative Research and Development Agreements, one with Motorola (signed June 24, 1993) and the other with EMCORE (signed

August 25, 1993), seek to improve metal-organic chemical vapor deposition equipment and develop safer process chemistries for the growth of compound semiconductor materials. The Motorola Cooperative Research and Development Agreement focuses on advanced precursors that can replace arsine and phosphine for growth of III-V materials via metal-organic chemical vapor deposition. This project will call on Sandia experts in chemical vapor deposition chemistry, gallium arsenide surface chemistry, materials growth and device fabrication. Transfer of numerical modeling capabilities based on the Surface CHEMKIN software developed under the Materials Sciences program is also an important part of this Cooperative Research and Development Agreement.

The second Cooperative Research and Development Agreement, with EMCORE, will also advance safer and more efficient process chemistries, however with a greater focus on metal-organic chemical vapor deposition reactor design. EMCORE is the leading manufacturer of high-speed rotating disk chemical vapor deposition reactors, a design pioneered independently by EMCORE and by researchers in the Chemical Vapor Deposition Science program at Sandia. EMCORE's commercially available *Turbo Disc* metal-organic chemical vapor deposition reactors have set industry standards for high uniformity deposition of semiconductor films. Researchers at Sandia have shown that this performance is an inherent property of the axially symmetric rotating-disk design that comes from well-established rules of fluid-flow. Sandia will be applying its extensive experience in modeling and fundamental chemistry studies of chemical vapor deposition in rotating-disk reactors to help EMCORE design a next generation, high-volume production scale rotating-disk reactor.

These Cooperative Research and Development Agreement programs are seen as important to both DOE and U.S. economic competitiveness because they will provide U.S. electronics industry first access to the cutting edge of semiconductor manufacturing technology. By developing safer, environmentally acceptable processes for the growth of compound semiconductor materials, U.S. companies will be able to implement those processes in the U.S. rather than moving them off-shore. The technology developed under this program will directly impact applications such as ultra-high-speed analog and digital signal processing, high-performance computing, infrared sensing, fiber and free-space optical communications, and flat-panel displays.

Thermodynamic Research Basic to Hazardous Waste Destruction Subject of Cooperative Research and Development Agreement

A Cooperative Research and Development Agreement has been approved between the Modell Development Corporation, Inc., of Framingham, MA, and the Oak Ridge National Laboratory for research and development in support of the use of supercritical water oxidation for the destruction of hazardous wastes. This Cooperative Research and Development Agreement is funded by the DOE Office of Environmental Restoration and Waste Management, Office of Technology Development. The effort is based on Office of Basic Energy Sciences/Division of Chemical Sciences supported research on aqueous and supercritical solutions. The work at Oak Ridge National Laboratory will be pursued in the Chemical and Analytical Sciences and the Chemical Technology Divisions. Modell Development Corporation, Inc., will test certain of the chemical processes, derived from the basic research, in the pilot-plant to develop the technology for possible scale-up of operations.

Small Business Innovation Research

Small Business Innovation Research Program Issues Annual Solicitation

The Small Business Innovation Research program issued its thirteenth annual solicitation for grant applications on December 1, 1994. About 200 Phase I awards of up to $75,000 each will be made to small businesses to evaluate the scientific or technical merit and feasibility of their projects. The solicitation will contain 44 technical topics including the following new ones this year sponsored by the Office of Energy Research: Advanced Instrumentation to Exploit Neutron and Photon Sources, Ceramic Fibers and Fiber Coatings for High Temperature Applications, Information Infrastructure for the National Information Initiative, High Temperature Superconductivity for Energy Applications, Improved Materials for the Pulp and Paper Industry, Advanced Drilling Technology, Advanced Environmental Monitoring Technology, Computerized Processing of Biological Data, and Cost-Effective Methods for Coating Polymers. The closing date for receipt of grant applications is March 1, 1995.

Higher Energy Efficiency Achieved for Thermophotovoltaics

Ten watts were generated in a thermophotovoltaic circuit for the first time in a recently initiated Small Business Innovation Research (SBIR) project that seeks to improve thermophotovoltaic generator efficiencies. The five-square centimeter cell circuits were reported by Lewis Fraas of JX Crystals, Inc. to achieve the theoretical limits for fill factors and open-circuit voltages as well. Thermophotovoltaics is based on the use of heat sources, including burners or flames, to drive photovoltaic cells. Efficiencies can be enhanced by driving the heat emission from a source through a narrow range of photon energies by special-material emitters and then collecting all of this energy by a photo cell. An advantage of these systems is that they are silent (no moving parts) and can burn a variety of fuels quite efficiently and completely, eliminating bad exhaust fumes. Applications include stand-alone generator units and electric vehicles. A second company, Quantum Group, Inc., that holds the first patents on this electricity generation approach, has expressed an interest to buy the JX Crystal generator circuits for its own studies. These new five-cell generator circuits will be further tested at DOE's Knolls Atomic Power Laboratory. This project was initiated through an SBIR topic managed by the Division of Advanced Energy Projects.

Supplemental Funding Agreement Signed to Improve Battery Technology

A Phase II Small Business Innovation Research (SBIR) Project has attracted supplemental funding from the New York State Energy Research and Development Authority to develop improved lithium-metal-sulfide batteries. Advanced Refractory Technologies, Inc., of Buffalo, NY, is developing battery spacers based on a novel idea using aluminum nitride. The project addresses durability, weight, size, and cost of the spacers. They will be developed for installation in batteries under an agreement with Westinghouse. Governor Mario Cuomo signed the agreement on October 31, 1994, providing an additional $200,000 for this project. Applications include electric vehicles, outdoor power equipment, and renewable energy storage and distribution devices. The agreement represents a situation in which this small business produces separators for Westinghouse, which in turn provides access to a wide market for the assembled batteries. This project was initiated through an SBIR topic managed by the Division of Advanced Energy Projects.

Small Business Innovation Research Project Wins R&D 100 Award

Boreas, Inc., of Burlington, Massachusetts, has received an award from R&D Magazine, for a liquid-helium cryogenic cooler, as one of the 100 technologically most significant new products for 1994. This is the eleventh Small Business Innovation Research company from the Department of Energy that has received this award since 1988. The Boreas B100 Cryocooler is a mechanical refrigerator that provides a reliable, highly efficient alternative to conventional cryocooling. Based on a 1989 Small Business Innovation Research Phase II award in the technical topic High Energy Physics Technology and Research, the cryocooler eliminates the need for bulk storage and replenishment of liquid helium. It should find immediate use in a variety of superconducting devices and should have application to high performance computers, switching networks, and data storage systems.

Small Business Innovation Research Program Holds Meeting on Commercialization Assistance

Seventy people from 47 companies with Small Business Innovation Research program Phase II projects attended the Kick-Off Meeting on August 29, 1994, in the Germantown auditorium for the Department's fourth Commercialization Assistance Project. The primary purpose of the project is to accelerate the rate of commercialization of Small Business Innovation Research funded technologies by providing individual assistance to Phase II awardees in the development of a business plan. The objectives of the meeting were to (1) explain in detail the effort that will be required of each awardees in the business plan development phase and (2) answer questions from the companies concerning the project. The highlight of the meeting was a panel session with three representatives from Fortune 500 Companies and Venture Capital Firms who explained what they were seeking from high technology small businesses.

Companies that produce the best 20 business plans will be invited to participate in the subsequent phases of the project. The culmination of the program will be the Commercialization Opportunity Forum in which the Small Business Innovation Research program awardees will make presentations to a group of at least 40 investors from Fortune 500 Companies and Venture Capital Firms (March 28-29, 1994, in Tysons Corner, Virginia). The Department's Small Business Innovation Research program is located in the Division of Advanced Energy Projects in the Office of Basic Energy Sciences.

Small Business Technology Transfer Pilot Program Makes Phase I Award Selection

The Small Business Technology Transfer program has chosen 21 grant applications for awards from 487 received in 12 technical topics, in response to its first annual solicitation. The Phase I grants are for about $100,000 each over a nine-month period, and are expected to begin on September 30, 1994. About one-third of these projects will receive Phase II awards at a maximum of $500,000 for research to be conducted over a two-year period.

The primary objective of the program is to increase the commercialization of federally-funded research and development by small businesses collaborating with research institutions, which include Federally Funded Research and Development Centers, Universities and Colleges, and other non-profit organizations. Thirteen of the 21 projects involve the participation of DOE National Laboratories.

The technical topic areas with the most awards are Specialized Components for and Research on High Energy Electron Accelerators, and Control Software for Fossil Energy Applications, with four

each. The Department's Small Business Technology Transfer program is located in the Division of Advanced Energy Projects in the Office of Basic Energy Sciences.

Small Business Innovation Research Program Makes Phase II Award Selection

The Phase II award selection was completed on schedule for the eleventh consecutive year. Sixty-three projects were chosen for awards out of 156 grant applications submitted. Seventeen of these began their projects in April 1994, in our early submission procedure, with no gap in funding between Phases I and II. The Department of Energy continues to be the only agency that allows its awardees the opportunity to achieve funding continuity. The 63 Phase II awards are in 20 states and average about $595,000 for a 2-year period. The technical topic areas with the most awards are Technology and Instrumentation for High Energy Accelerators, Plasma Confinement Systems Technology, and Advanced Environmental Control Technology for Fossil Energy, with seven awards each.

Small Business Innovation Research Program Makes Phase I Award Selection

The Phase I award selection for the Small Business Innovation Research program was completed on schedule for the twelfth consecutive year. From a record number of 2276 grant applications submitted in 43 technical topics, a record 216 projects were chosen for awards. The Phase I grants are for about $75,000 over a period of about six months, and will begin on August 15, 1994. The technical topic areas in ER with the most awards are Technology and Instrumentation for High Energy Accelerators (16), Nuclear Physics Instrumentation and Techniques (11), and Plasma Confinement Systems Technology (10). The Department's Small Business Innovation Research program is located in the Division of Advanced Energy Projects/Office of Basic Energy Sciences.

Small Business Technology Transfer Pilot Program Receives Phase I Grant Applications

The Department received 487 grant applications in response to its first annual Small Business Technology Transfer program solicitation, which contained 12 technical topics, by the closing date of April 11, 1994. The most popular topics, with the indicated number of applications, were Environmentally Benign Physical and Chemical Processes (74), Control Software for Fossil Energy Applications (70), and Flat Panel Display Technology and Manufacturing Processes (58).

The Small Business Technology Transfer program funds cooperative research or research and development conducted jointly by a small business and a non-profit research institution. On August 11, 1994, the Department expects to select about 25 applications for Phase I grants of at most $100,000 over a period of nine months. About one-third of these projects will receive Phase II awards at a maximum of $500,000 for research to be conducted over a two-year period.

Small Business Innovation Research Program Receives Phase I Grant Applications

The Department received a record 2,280 grant applications in response to its twelfth annual Small Business Innovation Research program solicitation, which contained 43 technical topics, by the closing date of February 15, 1994. This was the program's first solicitation that contained technical topics in both defense and non-defense related research. The most popular topics, with the indicated number of applications, were Green Car: Scientific Approaches to Automotive Innovations (190), Advanced Control Technology for Fossil Energy (138), Innovative Fossil Solids and Liquids Processing and Related Crosscutting Applications (121), Design and Applications of Novel Materials (118), and Expedited Waste Site Characterization (115). The award selection is scheduled for June 15, 1994, when about 200 applications will be chosen for grants of at up to

$75,000 over a period of about six months. About one-third of these projects will be anticipated to receive Phase II awards at a maximum of $750,000 in Fiscal Year 1995 for projects to be conducted over a two-year period.

Small Business Innovation Research Program Makes Phase I Award Selection

The Small Business Innovation Research program has selected 33 grant applications for Phase I awards from 509 received in response to the second program solicitation for fiscal year 1993. This solicitation was issued due to the Small Business Research and Development Enhancement Act of 1992, Public Law 102-564, which requires for the first time the participation in Small Business Innovation Research of the Department's programs in Environmental Restoration and Waste Management, and Arms Control and Nonproliferation. The 33 Phase I grants are for about $75,000 each over a period of about six months, and will begin on December 28, 1993. The technical topic areas with the most awards are Sensors for Monitoring Environmental Remediation Activities, and Technologies for Domestic Nonproliferation and Safeguards, with nine each. The Department's Small Business Innovation Research program is located in the Office of Basic Energy Sciences/Division of Advanced Energy Projects.

Small Business Innovation Research Program Issues Annual Solicitation

The Small Business Innovation Research program will issue its twelfth annual solicitation for grant applications on November 15, 1993. About 200 Phase I awards of up to $75,000 each will be made to small businesses to evaluate the scientific or technical merit and feasibility of their projects. The solicitation will contain 43 technical topics including the following new ones this year from the Office of Energy Research: Green Car: Scientific Approaches to Automotive Innovations, Improved Onstream Methods of Nondestructive Evaluation, Bacterial Identification and Sampling, and Nuclear and High Energy Physics Educational Devices. The closing date for receipt of grant applications is February 15, 1994.

Integrated Research Highlights

Researchers at Oak Ridge National Laboratory Create Harder Than Steel Polymer Surfaces

Researchers at Oak Ridge National Laboratory (ORNL) using an ion beam processing technique have succeeded in creating polymers with surfaces that are harder and more wear resistant than steel. By bombarding a sample with energetic ions, investigators are able to change the bonding of the polymeric building blocks at the molecular level. This in turn gives rise to an enhanced surface hardness of approximately 50 times that of ordinary plastic and twice that of steel. These ion beam processed polymers can potentially be used in applications that have been limited to using heavier metallic alloys or inherently brittle ceramics. Further, the effect has been demonstrated in ordinary plastics such as polyethylene which comprise household soda and milk bottles. Such processing technology can potentially have a great impact on applications for which a hard, thin, wear-resistant coating is essential in materials performance. Examples of applications that would benefit from such a discovery include engine components, orthopedic devices, textile manufacturing components, hard disk media, optical coatings, and cutting tools.

This work is a result of the integration of research and technologies supported by Basic Energy Sciences, Energy Efficiency and Renewable Energy, and ORNL's Laboratory Directed Research and Development Fund.

Crash Model of a Ford Taurus Run in 26 Hours

The first automobile crash analysis, using a massively parallel computer, has been accomplished by a team of Oak Ridge National Laboratory researchers headed by Thomas Zacharia of the Metals and Ceramics Division. Computer modelling of car crashes is an integral component of automobile companies' efforts to design better, safer, and more crash-worthy cars because a single physical car crash can cost between $50,000 to $75,000. Current computer models used by industry, however, require several weeks to run despite their relative simplicity. Using the DYNA-3D code, a detailed finite-element crash model of a Ford Taurus 4-door sedan, comparable to industry's results, was run in 26 hours using only 30 of the 512 available nodes of the Oak Ridge National Laboratory Intel Paragon. The Zacharia team was collectively supported in this effort by the Office Basic Energy Sciences/Materials Sciences Division, the Office of Scientific Computing and the Office of Energy Efficiency and Renewable Energy.

Program in Nuclear Chemistry Addresses Important Radioactive Waste Concerns

The May 2, 1994 edition of the American Chemical Society publication, Chemical and Engineering News, includes an article by Professor Darleane Hoffman (Lawrence Berkeley Laboratory) entitled "The Heaviest Elements". The article describes her basic research program that is supported by the Chemical Sciences Division of the Office of Basic Energy Sciences on the man-made transuranium or actinide elements and the several new elements beyond the actinides that have been discovered. This program focuses on the study of the chemical, physical, and nuclear properties of the heaviest elements and expands our understanding of the behavior of these elements in the nuclear fuel cycle, the environment, and waste management systems.

Professor Hoffman has been at the Lawrence Berkeley Laboratory for ten years and has graduated twelve students trained in the chemistry, physics, and analysis of the actinides. Eight of these graduates are currently employed by the Department of Energy and other laboratories in areas of environmental radiochemistry. One such project on actinide separations is funded by Environmental Management's Office of Technology Development. She has six graduate students currently. Though retired from the University in 1991, she has been appointed Professor of the Graduate School so she can continue to accept students. In addition to graduate students, Professor Hoffman attracts postdocs to work on the chemistry of the actinide elements under environmental conditions. This is one of a very few academic programs that contribute highly trained personnel who are qualified to address the chemical concerns of radioactive wastes in the environment.

Basic Research on Supercritical Water Leads to Method for Waste Disposal Technology Development

Research supported by the Office of Basic Energy Sciences, Division of Chemical Sciences, on the fundamental chemical and physical properties of supercritical fluids has provided a major assist to an understanding of the supercritical water oxidation waste disposal technology. The development of methodology for the Raman spectroscopic analysis of supercritical solutions now permits the study of the fundamental mechanism of solvation of organic and inorganic solutes under supercritical conditions and an understanding of the process of supercritical water oxidation. Based on these studies, a pilot-scale facility will be constructed at the Pacific Northwest Laboratory to test the feasibility of supercritical water oxidation for the chemical destruction of organic pollutants in Hanford, industrial, and municipal waste streams. Funding for this pilot-project comes from EM-50, an ER CRADA, the Innotech Corp. of Little Rock, Ark., and the Battelle Memorial Institute. Of immediate interest is the effluent from the de-watering of municipal waste sludges, and a U.S. Army waste product called "redwater" which contains nitrogen

compounds from explosives and propellants manufacturing.

Nuclear Waste Highlights Basic Energy Sciences Contribution

An article appeared on January 31, 1994, in a waste management community newsletter, Waste Tech News, describing the impact of research by an Argonne National Laboratory chemist. The article states: "Inspectors who search for evidence of clandestine manufacture of nuclear weapons should find their jobs easier following research at the DOE's Argonne National Laboratory". The research is the study of actinide spectroscopy and photophysics, and resulted in the development of an ultrasensitive, signature method for detecting the presence of curium-242 from the reprocessing of recently irradiated uranium targets. Detection sensitivities on the order of a few atoms are sought. This project is supported by the Office of Arms Control and Non-proliferation in the Department of Energy Defense Programs, but stems directly from the long-term basic research supported by the Office of Basic Energy Sciences/Division of Chemical Sciences.

Thermoacoustics Technologies

A sound wave is usually thought of as consisting of pressure and displacement oscillations, but always attendant are also temperature oscillations. The combination of these effects are small enough that they are unnoticed in everyday life. Nevertheless, work in the last decade at Los Alamos National Laboratory has shown how thermoacoustic effects can be harnessed to produce powerful, reasonably efficient heat engines: prime movers, heat pumps, and refrigerators. Thermoacoustic engines typically have no moving parts, or at most a single oscillating moving part (such as a loudspeaker) with no sliding seals. Thus, these engines have the potential for extreme simplicity and reliability.

Since the 1980's, Drs. Gregory Swift, Robert Ecke and coworkers have been investigating the thermoacoustic process from a thermodynamic point of view. With the support of the Office of Basic Energy Sciences/Division of Materials Sciences, they have extended theory, made simple measurements, and built a thermoacoustic refrigerator with a cooling power of tens of Watts. More importantly, their research spawned a number of collaborative efforts which have resulted in advances in the theory, design and construction of thermoacoustic devices. More recently, they have continued their applied work using resources from the Advanced Industrial Concepts Division of the Office of Energy Efficiency and Renewable Energy. Thanks in large part to their efforts, there are now at least 6 highly talented thermoacoustic scientists and engineers in the U. S. The number of academic institutions, laboratories, and corporations involved in thermoacoustics is about 20 worldwide, and a few million dollars are committed to the development of thermoacoustic devices.

Basic Research Results in Improved Nuclear Weapons Detection

An article appearing on January 3, 1994, in a suburban Chicago newspaper, the Daily Herald, described research by an Argonne National Laboratory chemist and stated "his research team dramatically improved the accuracy and speed of nuclear weapons material inspections." The article noted the Clinton administration's growing concern that North Korea is developing a nuclear weapons program and stated that Argonne is working on ways to uncover their clandestine manufacture. Detection sensitivities on the order of a few atoms are sought. The work described in the article is supported by the Office of Arms Control and Non-proliferation in the Department of Energy Defense Programs, but stems directly from a basic research project supported by the Office of Basic Energy Sciences/ Division of Chemical Sciences.

Geoscience Research Knowledge Transferred to Oil and Gas Production

The September, 1993, newsletter from Los Alamos National Laboratory (LANL) reported on fracture mapping used by LANL researchers to map oil flow paths by locating microearthquakes. The researchers used downhole seismometers to monitor weak seismic disturbances generated as oil was pumped from a nearby well. The microearthquake locations define a network of subsurface fractures which include important flow paths. LANL is working with independent oil producers and other DOE laboratories in a "Partnership" funded by DOE's Office of Fossil Energy to enhance domestic oil and gas production. Hydrofracturing is used to increase production, but can also be used to provide a new class of information on fracture distribution using this approach.

This successful technology transfer effort illustrates the role of strategic basic research in providing tools for the future. The approach used is based on research at Los Alamos by M. Fehler and L. House, Professor K. Aki at University of Southern California and Dr. Arthur Cheng at Massachusetts Institute of Technology supported by the Office of Basic Energy Sciences/Geoscience Research Program funded over the past decade. The basic research results have been published in the Journal of Geophysical Research, Geophysical Research Letters, and the International Journal of Rock Mechanics and Mineral Science. A current research project at Los Alamos continues development of the method and evaluation of appropriate algorithms for data analysis. To illustrate even further the close coupling of basic and applied research in this project, it is noted that the basic research was motivated by an applied program in the Geothermal Energy - Hot Dry Rock Program at Los Alamos, and the original hydrofractures (which provided the data for analysis) were created in connection with the Hot Dry Rock Program.

This example serves to illustrate a very common theme at the DOE laboratories where applied research efforts generate questions that cannot be answered in terms of conventional knowledge, but which become the subject of a more basic research effort. In turn, the basic research effort leads to utilization in other, initially unforeseen, technology areas.

Planning and Information Transfer

Joint Workshop Planned on Combustion Modeling

Earlier in 1994 an information meeting was held in which principal investigators, supported by the Offices of Energy Research, Energy Efficiency and Renewable Energy, and Fossil Energy, described their programs in combustion modeling for each other and for the Department of Energy management. The meeting helped to enhance the effectiveness of the programs through improved communication between the principal investigators and between the Department of Energy and industry. On Tuesday, November 8, 1994, representatives from the Office of Basic Energy Sciences, the Office of Fossil Energy, and the Combustion Research Facility of Sandia National Laboratories, California, convened a follow-up meeting to discuss mechanisms for improving the communication between the programs of the two offices. One outcome of this meeting was a decision to sponsor a workshop related to design and optimization models for coal fired power plants. To define the scope of the collaboration between Fossil Energy and Energy Research, the participants in the November 8 meeting recognized that industry would have to be involved. The workshop, which is to be held in the Spring of 1995, will lead to the formation of a working group of industrial, academic, and government scientists for the development of combustion computational models. The working group will review progress in the development of models in their individual communities and identify gaps in the research that could prevent the

development of combustion models needed to meet national energy efficiency and emission control goals.

Coordination on Composite Research with Energy Efficiency and Renewable Energy/Office of Industrial Technologies

Dr. John N. Mundy of the Office of Materials Sciences/Basic Energy Sciences (BES/MS) delivered an invited presentation at the Continuous Fiber Ceramic Composites (CFCC) Working Group meeting sponsored by the Office of Energy Efficiency and Renewable Energy's Office of Industrial Programs (OIP). CFCC Program Manager Scott Richlen stressed the increasing requirement that the OIP allocate their resources to industrial organizations, with the anticipated consequence that the capacity of the OIP to support basic and longer-term studies which serve as the origin of new developments and improvements will be inhibited. Dr. Mundy presented an overview of CFCC related basic research activities that are supported by BES/MS. His presentation included program summaries of relevant BES/MS programs and identification of their cognizant principal investigators and their affiliations and phone numbers. Dr. Mundy referenced pre-existing BES/MS interactions with OIP and offered suggestions for potential routes of enhanced interprogrammatic interactions. He also provided information concerning access to relevant BES/MS user facilities. This CFCC Working Group Meeting took place on October 18, 1994, in Bozeman, Montana.

More Interaction Between the Office of Energy Research and Energy Efficiency and Renewable Energy

Dr. John N. Mundy, of the Division of Materials Sciences, Office of Basic Energy Sciences, has been invited by the Office of Industrial Technologies to present an overview of the Materials Science programs at the semi-annual meeting of the Continuous Fiber Ceramic Composites (CFCC) Working Group. Continuous fiber ceramic composites are lightweight, tough, corrosion resistant materials with high temperature strength, and thus have strong market potential for American industry. The Office of Industrial Technologies CFCC program that began in the Spring of 1992, benefitted from earlier Basic Energy Sciences (BES) ceramic programs, and the continuing dialogue between the two divisions will ensure that the CFCC industrial contractor teams are made fully aware of the ongoing BES fundamental research progress in this critical technology. Dr. Mundy will make this presentation on October 18, 1994, in Bozeman, Montana.

Opportunities in Photovoltaics Research

Department of Energy solar-photovoltaic materials research programs, future needs and opportunities, and potential areas for synergistic collaboration was the subject of a meeting of the Energy Materials Coordinating Committee, Subcommittee on Semiconductors. Representatives from the Office of Basic Energy Sciences, Office of Energy Efficiency and Renewable Energy, Office of Defense Programs, Office of Fossil Energy, and the National Renewable Energy Laboratory met to coordinate on-going research and to explore and discuss future opportunities for such research as it applies to photovoltaic and related technologies. The meeting was held on Tuesday, September 27, 1994, at the Aerospace Building, 901 D Street, S.W.

Emerging Energy Technology Coordination Group Discusses Integration

Mr. Paul Stone, Director of the Federal Technology/Business Development office of Dow Chemical Company, made a presentation, *Perspectives of Integrating Pure and Applied Science*, to the DOE Emerging Energy Technology Coordination Group about the changing roles of basic, strategic, and applied research, in Academic,industrial and government research institutions. Mr. Stone described the continuing trend for industry to cut back its R&D programs, although for certain

market niches there might be a sudden scale-up of research efforts. He gave graphic examples of research and the decision processes leading to successes in the marketplace (of about 1 in 700 projects). He distributed copies of a draft paper, *The Concept of Strategic Research*, written by John A. Armstrong, IBM Vice President for Science and Technology (ret.), reflecting remarks for the Forum on Science in the National Interest (Jan 31-Feb.1, 1994). Mr. Stone provided the Coordinating Group with added insight to help coordinate basic, strategic, and applied research programs toward the national goals for industrial competitiveness. The Group meets approximately quarterly, convening representatives from EE's Office of Industrial Technology, ER's Advanced Energy Projects Division, Office of Basic Energy Sciences, FE's Office of Advanced Research,and DP's Office of Economic Competitiveness. Meeting notices are widely distributed, and other interested parties are welcome to participate.

Joint Research Efforts Focus on Ceramic Matrix Composites

The Office of Fusion Energy (OFE), and the Office of Basic Energy Sciences (BES), jointly sponsored a Research Assistance Task Force (RATF) meeting on Radiation Resistant Ceramic Matrix Composites, hosted by Rensselaer Polytechnic Institute (RPI) on July 11-13, 1994, in Troy, New York. Forty-five participants attended the meeting representing 6 private companies, 8 government laboratories, 6 universities, and 3 DOE offices. The focus was on the development, optimization, and utilization of silicon carbide (SiC) fiber reinforced SiC matrix composites for fusion systems. Technical issues discussed included their radiation stability and mechanical behavior, SiC fiber performance and availability, synthesis routes for SiC/SiC composites, and component design criteria. A commitment was made for continued programmatic coordination between the Naval Reactors Program, OFE, and BES. Joint research efforts will be pursued in mechanical behavior and testing, irradiation effects, and the utilization of the analytical tools and expertise available at the National User Facilities to evaluate the performance of these materials in radiation environments.

A report summarizing the results and recommendations of the meeting will be compiled by Dr. Helen M. Kerch, BES, Dr. Russ Jones, Pacific Northwest Laboratories, and Professor Don Steiner, RPI which will subsequently be published in a peer-reviewed journal.

Fossil Energy Program Managers Visit and Review Basic Energy Sciences Program at Ames Laboratory

James Carr, Rod Judkins, and Nancy Cole of the Office of Fossil Energy/ Advanced Research and Technology Development program visited and reviewed Office of Basic Energy Sciences (BES) funded programs at the Ames Laboratory at Iowa State University on July 19 and 20, 1994. Of particular interest to the Fossil Energy visitors were the Ames Laboratory capabilities for metal powder production and compaction (metal fabrication by powder metallurgy) of high-temperature, corrosion resistant alloys, producing protective coatings for corrosion resistance, purification of rare earth compounds, and producing ceramic fibers and thin films for application in Fossil Energy funded programs. One subject of attention was the possibility of the preparation by the Materials Preparation Center at the Ames Laboratory of rare-earth doped iron aluminides for delivery to a Fossil Energy supported program at Oak Ridge National Laboratory. Ms. Cole also plans a return visit to the Ames Laboratory to discuss the unique non-destructive evaluation research program at Ames.

Thermophotovoltaic Generation of Electricity will be Topic of Conference

Dr. Dale D. Koelling from Argonne National Laboratory, who is beginning an assignment with Basic Energy Sciences/Materials Sciences, will participate in the First National Renewable Energy

Laboratory Conference on Thermophotovoltaic Generation of Electricity on July 24-27, 1994, at Copper Mountain, Colorado. This conference will take place under the auspices of the Office of Energy Efficiency and Renewable Energy. A new degree of freedom in thermophotovoltaic energy conversion system design has recently been achieved with highly efficient cells made from compound semiconductor systems that allow the spectral response to be tuned to a light source. Such compound semiconductors also fall within the domain of past Basic Energy Sciences/ Materials Sciences research achievements and on-going research. Dr. Koelling's participation in this conference is aimed at continuing the good cooperation that is in place between Energy Efficiency and Renewable Energy and Basic Energy Sciences/Materials Sciences, and in further defining the evolution that is taking place in the Basic Energy Sciences/Materials Sciences compound photovoltaic semiconductor research portfolio.

Coordination Activities Between Basic Energy Sciences and Transportation Technologies

A second meeting of staff members from the Office of Basic Energy Sciences and the Office of Transportation Technologies was held on May 31, 1994,to continue the coordination of programs of the two offices in electrochemical technology. This collaboration was formalized last February 17th in a meeting which identified several areas where Basic Energy Sciences research provides information needed by the Electric and Hybrid Propulsion Program. At the May meeting, action was taken to increase the efficacy of the collaboration by: the scheduling of a working meeting on surface modification and processing involving investigators from both Programs; the scheduling of two Energy Materials Coordinating Committee meetings to examine and discuss the on-going and planned research in electrochemical topics; planning two seminars, one in battery technology issues and problems and one in fuel cell technology issues and problems to be given at the Office of Basic Energy Sciences by representatives from the Office of Transportation Technologies; implementing a joint Division of Chemical Sciences and Electric and Hybrid Propulsion Program battery research contractors meeting (planned for the Fall of 1994); planning future cooperative budget submissions on relevant research.

Symposium on High-Temperature Intermetallics Attracts Broad International Participation

The high-temperature corrosive environments present in fossil-fuel power plants cause material failures that result in costly, unscheduled shutdowns and loss of life. An estimate showed that a one percent increase in service time of coal fired power plants would save the United States electrical utilities $1.2 billion per year. The economic production of electrical power is of world-wide interest, and the consequent need to develop high-temperature corrosion resistant alloys explains the participation of the major Organization for Economic Cooperation and Development countries at the conference on High-Temperature Intermetallics in San Diego, May 16-19, 1994. For Dr. John N. Mundy participating on behalf of the Basic Energy Sciences, the timing of conference was ideal, following the previous week's Fossil Energy review of their intermetallic programs and a workshop in which Basic Energy Sciences, Fossil Energy, and the Electric Power Research Institute jointly defined new activities in the synthesis and processing of high-temperature corrosion resistant coatings. Interactions initiated at these meetings will help to define the most important areas where fundamental research can enhance the applied programs' abilities to encourage the use of intermetallics by industry.

Basic Energy Sciences' Participation in Energy Efficiency Advanced Industrial Materials Meeting

To enhance coordination between Energy Efficiency and Renewable Energy, Office of Industrial Technologies and Energy Research, Office of Basic Energy Sciences, Dr. Helen M. Kerch, will present a programmatic overview of the Division of Materials Sciences at the Advanced Industrial Materials Program Annual Information and Review Meeting which is being held in Los Alamos,

June 1-3, 1994. Dr. Kerch will present Basic Energy Sciences-sponsored materials research that underpins the technologies targeted by the Office of Industrial Technologies. Materials areas to be discussed include high temperature corrosion resistant intermetallic alloys for wear environments, controlled porosity ceramics for industrial remote sensor applications, and advanced ceramic preparation techniques for wear resistant coatings. These Basic Energy Sciences research areas are of critical importance to industrial materials processing and design.

Energy Research Staff Included in Environmental Restoration and Waste Management, Program Coordination Meeting

Dr. John L. Burnett in the Division of Chemical Sciences, Office of Basic Energy Sciences, in the interest of Energy Research-Environmental Restoration and Waste Management (ER-EM) coordination, attended an Office of Technology Development, Environmental Restoration and Waste Management (EM-50), Program Managers' meeting on May 16 and 17, 1994. The meeting was held for the benefit of the EM-50 Program Managers and their Coordinators in the field for planning their Fiscal Year 1995 funded program. Dr. Helen McCammon, Office of Health and Environmental Research, Environmental Sciences Division, also attended the meeting. The meeting consisted of a brief summary of current EM-50 activities and plans for the next year and provided the Energy Research representatives with a overview of the program. Participations of Energy Research in Environmental Restoration and Waste Management reviews leads to greater coordination of mutual research interests.

Workshop with Fossil Energy and Electric Power Research Institute Focuses on Corrosion Resistance

High-temperature corrosion failures are a major contributor to costly and sometimes catastrophic unscheduled down-time of today's primary fossil, nuclear and secondary steam power plants, as well as for industrial heat-exchangers. Such failures result in loss of equipment life as well as annual multi-billion dollar losses to American industry according to the Electric Power Research Institute. The Basic Energy Sciences/Materials Sciences Center of Excellence for the Synthesis and Processing of Advanced Materials will conduct a workshop on this topic with the Office of Fossil Energy and the Electric Power Research Institute participation on May 13, 1994, in Oak Ridge, Tennessee. It will define the Center's contemplated new activity in the synthesis and processing of high-temperature corrosion resistant coatings and other corrosion-protection treatments. Dr. John N. Mundy, on detail to the Division of Materials Sciences from Argonne National Laboratory, will participate in this workshop.

Materials Sciences to Participate in Office of Fossil Energy's Annual Materials Conference

Dr. John N. Mundy, of the Office of Basic Energy Sciences/Materials Sciences program will deliver an invited presentation at the Eighth Annual Fossil Energy Materials Conference, sponsored by the Office of Fossil Energy's Advanced Research and Technology Development on May 10-12, 1994, at Oak Ridge, Tennessee. The Office of Fossil Energy's Advanced Research and Technology Development concerns include coal processing, liquefaction and gasification, as well as heat engines and heat recovery. Other participants will include customers and stakeholders from the Office of Fossil Energy and the private industrial sector.

Improved Communication Between Materials Sciences and Fossil Energy

Dr. John N. Mundy, on detail to the Office of Basic Energy Sciences/Materials Sciences Division from Argonne National Laboratory, will attend the annual Fossil Energy Materials Conference, which is sponsored by the Office of Fossil Energy/Advanced Research and Technology

Development, on May 10-12, 1994, at Oak Ridge, Tennessee. He will be discussing a scientific overview of Basic Energy Sciences/Materials Sciences projects in topics such as high temperature ceramics, high temperature corrosion resistant intermetallic alloys, gaseous corrosion, erosion, non-destructive evaluation, and welding. These Basic Energy Sciences research areas are of critical importance to contemporary clean, safe, fossil energy system performance with reduced down-time and consequential enhanced economic gains. Dr. Mundy will also discuss the reports of issues and technological barriers being attacked by the Fossil Energy/Advanced Research and Technology Development materials program with the view towards enhancing the scientific/ technical coordination between Fossil Energy/Advanced Research and Technology and Basic Energy Sciences/Materials Sciences supported investigators.

Coordination with Energy Efficiency to Formulate Research and Development for Direct Methanol Fuel Cell Technology

Dr. Steven Barnhart (Chemical Sciences) and Dr. Richard Kelley (Materials Sciences) participated in an Energy Efficiency and Renewable Energy/Transportation Technologies review meeting on Fuel Cells for Direct Methanol Oxidation on April 26-27, 1994, in Baltimore, Maryland. The purpose of the meeting was to bring together researchers and industrial fuel cell developers to provide a forum for scientific exchange that will (i) benefit the developer to improve the performance of direct methanol fuel cells and (ii) identify areas of opportunity for meaningful research by academia and research laboratories. The review meeting participants will formulate recommendations for research and development that will improve the prospects for direct methanol fuel cell technology. Basic Energy Sciences provide substantial basic research support in areas directly related to fuel cell and battery development.

Workshop on Computer-Aided Catalyst Design

Two members of the Office of Basic Energy Sciences/Chemical Sciences Division program staff participated in the DOE Energy Efficiency workshop on Computer-Aided Catalyst Design on Monday, April 25, at the National Academy of Sciences. This workshop brought together catalysis researchers from the DOE laboratories, industry, and academe, as well as program staff from various parts of DOE, NSF, and possibly other agencies. Discussions will focus on future directions and the identification of potential collaborative arrangements between industrial and National Laboratory groups.

Energy Efficiency Program Managers Visit Ames Laboratory

Dr. Charles Sorrell and Dr. Peter Angelini from the Office of Industrial Technologies visited Ames Laboratory on April 18, 1994, to become familiar with the laboratory's Materials Preparation Center and its capabilities in advanced materials processing and manufacturing. This visit will provide the Ames Laboratory with the opportunity to further refine their understanding of the needs of the Office of Energy Efficiency and Renewable Energy/Industrial Technologies.

Participation in Review Activities for the Energy Efficiency and Renewable Energy Superconductivity Program

The Office of Basic Energy Sciences/Materials Sciences (BES/MS) staffers have accepted invitations to participate in Energy Efficiency and Renewable Energy Superconductivity Program for Electric Power Systems fiscal year 1996 Field Work Proposal Meetings as follows:

Date, Time & Place	BES/MS Staff	Laboratory
Tuesday, April 12 10:00 a.m. 5E-081 Forrestal	Alan Dragoo Doug Finnemore	BNL
Tuesday, April 12 1:00 p.m. 5E-081 Forrestal	Alan Dragoo Doug Finnemore	ANL
Thursday, April 14 10:00 a.m. Energetics*/5th floor Conference Room	Doug Finnemore John Mundy	SNL
Thursday, April 14 1:00 p.m. Energetics*/5th floor Conference Room	Doug Finnemore John Mundy	LANL
Friday, April 15 10:00 a.m. 5E-081 Forrestal	Doug Finnemore	NREL

* Energetics
7164 Columbia Gateway Drive
Columbia, MD 21046
Craig Matzdorf
410/290-0370

Robert Gottschall has accepted an invitation to serve as a reviewer for the Energy Efficiency and Renewable Energy Superconductivity for Electric Power Systems on July 19, 20, and 21, 1994.

Coordination Activities With Fossil Energy/Advanced Research and Technology Development

Dr. John N. Mundy of the Office of Basic Energy Sciences/Materials Sciences Division will provide an overview of the Basic Energy Sciences/Materials Sciences projects in areas of critical importance to fossil energy technologies at the annual Fossil Energy Materials Conference which is sponsored by the Office of Fossil Energy/Advanced Research and Technology Development and will take place on May 10-12, 1994, at Oak Ridge, Tennessee. His presentation will include an overview of Basic Energy Sciences/Materials Sciences projects in topics such as high temperature ceramics, high temperature corrosion-resistant intermetallic alloys, gaseous corrosion, erosion, non-destructive evaluation, and welding. The basic understanding gained from research in these areas are of critical importance to contemporary clean, safe, fossil energy system performance with reduced down-time and consequential enhanced economic gains. Dr. Mundy will also absorb the reports of issues and technological barriers being attacked by the Fossil Energy/Advanced Research and Technology Development materials program with the view towards enhancing the programmatic coordination between Fossil Energy/ Advanced Research and Technology and Basic Energy Sciences/Materials Sciences supported investigators.

Chemical Sciences Program Manager Participates in Environmental Management (EM) Program Review

The Efficient Separations and Processing - Integrated Program in the EM Office of Technology Development solicited the assistance of Dr. John L. Burnett of the Division of Chemical Sciences, Office of Basic Energy Sciences for the technical review of a group of EM projects. The review addressed projects in research and technology development of chemical separations processes for

radioactive materials at the Los Alamos National Laboratory, Sandia National Laboratory, and the Lawrence Berkeley Laboratory.

Conference on Heterogeneous Catalysis and Surface Chemistry Will Bring Basic and Applied Researchers Together

The Ninth meeting of the Office of Basic Energy Sciences/Divisions of Chemical Sciences and Materials Sciences sponsored research on heterogeneous catalysis and surface chemistry will be held on May 25-27, 1994, in Oconomowoc, Wisconsin. The meeting will include researchers funded by Fossil Energy and Energy Efficiency. The meeting will consist of oral presentations of current research and poster presentations. The intent of the meeting is to bring together researchers with common interests to foster collaborations which will broaden the impact of the research and strengthen the interactions between Offices within the Department of Energy.

A Combustion Modelling Information Interchange

A Combustion Modelling Information Interchange was held March 29-30 at Argonne National Laboratory. The interchange was sponsored by the Combustion Coordinating Group (CCG) represented by the Department of Energy offices of Energy Research, Fossil Energy, Energy Efficiency and Renewable Energy, and Defense Programs. Recognizing that combustion modelling projects are sponsored by each of these offices, the Combustion Coordinating Group sponsored the interchange to promote increased dialogue and cooperation among the principal investigators. The interchange was by invitation only in order to keep the meeting intimate and to foster candor and spontaneity. In addition to members of the Combustion Coordinating Group and the Department of Energy sponsored principal investigators, representatives from industry who use combustion models for system design and optimization were invited to participate. The Combustion Coordinating Group is planning to follow this workshop with planning activities aimed at increasing the collaboration between the more basic and applied programs of the Department.

Silicon Carbide Composites for Fusion Applications

The Office of Fusion Energy, Division of Advanced Physics and Technology and the Office of Basic Energy Sciences, Division of Materials Science are planning a jointly sponsored Research Assistance Task Force entitled "Radiation Resistant Ceramic Composites" that is to identify research needs in developing Silicon Carbide/Silicon Carbide composites for fusion specific component applications. The silicon carbide/silicon carbide composite system possesses promising materials characteristics including low activation and superior high temperature mechanical properties both of which are considered critical for fusion structural components. Participants in the Research Assistance Task Force will include materials scientists from Department of Energy laboratories (Oak Ridge National Laboratory, Pacific Northwest Laboratory, Argonne National Laboratory, Lawrence Livermore National Laboratory, Knolls Atomic Power Laboratory), universities (University of California at Los Angeles, Rensselaer Polytechnic Institute, Cornell, Brown), and the composite materials industry (DuPont, Lanxide, General Atomics, and Materials and Electrochemical Research Corp.). This Research Assistance Task Force will focus on integrating the mechanistic understanding of ceramic composite behavior with the issues associated with their application and to develop improved composites in fusion power systems. Work needed to complete this understanding will be identified. It is expected that the synergism between participants will accelerate silicon/carbide/silicon carbide composite evaluation and assist in bringing the development of structural components to fruition.

The Research Assistance Task Force is being organized by Professor Don Steiner (Rensselaer Polytechnic Institute) and Dr. Russ Jones (Pacific Northwest Laboratory). Drs. Bill Wiffen of the

Office of Fusion Energy and Helen Kerch of the Office of Basic Energy Sciences/Division of Materials Sciences are acting as DOE liaisons.

Integration of Research Activities Discussed at Energy Efficiency and Renewable Energy Seminar

Drs. H. M. Kerch, O. Buck and R. J. Gottschall of the Office of Basic Energy Sciences/Division of Materials Sciences listened to a proposal presentation Development of a Uniform Droplet Process for the Production of Cost-Effective and Improved Materials Components to the Advanced Industrial Materials Program of the Office of Energy Efficiency and Renewable Energy on February 17, 1994. The presenters were Professor Jung-Hoon Chun of the Massachusetts Institute of Technology, Professor Teiichi Ando of Boston University, and Dr. Vinod K. Sikka of Oak Ridge National Laboratory. They seek to develop process-structure relationships that can be used as a process design and control tool for commercial spray forming, and thereby develop a cost-effective manufacturing process for improved materials components. The proposed effort is a logical progression from Basic Energy Sciences funded work on high-pressure gas atomization processes for powder production, developed at the Ames Laboratory, which is then followed by a spray process. Basic Energy Sciences/Materials Sciences also supports complementary advanced intermetallic alloy processing research at Oak Ridge National Laboratory. Another complementary technology developed at Oak Ridge and supported by the Office of Basic Energy Sciences/Divisions of Chemical Sciences and Advanced Energy Projects uses electric fields to form ceramic particles of uniform size. The latter technology is the subject of a Cooperative Research and Development Agreement for further commercialization.

Integration with the Office of Transportation Technologies on Electrochemical Technologies

A meeting was held in Forrestal on February 17, 1994, by staff of the Office of Basic Energy Sciences with staff of Transportation Technologies, specifically the Office of Propulsion Systems. The purpose of the meeting was to help coordinate the programs of the two offices and to review current research and development on electrochemical technology in the Electric/Hybrid Propulsion Division. Six Office of Basic Energy Sciences staffers, Jerry Smith, Cynthia Carter, Dick Kelley, Bob Gottschall, Otto Buck, and Steve Barnhart, attended representing the Divisions of Materials Sciences, Chemical Sciences and Advanced Energy Projects. Five staffers represented Transportation Technologies including John Brogan, Director of the Office of Propulsion Systems, Rebecca Dyer, Al Landgrebe, Edward Dowgiallo, and Pat Sutton. Michael O'Connell and Ray Warmer from the Office of Research and Development of the Office of Intelligence and National Security attended the meeting for coordination with related areas in Defense Programs.

Information was exchanged in detail on the $60 million Electric and Hybrid Propulsion Program and in summary form on Basic Energy Sciences research in electrochemical technologies (Division of Materials Sciences, $5.1 million, 26 projects) and the non-automotive battery program (Chemical Sciences Division, $3.5 million). Six action items were agreed upon including a meeting in Germantown to present the Basic Energy Sciences programs in more detail, to plan a joint (Chemical Sciences Division and Electric/Hybrid Propulsion Division) battery research contractors meeting, and to plan a Research Assistance Task Force meeting on surface processing.

Refinery of the Future

A meeting was held in Houston, Texas, February 14-15, on "The Refinery of the Future". The Meeting was co-sponsored by Energy Efficiency, Fossil Energy and the National Petroleum Refiners Association. The Department of Energy had representatives from Defense Programs, Energy Efficiency and the Office of Basic Energy Sciences. Industrial representatives were from the major oil companies, independent refiners, catalyst manufacturers and the national labs. The

total attendance was in excess of 100. The meeting was organized to define problems in the industry and then discuss the directions to overcome these problems.

The sessions on research needs focused on short term solutions to problems the industry is unable to solve themselves because, as they admit, they no longer have the research staff to do the necessary work due to the current trends in business practices. These research needs fall into several areas where Energy Research has either extensive knowledge and/or capabilities. These include high performance computing, materials, geology, combustion, catalysis, and global warming research in addition to access to the Department of Energy's unique facilities.

Need for Lean-Burn NO_x Abatement Identified in Automotive Symposium

A symposium on the abatement of lean-burn NO_x was held in Albuquerque, New Mexico, on February 2, 1994. Those present included representatives from the big three U.S. car manufacturers, two catalyst suppliers, Allied Signal, Stanford Research Institute (not for profit) and six national labs, as well as DOE Headquarters people from Defense Programs, Energy Efficiency and Renewable Energy and Energy Research. Defense Programs set up the symposium to review the status of removing NO_x from the emission of fuel efficient lean burn engines and to explore ways to pool the scientific and technical talent to help the auto industry meet the ever more stringent emission standards. Their intent is to establish a CRADA to facilitate collaborations.

Attention was focused on European and Japanese competition, with Toyota and Mazda being most advanced in mounting significant efforts in developing new catalytic systems for NO_x abatement. Kathy Taylor of General Motors stated the urgency of coming up with a new catalytic system by noting 1994 as the first year of the phase-in of new emission standards. More than 50 percent reduction in NO_x at more than 96 percent hydrocarbon conversion is needed for vehicle life up to 100,000 miles by 1996. The greatest needs, as identified by various speakers are: 1) understand what factors impacted catalyst selectivity; 2) understand/ determine the mechanisms of NO_x reduction; 3) learn why zeolite catalysts work as they do to hopefully guide the discovery of more effective nonzeolite catalysts; 4) clear identification of reaction intermediates and their role in the catalytic conversion; 5) how to obtain higher hydrothermal catalyst stability under oxidizing as well as stoichiometric conditions; and 6) better diagnostic techniques of measuring catalytic emissions. It was evident that basic research could make significant contributions to meet these needs. The urgency for solutions by the auto industry is, however, problematic to the process best known to provide the knowledge and understanding implicit in the statement of needs. Energy Research was represented by Dr. F. Dee Stevenson of the Office of Basic Energy Sciences/Chemical Sciences Division.

Combustion Modelling Information Interchange

A Combustion Modelling Information Interchange is planned for March 29 and 30 at Argonne National Laboratory. The interchange is being sponsored by the Combustion Coordinating Group (CCG) representing the Department of Energy Offices of Energy Research, Fossil Energy, Energy Efficiency and Renewable Energy, and Defense Programs. Recognizing that combustion modelling projects are sponsored by each of these offices, the Combustion Coordinating Group is sponsoring the interchange to promote increased dialogue and cooperation among the principal investigators. The interchange is by invitation only in order to keep the meeting intimate to foster candor and spontaneity. In addition to members of the Combustion Coordinating Group and the Department of Energy-sponsored principal investigators, representatives from industry who use combustion models for system design and optimization have been invited to participate. The Combustion Coordinating Group is planning to follow this workshop with planning activities aimed

at increasing the collaboration between the more basic and applied programs of the Department.

Coordination with the Office of Environmental Restoration and Waste Management

Office of Basic Energy Sciences (BES)/Chemical Sciences staff member, Dr. F. Dee Stevenson, has again assisted the Office of Environmental Restoration and Waste Management (EM) as a member of their Core Planning Group for the Efficient Separations and Processing - Integrated Program (ESPIP), a program in the Office of Technology Development (EM-50). Dr. Stevenson attended the Technical Information Exchange Meeting of the ESPIP research and technology program and participated in the follow-on Core Planning Group Meeting, both of which were held near the Dallas/Ft. Worth airport January 10-12, 1994. The role of the Core Planning Group is to assist in determining the comprehensiveness of the technical areas covered, priorities and strategies for making ESPIP effective in providing needed separation technology options for the Office of Waste Management (EM-30) and the Office of Environmental Restoration (EM-40). Coordination between EM and BES also occurs at the research level by the partial support of BES principal investigators at Argonne National Laboratory and Oak Ridge National Laboratory by the ESPIP program for work of particular interest to EM. These complementary efforts provide a welcome synergism.

Interactions with Energy Efficiency on Materials Technologies

Four Basic Energy Sciences program managers participated in a meeting on materials technologies organized by the Office of Energy Efficiency and Renewable Energy. As a part of a continuing effort to build a stronger pathway from the discovery of new scientific understanding to successful processes and products in the marketplace, a meeting was held at which an important presentation was given at the Forrestal Building by MIT professor Joel Clark, founder of the Materials Systems Laboratory. The subject was modeling of the effect of changing materials technologies on product manufacturing, longevity, disposal, recycling and, ultimately, total economic viability. Professor Clark has done a considerable amount of such work for the "Big 3" automakers, to help them make decisions on substituting materials for parts or components in automobiles. For example, Professor Clark has addressed the replacement of steel parts with aluminum parts. The meeting explored applications of these assessment methods to other industries. The question whether these modeling methods identified new needs for basic scientific understanding and data was discussed. Follow-on interactions regarding this question are anticipated.

The Office of Basic Energy Sciences was represented by Helen Kerch and Alan Dragoo from the Division of Materials Science, Subhendu Datta from the Division of Engineering and Geosciences, and Cynthia Carter from the Division of Advanced Energy Projects.

Basic Energy Sciences Liaison with Energy Efficiency and Renewable Energy/Materials Processing Division

John Mundy and Bob Gottschall from the Office of Basic Energy Sciences/Division of Materials Sciences met with Bill Obenchain of Energy Efficiency and Renewable Energy/Materials Processing Division on December 29, 1993, to discuss research and development needs for the steel industry.

Joint Workshop is Planned on the Role of Plants in Bioremediation

A workshop is currently being planned by the Office of Basic Energy Sciences/Energy Biosciences Division and Environmental Restoration and Waste Management/Office of Research and

Development, on the prospects of utilizing plants for accumulating polluting inorganic ions. The emphasis of the workshop will be on the research needs in plant science required to further the use of these organisms in bioremediation. Currently there are numerous discoveries being made concerning how specific ion uptake is genetically controlled in plants both with respect to which ions are absorbed and in what quantity. The prospect of utilizing plants for energy related clean-ups could be greatly enhanced with the generation of much new knowledge in this area. The individuals in the two units who are pursuing this planning are Ms. Rashalee Levine (EM-54) and Dr. Robert Rabson (ER-17). Contacts are being made with specialists in the field to plan the meeting and identify and invite the appropriate experts who would participate.

First Separation Scientists Meeting Held to Further Collaborations

The first biennial meeting of the research investigators focussing on the separations of the components of complex mixtures supported in the Separations and Analysis Program in the Office of Basic Energy Sciences/ Division of Chemical Sciences was held in Seattle, Washington, on October 13-15. This meeting involved oral and poster presentations of the most recent research endeavors by the current academic and national laboratory separations science investigators. The topical presentation areas ranged from ligand design and solvent extraction to membrane and chromatographic separations. In attendance from Headquarters were Clement R. Yonker and John L. Burnett from the Division of Chemical Sciences and Teresa Fryburger from the Office of Environmental Remediation and Waste Management. Also in attendance were Robert Welleck and Edgar O'Rear from the National Science Foundation, and Dr. J. L. Humphery from Humphery and Associates, an industrial representative. The goal of this meeting was to enhance the interaction among this diverse group of researchers and to establish collaborations of mutual interest to further the basic separations science funded in this Program.

New Approach Being Developed for Environmental Research and Development

Dr. Steven G. Barnhart (detailed to the Division of Chemical Sciences of Basic Energy Sciences from Sandia National Laboratory) attended a meeting of the Standing Working Group to Develop a New Approach for Environmental Research and Development at the Department of Energy. The meeting was held at Argonne National Laboratory October 5-8, 1993. The purpose of this meeting was to "integrate Department of Energy resources by bringing together individuals from the national laboratories, operations offices, and Department of Energy Headquarters to establish criteria for managing and coordinating environmental technology development across the Department of Energy." These sessions, which are coordinated by the Strategic Laboratory Council, focus on further development of the technology program models outlined at the September 17, 1993, working group meeting. This Standing Working Group will complete development of the final model by November 15, 1993.

Defense Programs Workshop Focuses on Nuclear Materials Science and Technology

Dr. John L. Burnett, Division of Chemical Sciences of Basic Energy Sciences, attended the Nuclear Materials Science and Technology Workshop that was held in Falls Church, Virginia, on Tuesday, October 5, 1993. This workshop was organized by Defense Programs to assess the changing needs and disposition of nuclear materials in the Department of Energy's programs.

Basic Energy Sciences Participates in High-Level Waste Tank Focus Group

Bill Luth of the Office of Basic Energy Sciences/Division of Engineering and Geosciences joined the focus group on High Level Waste Tank - Technology Development and participated in the first meeting on October 1, 1993. He will serve as liaison for other ER programs. The immediate

need is to identify the steps to be taken to achieve fully integrated, timely, and cost-effective technical solutions for the high-level waste tank problems. The focus group is led by the Office of Technology Development (EM-50) and involves participation from the Office of Waste Management (EM-30) representatives. Weekly meetings are anticipated until a strategic plan is developed by the team and its stakeholders.

Interagency and International Cooperation

Ames Laboratory Participates in "NASA Technology 2004"

The Materials Preparation Center (MPC) at Ames Laboratory participated in Technology 2004, a NASA sponsored exhibition of technology developed throughout the Federal Laboratory system at the Washington Convention Center on November 8-10, 1994. The Materials Preparation Center is a DOE Users Facility which provides, on a cost recovery basis, services to industry, universities, and DOE and non-DOE government laboratories that cannot obtained commercially elsewhere. These services include providing materials with ultrahigh purity, single crystals and special chemical compositions. Dr. Thomas Lograsso, Associate Director, and Dr. Timothy Ellis, Manager of the Rare-Earth Metals Section, represented the Materials Preparation Center at the Ames Laboratory booth. Approximately 30-35 contacts with industry representatives were made during the 3-day exposition, and many expressed interest in working with the Materials Preparation Center in obtaining materials for use in their development of new products.

Condensed Matter and Materials Theory Coordination Meeting

Dr. Dale D. Koelling of Basic Energy Sciences/Materials Sciences will participate in a Government Condensed Matter and Materials Theory Coordination Meeting at the National Science Foundation (NSF) on November 7, 1994. The purpose of the meeting is to discuss the theory programs in this area of the NSF, of the DOE, and of the defense agencies: What is funded now; where are the future opportunities; what constraints exist; what areas overlap; are there opportunities for increased cooperation? Despite the complexity of the problem, materials theory has advanced to a stage where it can point guide directions of research as well as provide a rational framework for the interpretation of experimental results. To achieve a greater possibility of success will require better coordination.

BES Staff Member to Participate in National Science and Technology Council Sub-Group Meeting on October 18-19, 1994

Dr. Helen M. Kerch, Division of Materials Sciences (DMS) will represent the Department of Energy at a meeting of the newly established Nondestructive Evaluation (NDE) Communication Group which is part of the Materials Technology (MatTech) Subcommittee of the Civilian Industrial Technology Committee (CIT) under the National Science and Technology Council (NSTC). The meeting will take place in Arlington, Virginia on October 18-19, 1994, with representation from the Departments of Energy, Commerce, Defense, Transportation, and the National Aeronautics and Space Administration. The objectives of the new NDE Communication Group are to coordinate relevant NDE research among agencies of the Federal Government, to identify issues and concerns, and to bring them to the attention of MatTec and other groups under the NSTC. Dr. Kerch will provide an update of current and planned NDE programs and will present an overview of the organizational elements in DMS performing the research. A summary record of the Communication Group's findings will be assembled and distributed to all participants.

Megascience Forum Follow-up Meeting

The Organization for Economic Development and Cooperation Megascience Forum Follow-up Meeting on Neutron Sources will be ehld on November 3 and 4, 1994, in Knoxville, Tennessee. The purpose of this meeting is to explore mechanisms for international collaboration in instrument research and development and to define ways to enhance international cooperation in the use, design, and construction of facilities and instrumentation.

Panel on Computational and Theoretical Techniques for Materials Sciences

Dr. Dale D. Koelling (Argonne National Laboratory scientist on assignment to the Division of Materials Sciences) is a member of a National Academy of Sciences Panel on Computational and Theoretical Techniques for Materials Sciences which was organized by the Naval Studies Board of the National Research Council as requested and funded by the Naval Research Laboratory. The Panel's charge is to assess which computational efforts are likely to prove most productive for the Navy as the advantages of massively parallel computing are realized. The Panel is delving into the following questions: What is the likely impact on the prediction of materials properties, processing models and performance predictions? Which codes/algorithms are the most likely to be impacted? Can we then achieve the coupling of *ab initio* calculations with modeling and performance simulations? The next meeting of this Panel, in which Dr. Koelling has been requested to participate, will be on September 30, 1994.

Aircraft Manufacturing and Materials Technology Subcommittee Under the National Science and Technology Council

The Aircraft Manufacturing and Materials Technology (AMMT) subcommittee is under the MatTec committee of the Committee on Civilian and Industrial Technology (CIT), National Science and Technology Council (NSTC). The Office of Basic Energy Sciences/ Materials Sciences Division (BES/MS) has been regularly represented in the past year of bi-weekly AMMT meetings, the most recent of which took place on August 19, 1994, and a Workshop sponsored by AMMT, by Drs. Otto Buck, John Mundy, and Yok Chen. The subcommittee believes that Basic Energy Sciences research activities in strategic topics such as light-weight and heat-resistant structural alloys, welding and joining, high-rate (sheet) metal forming, on-line sensing and non-destructive evaluation, corrosion, etc. are relevant to the quality and competitive manufacture of aircraft, and they know that there are representatives from the industry that agree with us. It is now our understanding, however, that NSTC has determined that the multi-agency AMMT program is to have a "near-term focus" that is to be based on "available technology" and therefore BES/MS will not be a participant.

Invited Presentation to U.S.-Japan Seminar Stresses Importance of Solidification Processing

Bob Gottschall, Office of Basic Energy Sciences/Materials Sciences Division, delivered an invited presentation to a U.S.-Japan Cooperative Sciences Program Seminar entitled Solidification Processing for the 21st Century on July 22, 1994, in Lenox, Massachusetts. This seminar was sponsored by the National Science Foundation and the Japan Society for the Promotion of Science. Solidification processing, which includes casting, welding and the processing of semiconductors and superconductors, is at the heart of manufacturing technologies and is of critical importance to the entire metals industry, including steel and aluminum, and to the semiconductor industry. It is anticipated that technological improvements in solidification technologies will lead to waste minimization, less environmentally undesirable effluence, more precise achievement of final component shape, less machining, reduced cost and improved manufacturing quality. Bob's presentation stressed the activities of the Division of Materials

Sciences' Center of Excellence for the Synthesis and Processing of Advanced Materials and the recently announced BES university-industry grant program.

Workshop Focuses on Synthesis and Processing in Chemical Manufacturing for a Sustainable Future

Dr. F. Dee Stevenson, Office of Basic Energy Sciences/Chemical Sciences Division, participated in the Workshop on Synthesis and Processing in Chemical Manufacturing on July 12-13, 1994, which was jointly sponsored by the Environmental Protection Agency and the National Science Foundation. The workshop was held to establish research needs important for finding more benign chemistry and engineering to make industrial processes more environmentally acceptable. The research needs focus was intended to be not just for the relatively small Environmental Protection Agency research program, but for other agencies with larger research budgets, such as the National Science Foundation. There seemed to be little appreciation for the significant work of Department of Energy Laboratories and recognition of DOE efforts in environmental research. Though other funding agencies were rarely mentioned specifically, it was evident that leveraging with the research programs of all agencies was an important goal of the Environmental Protection Agency. There was a strong belief among attendees that advances in chemistry, biotechnology, engineering, and advanced computing could lead to new versions of old processes "without the environmental baggage" of the old processes. Integration of disciplines was considered essential by industrial spokespersons. Catalysis was particularly recognized as having a prominent role to play. About 75 people attended the workshop from academe, industry, Department of Energy Laboratories, and various government agencies. Representatives from Southern Research International and the Electric Power Research Institute also attended.

Recent Coordinating Activities in the Office of Basic Energy Sciences - Engineering Research Program

Dr. Oscar Manley, Engineering Research Program manager, was invited to make a presentation entitled "Research and Results in the Engineering Sciences" on June 29, to a group of government science and technology managers attending an Office of Personnel Management (OPM) training course at the OPM training center in Oak Ridge, Tennessee.

Separately, Dr. Manley has been active in helping prepare the vision statement/strategy document being drafted by the Civilian and Industrial Technology/Committee on Energy and Natural Resources Joint Subcommittee for Environmental Technology (JSET - successor to the Subcommittee on Technology, Engineering, and Research). JSET sees its primary role to be defining the area of environmental technologies insofar as they help with attaining sustainable economic development. A document including a set of white papers is being prepared by some of the other subcommittee members.

Conference on National Materials Policy Emphasizes Technical Partnerships

The 13th Biennial Conference on National Materials Policy was sponsored by the Federation of Materials Societies, funded in part by the Department of Energy/Office of Energy Efficiency and Renewable Energy, and took place in Williamsburg, VA on June 6-9, 1994. The theme of this years Conference was "Technical Partnerships: A Road to Commercialization." Speakers included Dr. Mary L. Good (Undersecretary for Technology, U.S. Department of Commerce) who discussed the Advanced Technology Partnership and the Partnership for a New Generation Vehicle programs; Dr. H. Lee Buchanan (Director, Technical Reinvestment Project/Department of Defense), who discussed the importance of dual-use technologies for Department of Defense over and above defense technology transfer; Dr. Joseph Bordogna (Assistant Director for Engineering,

National Science Foundation) who spoke on the role for universities; and Dr. Robert J. Eagan, (Director, Materials Programs, Sandia National Laboratories) who reported on dual technologies. Mr. David Cheney (until recently with the Council on Competitiveness and now with the Department of Energy) served as a Panel Moderator and made remarks on technology partnerships and industrial competitiveness. Basic Energy Sciences participants were Drs. Cynthia Carter, John Mundy, and Bob Gottschall.

Solid State Sciences Committee Meetings

The Solid State Sciences Committee of the National Research Council met on June 19-20, 1994. Government presentations were made by Jasper Lupo (Department of Defense), Arati Prabhakar (National Institute of Standards and Technology), Bill Harris (National Science Foundation), Bob Gottschall (U.S. Department of Energy/Materials Research) and Bill Oosterhuis (U.S. Department of Energy/Synchrotron and Neutron Scattering User Facilities).

Joint Meeting of the Steering Committees for the U.S. Japan Cooperative Program on Neutron Scattering

The Department of Energy/Institute for Solid State Physics and the Department of Energy/Japan Atomic Energy Research Institute Steering Committees for the U.S.-Japan Cooperative Program on Neutron Scattering will meet on June 21 and 22, 1994, in Tokai, Japan. The purpose of the meeting is to review the research accomplished this year and proposed activities for next year. The activities include personnel exchanges, instrument development, and neutron scattering. Attending the meeting will be J. Axe, G. Shirane, S. Shapiro (Brookhaven National Laboratory); H. Mook, R. Nicklow (Oak Ridge National Laboratory); Y. Fujii, Y. Endoh, K. Kakurai, H. Yamaoka, S. Kawarazaki (Institute for Solid State Physics); S. Fundahashi, Y. Morii, S. Katano (Japan Atomic Energy Research Institute); and Iran Thomas (Department of Energy).

Council on Civilian and Industrial Technology/MatTec/Task Group on Structural Ceramics Holds Meeting

The Council on Civilian and Industrial Technology/MatTec/Task Group on Structural Ceramics met on May 11, 1994. It's membership consists of representatives from 23 Federal program funding offices from six Federal agencies. It is chaired by Bob Gottschall, Office of Basic Energy Sciences/Materials Sciences Division. This meeting was designed to dovetail with the Interagency Coordinating Committee on Structural Ceramics, which has the identical membership and always meets on the preceding day.

The funding levels for nonclassified research in structural ceramics are as follows:

Funding in $M

	FY 1993	FY 1994	FY 1995
Total Federal	137	145	126
Total DOE	57	62	61
Basic Energy Sciences	11	12	12

The term structural ceramics refers to those ceramics which are intended for mechanical load bearing applications at temperatures in excess of 1000 degrees Celsius. The principal applications for such materials include various turbine and other propulsion (including automotive) components, high speed machine cutting tools and high temperature heat exchangers. Thus

structural ceramics are of critical importance to the power, propulsion, chemical processing and other industries as well as to the unique and discrete missions of different agencies.

The agenda for these meetings consisted of a program overview from each program office identifying their programmatic mission; mission need for structural ceramics; principal performers, customers and stakeholders; recent accomplishments; technological barriers; and facilities or resources that may be shared amongst different agencies. Other agenda items focused on improving the interaction and cooperation amongst these 23 Federal program offices with their multivarious missions, and mechanisms for expanding the already intense interactions that these programs have with the private industrial sector. The latter includes workshops, open-style agency contractor reviews; professional society and trade association meetings, committee and publications activities; multi-institutional personnel interchanges; round-robin sample evaluations; Cooperative Research and Development Agreements and industrial participation in national laboratory and proposal review and evaluation procedures.

A synopsis report of this activity will be published and sent to interested industrial and other organizations. These meetings were closed to non-government personnel because multi-agency coordinated planning requires discussion of future plans beyond the last public President's Budget and contemplated Requests for Proposals for which federal procurement requirements prohibit "leaking" information to non-government individuals or organizations.

Materials Sciences Division Involvement with Customers from Aerospace Industry

The Aerospace Manufacturing and Materials Group which is under the National Science and Technology Council/Council on Civilian and Industrial Technology/MatTec is sponsoring a workshop on May 18-19. It is expected that industrial customers will identify research needs and opportunities that relate to aerospace manufacturing and materials sub- and supersonic air frames and propulsion systems. The Basic Energy Sciences program sponsors research in topics such as corrosion, welding, non-destructive evaluation, robotics, high-strength light-weight alloys, heat resistant engine materials, and ceramic matrix composites that are of critical concern to the aerospace industry. Dr. Otto Buck of the Office of Basic Energy Sciences will participate in the workshop. It is our understanding that the deliberations of this workshop are intended to provide input to the FY 1996 budget process.

To complete preparations for the government/industry workshop on May 18-19, a coordination meeting of the Aeronautics Materials and Manufacturing Technology Interagency Working Group was held on May 9, 1994, at the National Aeronautics and Space Administration Headquarters.

Agencies Integrate Geosciences Programs at the Advanced Photon Source

The Office of Basic Energy Sciences (BES)/Geosciences program and the National Science Foundation (NSF)/Earth Sciences Division completed an on-site review of proposed research and beamline instrumentation at the Advanced Photon Source (APS) on April 4th and 5th. Both organizations have complementary proposals before them to provide support for instrumentation of two beam-lines in one sector of APS. The proposals have been submitted through the University of Chicago representing the Geosciences, Soil Sciences, and Environmental Sciences components of CARS (the Consortium for Advanced Radiation Sources). The consortium involves four Illinois Universities and User Groups from these disciplines in addition to Materials Sciences, Chemistry, and Biology.

The presentations and the proposals were highly regarded by the NSF program panel and BES/Geosciences. Although final approval has not been obtained, preliminary commitments of

$5.5-6.0 million from NSF and $3.0 million from BES/Geosciences have been provided for the initial 5 year period. Additional funding is being sought from the Keck Foundation and the Department of Agriculture, both of whom were represented at the review.

It is recognized by both the NSF and the BES/Geosciences programs that the high intensity light in the X-ray region at the APS will enable scientists to address a new series of questions in the earth, soil and environmental sciences. Interests by NSF in High Pressure research complement our interests in mineral-fluid interactions at the atomic scale, while developments in time-resolved x-ray diffraction, spectroscopy at high spatial resolution, and microtomography will advance the field as a whole. We are currently supporting research using synchrotron related research at SSRL and NSLS by investigators at Stanford University, Argonne National Laboratory, and Brookhaven National Laboratory.

National Academy of Engineering Holds Forum on Environmental Technologies

Robert Frosch and Robert White cochaired a Forum of the National Academy of Engineering on March 18, 1994, which covered discussion of Academy workshops on environmental regulations, industrial ecosystems, and U.S./Japan perspectives on industrial ecology. The Forum, attended by a cross-section of industry, White House, Congressional, university, media, and international representatives, reinforced the importance of environmental research for the development of new environmental technologies. Fred Koomanoff attended the forum.

Interagency Working Group on Aeronautics Materials and Manufacturing Technology

The next meeting of the Aeronautics Materials and Manufacturing Technology Interagency Working Group will be held on March 23, 1994, at NASA Headquarters. As reported previously the group convened on March 9, 1994. The major topic of the upcoming meeting will be a crosscut of materials and manufacturing projects. The Office of Basic Energy Sciences will be represented by Dr. Otto Buck from the Division of Materials Sciences.

Metal Casting Research Being Inventoried

The National Science and Technology Council's Council on Civilian and Industrial Technology is assembling an inventory on federally supported research in metal casting, and will sponsor a workshop on that subject through the Rand Corporation's Critical Technologies Institute (Christopher T. Hill). Basic Energy Sciences research activities related to metal casting amounting to $1.28 million for fiscal year 1994 were submitted for the inventory. Bob Gottschall will represent the Office of Basic Energy Sciences at the workshop entitled "U.S. Metal Casting: Technical Priorities and Strategies,"on March 29-30, 1994, in Cleveland, Ohio. The purpose of the workshop is to identify technical challenges and opportunities in metal casting. Priorities and mechanisms for improved program coordination and allocation of the research and development resources will also be discussed. A goal of the workshop is to improve future cooperative research, technology development, and technology transfer activities involving government and industry, universities, and other institutions.

Interagency Working Group Established on March 9, 1994 for Aeronautics Materials and Manufacturing

The Steering Committee of the Aeronautics Materials and Manufacturing Technology Interagency Working Group held an organizational meeting on March 9, 1994, at NASA Headquarters. Presently reporting to the Civilian Industrial Technology Committee, the objective of the Aeronautics Materials and Manufacturing Technology Interagency Working Group is to establish

national goals concerning support of aerospace industry, mainly for air frame and propulsion systems. The committee, chaired by Steve Moran (NASA) will generate a strategic plan, based on industrial needs, by September, 1994. Most likely, materials processing will be on of the major topics for the committee. The Department of Energy was represented by Rick Peavy (Defense Programs), Sid Diamond (Energy Efficiency and Renewable Energy), and Otto Buck (Division of Materials Sciences/Office of Basic Energy Sciences).

Roundtable on World Automotive Marketplace to Meet at Department of Commerce

The Departments of Commerce, Energy, and the Bureau of Mines are sponsors of the Roundtable on World Automotive Marketplace to be held at the Department of Commerce Auditorium on March 22, 1994. Basic Energy Sciences will be represented by Drs. Robert J. Gottschall (Division of Materials Sciences), William H. Kirchhoff (Chemical Sciences Division, and Walter M. Polansky (Advanced Energy Projects).

Materials Subcommittee Holds First Meeting

The newly formed Materials Subcommittee, designated Mat Tec (nee COMAT), of the Council on Civilian Industrial Technology which is under the National Science and Technology Council met on February 24, 1994. The main agenda item was to draft a charter which will be submitted to the Civilian Industrial Technology. DOE was represented by Bob Gottschall, Office of Basic Energy Sciences/Division of Materials Sciences and Rick Peavy (Defense Programs/Technology Transfer).

Federal Interagency Chemistry Representatives Meeting Held

The annual meeting of the Federal Interagency Chemistry Representatives was hosted by the National Science Foundation on February 9, 1994. This is a group consisting of representatives from all Federal Agencies that support basic research in chemistry and the chemical sciences, and has been meeting for more than twenty years. The purpose of the group is to provide information about and coordination between chemistry programs government wide. Meeting attendees usually include representatives from the National Science Foundation, Department of Energy, National Institutes of Health, and the Department of Defense agencies. Other agencies including the Environmental Protection Agency, the National Aeronautics and Space Administration, and the Department of Agriculture occasionally send representatives as do some non-Federal organizations such as the Petroleum Research Fund of the American Chemical Society. The Office of Basic Energy Sciences was represented by Dr. Robert S. Marianelli of the Division of Chemical Sciences and Dr. Richard Kelley of the Division of Material Sciences. The Office of Health and Environmental Research was represented by Dr. Rowland Hirsch of the Medical Application and Biophysical Research Division.

Interagency Materials Technology Subcommittee to Hold First Meeting

The Materials Technology Subcommittee of the Committee on Civilian Industrial Technology (CIT) of the National Science and Technology Council (NSTC) is scheduled to meet on February 15, 1994. The intent of this first meeting of this newly formed group is to chart its activities in the context of CIT's objectives and the needs for interagency planning and coordination in materials research and development. It is intended to follow directions to be issued by the CIT at its forthcoming meeting of February 9, 1994. The Department of Energy will be represented at this Materials Technology Subcommittee by Bill Oosterhuis and Bob Gottschall of the Office of Basic Energy Sciences/ Division of Materials Sciences.

Interagency Coordination of User Programs at Large User Facilities

Bill Oosterhuis of the Office of Basic Energy Sciences/Division of Materials Sciences and Roland Hirsch of the Office of Health and Environmental Research participated in an informal, interagency meeting at the National Institute for Health on January 13, 1994. It was held for the purpose of coordinating research activities sponsored by the Department of Energy, the National Institute for Health, and the National Science Foundation, which depend on large user facilities. Information concerning the operations or construction status of the various neutron and synchrotron radiation sources and high magnetic field NMR was shared among the agency representatives.

The Office of Basic Energy Sciences will be represented by Dr. John Mundy at the 18th Annual Cocoa Beach Conference on Composites, Materials and Structures

The annual conference at Cocoa Beach, January 9-14, 1994, provides an exceptional arena for the many research groups funded by various government departments (Energy, Defense, and the National Aeronautics and Space Administration) to discuss research progress in the processing, structural analysis, and physical properties of both metal and ceramic matrix composites. The Office of Basic Energy Sciences/Materials Sciences Division programs provided some of the initial insight into the value of metal and ceramic matrix composites for their high temperature structural properties. John Mundy's participation is important in maintaining the bridge between Materials Science Research programs designed to establish basic understanding and the successful application of these composite materials in high temperature industrial processes and the significant energy savings that ensue.

Organization for Economic Cooperation and Development's Megascience Forum: Expert Meeting on Synchrotron Radiation Sources and Neutron Beams

This meeting was held at the Riso National Laboratory, Foskilde, Denmark, on November 29 through December 1, 1993. The purpose of the meeting was to review the current and future scientific challenges of synchrotron radiation and neutron beam research; the size and structure of research using multipurpose synchrotron radiation and neutron sources from a worldwide perspective and their importance to the fields of physics, chemistry, biology, and medicine; the extent, strength, and weaknesses of existing cooperation mechanisms with regard to the conception, design, construction, and operation of these facilities; the projects being proposed or envisaged in relation to existing and approved projects; and specific policy issues related to the construction, operation, and use of multipurpose facilities. The U.S. delegation consisted of Iran L. Thomas (Department of Energy), Bill R. Appleton (Oak Ridge National Laboratory), Martin Blume (Brookhaven National Laboratory), David Huber (University of Wisconsin), Loretta Inglehart (National Science Foundation), Charles Coulter (National Institutes of Health), and David Moncton (Argonne National Laboratory). Frank Murray and Katherine Van Sickle (House Committee on Science, Space and Technology staff) attended as observers.

The first two days of the meeting included talks describing almost every neutron source and synchrotron in the world, proposed facilities and recommendations. Iran Thomas gave the U.S. talk which consisted of a description of the U.S. sources; extent of foreign use of them; and the U.S. recommendations on access to facilities based on merit, on collaboration on design, construction, and research on beam line instrumentation, on building specialized beamlines jointly, and on reciprocal access to complementary neutron facilities.

On Wednesday, there was a discussion a draft report on the meeting. In the end, the draft report contained the U.S. position with one exception. The U.S. recommended a separate meeting on more extensive collaborations on neutron sources. There was support for such a meeting from

some of the smaller European countries, but the larger ones were not enthusiastic. Probably because Europe still does not have a conceptual design and does not know how much their spallation source will cost. After the discussion of the report, the participants visited the neutron scattering facilities at the Riso reactor. The facility is open to users based on the merit of their proposals with no charge for the neutrons. AT&T Bell Laboratories has an experimental station off the cold-neutron guide.

On the whole it was a useful meeting. The participants clarified the issue of access to major facilities based on merit and established principles for collaboration. It was difficult for the Europeans to act as a single community, yet, they lead the world in both synchrotrons and neutron sources. They built the European Synchrotron Radiation Source in record time and provided the funds to fully instrument it; they are essentially building a new reactor at the Institute Laue-Langevin; an they have the world's best spallation source.

Mechanics of Materials Interfaces Subject of Symposium

Dr. Subhendu K. Datta, Office of Basic Energy Sciences/Division of Engineering and Geosciences, was the co-organizer (with Professor S. Rokhlin, Ohio State University, and Dr. Y. D. S. Rajapakse, Office of Naval Research) of a symposium entitled "Ultrasonic Characterization and Mechanics of Interfaces" at the Winter Annual Meeting of the American Society of Mechanical Engineers (ASME), New Orleans, November 28 - December 3, 1993. The symposium brought together researchers from the materials science and mechanics communities to discuss recent advances in ultrasonic interface characterization and interface mechanics. The proceedings of the symposium has been published as a bound volume by the ASME Press.

Technology Transfer Awards and Recognition

Pollution Prevention Award Goes to Argonne National Laboratory Spinoff Company

Eichrom Industries, Inc., a spin-off company of a basic research program under the sponsorship of the Division of Chemical Sciences, Office of Basic Energy Sciences, was awarded the Eighth Annual Governor's Pollution Prevention Award of the State of Illinois for 1994. These awards are presented to honor businesses and other organizations in Illinois that have successfully reduced both the generation of wastes and the use of toxic chemicals. Eichrom was cited for delivering innovative and cost-effective metals separations products for analytical, process, recycling, and decontamination applications world-wide. Specifically, Eichrom has developed several different types of what has been named "Spec" resins as an alternative method to the three common analytical methods (precipitation, solvent extraction, and ion exchange) used to determine the levels of radioactivity and other pollution metals in the environment. The technology is based on discoveries that were made possible by fundamental research supported by the Division of Chemical Sciences and development supported by the Division of Advanced Energy Projects.

Chemist Receives Prestigious R&D 100 Award

Dr. E. Phillip Horwitz, Chemistry Division, Argonne National Laboratory, recently won an R&D 100 Award for the synthesis of DiPhonix Ion Exchange Resin, a new chelating ion-exchange resin used for the removal of radioactive and hazardous metal ions from aqueous solutions and organic solvents. Dr. Horwitz's research is supported by the Office of Basic Energy Sciences/Division of Chemical Sciences. This synthesis represents a major breakthrough in the design of a versatile resin with a wide range of applications that can be produced on the plant scale at reasonable cost.

This achievement will be further recognized by the presentation of an Argonne National Laboratory Pacesetter Award.

BES Investigators to Receive Columbus Award

Gregory J. Yurek, Founder, President and Chief Executive Officer, and John VanderSande, Founder and Board Member of American Superconductor Corporation, are winners of the Massachusetts Columbus Award. Both were investigators on a Basic Energy Sciences/Materials Sciences grant to Massachusetts Institute of Technology that was important to the development of American Superconductor's metallic precursor process for the manufacturing of high temperature superconductor wires. VanderSande is currently supported by Materials Sciences.

The Columbus Award recognizes their pioneering inventions and innovations in the area of high temperature superconductivity. A special ceremony and reception will be held on October 12, 1994, at the Massachusetts State House in their honor and at the time they will be presented with a $5,000 cash prize and a specially minted silver medal. The Columbus Award has been established as part of the state's commemoration of the 500th anniversary of the explorer's historic voyages. The award honors the spirit of discovery embodied by Columbus.

SBIR Funding Awarded to American Superconductor

The American Superconductor Corporation (NASDAQ:AMSC), announced on July 14, 1994, that it received a $600,000 Phase II Small Business Innovation Research award from the Department of Energy. American Superconductor, a company spun out from Massachusetts Institute of Technology in 1987, was founded independent of federal financing, yet the development of one of the company's core wire manufacturing technologies was supported directly by an Office of Basic Energy Sciences grant to the founders at the Massachusetts Institute of Technology.

The company will use the Small Business Innovation Research funding to enhance its processes for the fabrication of high temperature superconductors wires for commercial applications. The high temperature superconductor wires, which transmit electricity with no electrical losses, are being developed to produce more efficient electrical equipment including underground power transmission cables, large electrical motors, transformers and generators. This equipment will result in the more efficient use of electric power.

Press Coverage for Argonne National Laboratory Accomplishment

Several newspapers, including the Waste Tech News from Denver, Colorado, and some local Illinois papers, have reported on the waste treatment applications of the Diphonix ion exchange resin developed at Argonne National Laboratory and Eichrom Industries, Inc. of Darian, Illinois. The applications cited are the treatment of wastes containing both radioactive and chemical materials (mixed wastes) in which the radioactive component is cleanly separated - sometimes to below drinking water levels - for less cost and more efficient handling or disposal. Office of Basic Energy Sciences support for the fundamental research and development of the Diphonix ion exchange resin was provided by the Office of Basic Energy Sciences/Divisions of Chemical Sciences and Advanced Energy Projects.

1994 R&D 100 Award for Development of Interfacial Force Microscope

On June 3, 1994, R&D Magazine announced that Sandia National Laboratories/New Mexico had been selected as one of the 1994 winners of the R&D 100 Award. The R&D 100 Awards recognize the 100 most technologically significant new products of the year. Dr. J. E. Houston of

Sandia will be recognized for the development of the interfacial force microscope at an Awards Banquet to be held in Chicago on September 22, 1994. Dr. Houston developed the interfacial force microscope as part of an Office of Basic Energy Sciences/Materials Sciences program on the "Fundamental Science of Adhesions" to improve the ability to measure interatomic force distance relationships for atoms at the surface of a material. This instrument can measure the force required to break the bond in a single molecule and can measure the distance to within a single atomic diameter.

A Cooperative Research and Development Agreement has been established between Sandia, Digital Instruments, AT&T and the University of New Mexico to develop a commercial instrument base on Dr. Houston's discovery. Through the sophisticated technology of Sandia's Microelectronics Development Laboratory, semiconductor processing methods are being developed to microengineer the interfacial force microscope on a chip.

Joseph Greene Honored with the 1993 Semiconductor Research Corporation Technical Excellence Award

Professor Joseph E. Greene has been awarded the 1993 Semiconductor Research Corporation Technical Excellence Award for "outstanding research contributions in the development of low energy accelerated ion doping during MBE Si and Si_xGe_{1-x} film growth." This award is given by the Board of Directors of the Semiconductor Research Corporation based on the impact this DOE-supported research has had, and is expected to have, on the U.S. semiconductor industry. Professor Greene's research is funded by the Office of Basic Energy Sciences/Materials Sciences at the Frederick Seitz Materials Research Laboratory at the University of Illinois. Professor Greene had been separately elected to the Governing Board of the American Institute of Physics and as a Fellow of the American Vacuum Society.

Jointly Funded Chemist Wins Award for Automotive Advances

Lawrence Livermore National Laboratory scientist, Dr. Charles K. Westbrook, has won this year's "Midgley Award". The award, sponsored by the Detroit Section of the American Chemical Society in cooperation with Ethyl Corporation, is given each year for outstanding research contributions in the field of chemistry related to the automotive industries. The late Thomas Midgley, Jr., was an Ethyl vice president noted for his creative, far-seeing research. The citation for Dr. Westbrook, whose research is jointly supported by the Chemistry Division of the Office of Basic Energy Sciences and the Office of Transportation Technologies of the Office of Energy Efficiency and Renewable Energy, states: "In his collaborative work with Ford Motor Company, Dr. Westbrook established that flame quenching on cold engine chamber walls was not the dominant source of unburned hydrocarbon emissions from automotive engines, leading to a better recognition of the role of piston ring crevices. His work also influenced the design of direct-injected stratified charge engines. His more recent research has shown how fuel size and structure influence knock tendency and how different antiknock compounds alter those trends."

1994 Federal Laboratory Consortium Awards to David Jiles from Ames Laboratory and Alexander Pines from Lawrence Berkeley Laboratory

Two of the 1994 Federal Laboratory Consortium Awards will be given to Drs. David Jiles, Ames Laboratory and Alexander Pines, Lawrence Berkeley Laboratory. The basic research leading to these technology transfers was supported by the Division of Materials Sciences/Office of Basic Energy Sciences (Dr. Pines, 100 percent; Dr. Jiles, 30 percent. The awards will be presented at the Spring Meeting of the Consortium April 11-14, 1994, in Kansas City, Missouri.

The award citations read as follows:

- David C. Jiles, Ames Laboratory, "for unusual devotion and effort in transferring a new magnetic inspection system to the transportation and public utility industries."

- Alexander Pines, Lawrence Berkeley Laboratory, "for conception, transfer to industry, and implementation-in-place of Double Rotation Solid-State Nuclear Magnetic Resonance programs, which will benefit numerous industries with high resolution analytical instrumentation."

Peer Review Activities

Annual Energy Biosciences Review Panel Meeting

The annual ad hoc Office of Basic Energy Sciences/Energy Biosciences Division panel meeting used to peer review the quality research applications will be held in Annapolis, Maryland, December 8-11, 1994. Each of the panel reviewers provides independent reviews of some of the applications in addition to the mail reviews already received. Some 17 panelists representing different topic areas will be on the panel. They are selected for their expertise in particular subjects that are being covered. With these multiple independent peer reviews for each of the applications it is feasible to make a judgement on the part of the staff as to which of the applications are of highest quality. This year some 118 applications, both new ones and renewals, will be considered at the panel meeting after a prior selection for quality based on mail reviews out of a larger number submitted.

Materials Sciences to Conduct Laboratory Management Reviews

The Office of Basic Energy Sciences/Materials Sciences program has scheduled its annual late winter Management Reviews for 14 institutions that it funds under a Financial Plan. The agenda for these meetings will relate to strategic planning activities in support of the forthcoming FY 1997 budget process for the Division of Materials Sciences. The meetings frequently will include programmatic and institutional issues. Typical agenda items include overall goals of the Materials Sciences program; coordination of Materials Sciences programs with other DOE funded programs; program directions; laboratory management structure and changes; recent past, on-going, or future program and peer reviews; user facility issues; construction and construction project R&D issues; capital equipment needs; etc.

Materials Sciences has invited program personnel from other offices within Energy Research, Environmental Restoration and Waste Management, Fossil Energy, Defense Program and Energy Efficiency and Renewable Energy to participate in these Management Reviews.

All of these Management Reviews will take place in Conference Room E-301, GTN. Their schedule is as follows:

Laboratory	Date	Time
SSRL	February 7	10:00 - 11:00
LANL	February 8	9:00 - 11:00
LBL	February 10	9:00 - 12:00
ANL	February 21	1:00 - 4:00
LLNL	February 22	9:00 - 11:00
SNL/A&L	March 1	9:00 - 12:00
NREL	March 1	1:00 - 2:00
INEL	March 2	9:00 - 10:00
Illinois	March 6	1:30 - 3:30
Ames	March 8	9:00 - 11:00
PNL	March 9	10:00 - 12:00
BNL	March 13	10:30 - 3:30
ORNL	March 14	1:00 - 4:00

Chemical Sciences Division Reviews Programs at Argonne

An on-site review of programs supported by the Chemicals Sciences Division of the Office of Basic Energy Sciences was held, at Argonne, the week of November 14, 1994. Programs in heavy element chemistry, natural and artificial photosynthesis, and photoelectron spectroscopy of reactive species were examined by Gerald Babcock (Michigan State), Tom Baer (North Carolina), Don Bryant (Penn State), Roger McFarlane (IBM), Fred Richardson (Virginia), and Peter Wolynes (Illinois). The Chemical Sciences division was represented by Harry Dewey, Mary Gress and Allan Laufer. Lab reviews are on a three year cycle and the review covered about one-third of the existing program in the Chemistry Division. External reviewers provide insight into the timeliness and quality of research supported at the national laboratories and their candid comments are quite useful to lab management and the Department of Energy staff.

Accelerator Readiness Review at the Notre Dame Radiation Laboratory (NDRL)

In preparation for the installation and commissioning of a new 8-MeV linear electron accelerator for chemical reaction kinetics experiments, an Accelerator Readiness Review Team has been organized by Notre Dame University to comply with the requirements of DOE Order 5480.25. The team, chaired by the University's Research Programs Director, consists of nuclear physicists from the University Physics Department, the Director of University Risk Management, and two experts from Argonne National Laboratory. Dr. Albert E. Evans of the Office of Basic Energy Sciences and Mr. Jeffrey C. Dooling of the Chicago Operations Office attended the initial meeting of the Review Team at Notre Dame University on November 18, 1994. The accelerator is expected to be ready for routine operation by March 1, 1995.

Chemical Sciences Peer Review Held at Brookhaven National Laboratory

From Tuesday evening, October 25 through midday Friday, October 28, principal investigators in the Chemistry Department at Brookhaven National Laboratory (BNL) conducting theoretical and experimental research in chemical physics related to combustion were reviewed by three outside reviewers, two from universities (University of Pennsylvania and the University of Maryland) and one from Sandia National Laboratories, California. Each of the individual reviewers will submit a written report to the Department of Energy. Representing the Department of Energy and participating in all sessions between the reviewers, the principal investigators, and BNL management were three staff members from Energy Research, two from the Office of Basic Energy Sciences/Chemical Sciences Division (Allan Laufer and William Kirchhoff), and one from the Science and Technology Affairs Staff (Thomas York). The reviewers heard presentations from each of the BNL principal investigators being reviewed, visited their laboratories, and carried out extended discussions lasting several hours on their research accomplishments and plans. The purpose of the review is to provide guidance to BNL and DOE management and to the scientific staff on the scientific quality of their programs. Following the review, the Department of Energy and BNL management met to discuss the review and develop issues at the Department. The Brookhaven National Laboratory Chemistry Department program in chemical physics was last reviewed in 1991 and will be reviewed again in 1997.

Materials Sciences Program at Ames Laboratory Peer Reviewed

The Basic Energy Sciences/Materials Sciences program at the Ames Laboratory underwent its Annual External Peer Review on October 18-19, 1994. Each of the seven external peer reviewers provided an individual written report and a verbal debriefing to the Materials Sciences staff. The identification and program responsibility of the nine peer reviewers are:

Condensed Matter Physics:	Dr. John R. Smith, General Motors Dr. Bertram Batlogg, AT&T Bell Labs
Materials Chemistry:	Prof. Clifford Myers, State Univ. of NY Prof. Richard McCreery, Ohio State University
Metallurgy & Ceramics:	Prof. Alan Lawley, Drexel University Dr. K. S. Narasimhan, Hoeganaes Corporation Dr. C. L. Fu, Oak Ridge National Laboratory

Each individual Materials Sciences project at the Ames Laboratory is subjected to a rigorous and comprehensive external peer review at least once every three years. All Materials Sciences projects at the Ames Laboratory, however, are subjected to oversight by external peer review on an annual basis.

Chemical Sciences Review at Brookhaven National Laboratory

Each year, the Chemical Sciences Division of the Office of Basic Energy Sciences reviews its programs at each of the national laboratories. The purpose of these reviews is to seek the opinion of outside peers on the quality of the science performed with support from the Chemical Sciences Division and, where performance can be improved, to provide laboratory management with such guidance. The reviews are staged such that every principal investigator at every laboratory is reviewed at least once every three years. The reviews are held indepth with the external reviewers typically spending two days listening to presentations by a half dozen principal investigators and visiting their laboratories for lengthy informal discussions. The independent experts are drawn from universities, national laboratories, and industry and are selected for their expertise in the fields of research represented by the principal investigators. From Tuesday evening, October 25, through midday on Friday, October 28, 1994, principal investigators in the Chemistry Department at Brookhaven National Laboratory conducting theoretical and experimental research in combustion-related chemical physics will be reviewed by three reviewers, two from universities (University of Pennsylvania and the University of Maryland) and one from Sandia National Laboratories, California. Representing the Department of Energy and participating in all sessions between the reviewers and the principal investigators will be two staff members of the Chemical Sciences Division (Allan Laufer and William Kirchhoff), and one observer from the Office of Energy Research (Thomas York). Following the meeting, each of the individual reviewers will submit a report of his or her findings to the Department of Energy.

Reviews of the Solid State Physics and Materials Chemistry Programs at Los Alamos and Sandia National Laboratories

Reviews of the Solid State Physics and Materials Chemistry programs at Los Alamos and Sandia National Laboratories/Albuquerque were held during the week of September 12-16, 1994, at Los Alamos and Sandia. Participating in the review were members of the Basic Energy Sciences/Division of Materials Sciences staff, with detailees and outside consultants peers.

The review of Solid State Physics and Materials Chemistry projects at Los Alamos took place on September 12-13, 1994. The quality of these projects was seen to range from very good to excellent or outstanding. In particular, the research by Zach Fisk in developing new superconductors and other fascinating materials is seen as a real strength. The work by Greg Swift and Bob Ecke in understanding nonlinear dynamics, pattern formation, and novel engines, regenerators, and refrigerators is simply outstanding.

The review at LANSCE was entirely on the research carried out at LANSCE. The LANL plans for LANSCE and the opportunities presented by LANSCE were described. It is clear that if LANSCE operated reliably, that much significant science can be accomplished there. Much of the science by the scientific staff is outstanding. An unusual opportunity arises because of the LANL participation in the National High Magnetic Field Laboratory sponsored by the National Science Foundation. Pulsed magnetic fields produced at LANL used in conjunction with pulsed neutron beams opens up a new field of high magnetic field research using neutron scattering.

The review of Solid State Physics and Materials Chemistry projects at Sandia National Laboratories (SNL) took place on September 14-15, 1994. Each of these projects exhibited outstanding science, and it was clear that Division of Materials Sciences/Basic Energy Sciences support was critical to other support for specific applications of these activities. The work on CVD sciences is world class, and has been of immediate use to the semiconductor industry. The inverse micelle synthesis is also world class and we probably don't know the full potential of this synthesis technique yet.

Bill Oosterhuis toured the Center for Microelectronics Technologies, the Contamination-Free Manufacturing Research Center, and the Compound Semiconductor Research Laboratory on September 16, 1994. These are outstanding facilities with a variety of activities underway with support from Defense Programs (much of it based on results from BES-supported research) in conjunction with SEMATECH. SNL has a $100M CRADA with SEMATECH over five years. The capability that exists here to bridge the gap between the innovative, high-risk concepts from universities, and to translate these concepts into prototype devices is clearly something that is extremely valuable to the nation, as the electronics industry draws away from fundamental research due to competitive pressures. The Department has an outstanding opportunity to provide leadership in R&D for electronics, and will most likely develop tools which uncover new fundamental science.

Basic Energy Sciences Advisory Committee Meeting

The next meeting of the Basic Energy Sciences Advisory Committee is scheduled for October 20-21, 1994, in Room 1E-245 of the Forrestal Building. Discussions will focus on modifications in the design of the Advanced Neutron Source, panel on return on the taxpayers' investment in the basic energy sciences program, panel on priorities of support for major user facilities, and the identification of members to serve on panel to review accelerator Research.

Materials Sciences Program at Ames Laboratory to be Peer Reviewed

The Basic Energy Sciences/Materials Sciences program at the Ames Laboratory will undergo its Annual External Peer Review on October 18-19, 1994. The composition and program responsibility of their nine person peer review committee are:

Condensed Matter Physics	Materials Chemistry
Dr. John R. Smith General Motors	Professor Clifford Myers State University of New York
Dr. Bertram Batlogg AT&T Bell Labs	Professor Richard McCreery Ohio State University

Metallurgy & Ceramics

Professor Alan Lawley
Drexel University

Dr. K. S. Narasimhan
Hoeganaes Corporation

Dr. C. L. Fu
Oak Ridge National Laboratory

Peer Review at Los Alamos National Laboratory and Sandia National Laboratories/Albuquerque

The Solid State Physics and Materials Chemistry Branch from the Office of Basic Energy Sciences will review the projects it supports at the Los Alamos National Laboratory on September 12-13, 1994, and at Sandia National Laboratories/ Albuquerque on September 14-15, 1994. The review committee will consist of members of the Branch and will be augmented by expert consultants from universities, other federal agencies, and industry. These reviews will focus on the science that is being done, the opportunities for new investigators, the facilities available to the researchers to enable them to accomplish their tasks, and the people available to do the work.

Division of Chemical Sciences Programs Reviewed at Oak Ridge National Laboratory

On July 19 and 20, 1994, the operations of the High Flux Isotope Reactor and the Radiochemical Engineering Development Center in the Research Reactor Division and the Chemical Technology Division, respectively, of the Oak Ridge National Laboratory were reviewed. These reviews are conducted semi-annually by the Office of Basic Energy Sciences and the Facilities Division of the Office of Nuclear Energy as the Energy Research nuclear facilities managing office. All aspects of the operation of both facilities were discussed. This includes the services to users, in-pool and dry storage and shipping of the spent fuel elements, major maintenance items and upgrades, safety surveillance of the pressure vessel, new processing and waste handling equipment, the californium-252 and Savannah River target processing programs funded by Defense Programs, and budget constraints. Issues of concern are the storage and shipping of spent fuel, new and major costs of maintenance items and safety inspection and testing, future of the californium program as Defense Programs cuts back its activities, and operating problems resulting from multi-year flat budgets. A second Californium-252 Users Workshop is planned for April 1995 to highlight the increasing applications of this unique isotope in the medical and industrial communities.

Chemical Sciences Programs Reviewed at Oak Ridge National Laboratory

On April 25-27, 1994, two research programs in the Division of Chemical and Analytical Sciences of the Oak Ridge National Laboratory supported by the Chemical Sciences Division, Office of Basic Energy Sciences, were reviewed. These reviews are conducted annually and bring together Department of Energy and Oak Ridge National Laboratory management with reviewers chosen for their scientific expertise to assess the quality of programs supported by the Chemical Sciences Division and their relevance to the mission of the Department. Each year different aspects of the program are reviewed such that the programs of every principle investigator are reviewed on about a three-year cycle. The emphasis this year was on chemical separations and aqueous chemistry at elevated temperature and pressure. The three reviewers were drawn from academic institutions and from the consultant community for the electric power industry. The reviewed programs were found to be of the highest quality.

Basic Energy Sciences Advisory Committee Meeting

The Basic Energy Sciences Advisory Committee (BESAC) will meet in Washington, D.C., on April 14-15, 1994, in Room 6E-069 of the Forrestal Building. The Committee's agenda will include: a brief summary and discussion of the review activities of Ames Laboratory, Pacific Northwest Laboratory, Sandia National Laboratories, and Los Alamos National Laboratory that were conducted at the previous meeting in Albuquerque; a review of the status of the Combustion Research Facility; and, the initiation of an independent study to assess the overall effectiveness of the Basic Energy Sciences (BES) program. The Director of Energy Research, Dr. Martha Krebs, will attend the meeting to update the Committee on recent policy and planning developments within the Department, and within Energy Research, which will provide the framework for BESAC's study on how the Nation has received a return on the taxpayers' investment in the BES program, and on considering the future role of the BES program.

Chemical Sciences Reviews Programs at Pacific Northwest Laboratory

A review of Chemical Sciences Programs at the Pacific Northwest Laboratory was held on the week of February 14-18 at the laboratory. The programs under review included fundamental, experimental and theoretical research on cluster and solution chemistry related to waste remediation and environmental restoration, and on the thermochemistry of organic heterocyclic compounds related to coal chemistry. Reviewers included program managers from the Office of Basic Energy Sciences/Chemical Sciences Division as well as scientists active in the reviewed fields from Argonne National Laboratory, Oak Ridge National Laboratory, University of California at Los Angeles, University of Pittsburgh and Brown University. The review consisted of presentations by principal investigators and extensive informal discussions and, where appropriate, laboratory visits. Overall, the programs were found to be of high quality and in the few instances where weaknesses were identified, the Department of Energy and laboratory management were able to discuss corrective action. An important feature of this review is that the Department of Energy and laboratory management hear the reviewers observations together and can, therefore, work more easily together in strengthening the programs and developing plans for the future. Above and beyond this however, it is always rewarding to the programs to hear enthusiastic researchers discussing their work.

Four Laboratories Reviewed by the Basic Energy Sciences Advisory Committee

The Basic Energy Sciences Advisory Committee (BESAC) met at the Albuquerque Hilton, Albuquerque, New Mexico on February 24-25, 1994. The agenda included: presentations of Basic Energy Sciences program activities at Ames Laboratory, Pacific Northwest Laboratory, Sandia National Laboratories and Los Alamos National Laboratory; review and discussion of answers submitted by these laboratories to questions regarding management practices, research facilities and the impact of research on U.S. industry. The Committee prepared a draft report of their review of the four laboratories and planned future BESAC activities. The next meeting will be in Washington, D.C., on April 14-15, 1994, and will initiate an independent study to assess the effectiveness of the Basic Energy Sciences program in providing the Nation with a return on its investment.

Materials Sciences to Conduct Laboratory Management Reviews

The Office of Basic Energy Sciences/Materials Sciences program has scheduled its annual spring Management Reviews for 14 institutions that it funds under a Financial Plan. The agenda for these meetings will relate to planning activities in support of the forthcoming fiscal year 1996 budget process for the Division of Materials Sciences. It will include programmatic and

institutional issues. Typical agenda items include overall goals of the Materials Sciences program; coordination of Materials Sciences programs with other DOE funded programs; program directions; laboratory management structure and changes; program review activities; summary of new laboratory initiatives; summary of facility issues; summary of construction and construction project research and development issues; capital equipment needs; etc.

The Division of Materials Sciences has invited program personnel from other offices within the Offices of Energy Research, Environmental Restoration and Waste Management, Fossil Energy, and Energy Efficiency and Renewable Energy to participate in these Management Reviews.

The schedule for these Management Reviews is as follows:

Laboratory	Date	Time	Location
Ames	Feb. 7	1:00-3:00	Comfort Inn (Continental Room)
LANL	Feb. 9	9:00-12:00	A-410
PNL	Feb. 11	9:00-11:00	E-301
Univ. of Illinois	Feb. 14	1:00-3:00	E-401
LBL	Feb. 16	9:00-12:00	E-301
ANL	Feb. 18	9:00-12:00	E-401
SSRL	Feb. 23	9:00-10:00	E-301
LLNL	Feb. 24	9:00-11:00	E-401
NREL	Feb. 25	9:00-10:00	E-401
SNL/A & SNL/L	March 8	8:30-11:00	E-301
BNL	March 11	10:30-3:00	E-301
ORNL	March 14	1:00-4:00	E-301
EG&G	March 15	9:00-10:00	A-400

Council on Materials Sciences Panel Discusses Electron Beam Microcharacterization

The Office of Basic Energy Sciences receives formal program advice from one officially chartered Advisory Committee. However, the Basic Energy Sciences subprograms have extensive working relationships with other Department of Energy program offices as well as stakeholders from industry and academia. One such working group, the Council on Materials Sciences, held its annual meeting with the Basic Energy Sciences/Materials Sciences staff and guests from other Department of Energy program offices on December 14-15, 1993.

The present Council membership consists of seven academicians, three from industry and one that is jointly from a Department of Energy Laboratory and a university. The Council is Chaired by Professor C. Peter Flynn (University of Illinois) and exercises its own choice of membership. Members typically hold three or four year terms and represent a diversity of disciplines, expertise and perspectives from the field of materials science and engineering ranging from fundamental to applied, including both "small science" and big user facility issues. This annual dialogue does much to keep the Division of Materials Sciences staff tuned in to the non-monolithic perspectives of a broad mix of our Customers and Stakeholders.

A principal activity of the Council has been to sponsor a series of scientific studies referred to as panels in which the participants (most generally not Council members) identify emerging and future generic research and instrumentation needs and opportunities, and publish scientific findings in refereed journals. Professor John Silcox (Cornell University) made a summary presentation of the panel that he chaired entitled "Panel Study on Electron Beam Microcharacterization." This topic includes electron beam imaging down to subatomic resolution (necessary to image anions in

technological ceramics, superconductors, etc.); environmental real-time electron beam microcharacterization necessary to characterize in-situ superconducting, magnetic, corrosive, semiconducting, stress-dependent, and high temperature behavior; and various techniques of close-to-atomic scale lateral spatial resolution of chemical and electronic bonding analyses.

The Division of Materials Sciences operates four user centers that provide the physical (non-life) science community access to the only such dedicated facilities in the United States. (The National Science Foundation is presently phasing out its support of the one such user center that it has operated.) There have been revolutionary advances in several subareas of electron beam microcharacterization over the past four years in the Netherlands, Japan, and Great Britain which are having a strong impact on the course of the physical sciences and technologies in Europe and Asia. The United States is not presently equipped to compete with these overseas advances partly because there is no manufacturer of such instrumentation in the United States. The panel study is continuing to assess such emerging developments in electron beam microcharacterization, and will publish its findings in a refereed journal.

The Council discussed its plans for a future panel on the epitaxial growth of complex crystals and several other potential new panel studies. The group also reviewed and commented upon the scientific and technical findings of eight staff-directed Materials Sciences workshops, some of which were jointly supported by Customers such as other Department of Energy program offices or by the Electric Power Research Institute.

Division of Chemical Sciences Programs Reviewed at Argonne National Laboratory

During the weeks of November 7 and November 14, 1993, programs in the Chemistry and Chemical Technology Divisions of the Argonne National Laboratory supported by the Office of Basic Energy Sciences/Chemical Sciences Division were reviewed. In addition, the atomic physics program in synchrotron-based research was evaluated on November 18-19. These reviews are conducted annually and bring together Department of Energy and Argonne National Laboratory management with reviewers chosen for their scientific expertise to assess the quality of programs supported by the Chemical Sciences Division and their relevance to the mission of the Department. Each year different aspects of the program are reviewed such that the programs of every principle investigator are reviewed on about a three year cycle. The emphasis this year was on chemical separations, certain aspects of auctioned science, homogeneous catalysis, cluster science, and radiation chemistry. The reviewers were drawn from academic institutions. Overall, the programs were found to be of high quality.

It was pointed out at the executive session that the separations chemistry program has obtained 13 patents over the past ten years, seven of which have been commercialized.

Programs in Chemical Sciences at Brookhaven National Laboratory Reviewed.

During the week of October 25-29, programs in the Departments of Chemistry and Applied Science at Brookhaven National Laboratory (BNL) supported by the Office of Basic Energy Sciences/Chemical Sciences Division were reviewed. These reviews are conducted annually and bring together Department of Energy and Brookhaven National Laboratory management with reviewers chosen for their scientific expertise to assess the quality of programs supported by the Chemical Sciences Division and their relevance to the mission of the Department. Each year, different aspects of the program are reviewed and the programs of every principal investigator are reviewed at least once every three years. The emphasis this year was on combustion related research in the Department of Applied Science and research on catalysis and electron transfer related to solar photochemical energy conversion in the Department of Chemistry. The reviewers

were drawn from academic institutions and from the Naval Research Laboratory. Overall, the programs were found to be of high quality and in the few instances where weaknesses were identified, Department of Energy and laboratory management were able to discuss corrective action. An important feature of this review is that Department of Energy and laboratory management hear the reviewers observations together and can therefore work together in strengthening the programs and developing plans for the future. Above and beyond this however, it is always rewarding to hear enthusiastic researchers discussing their work.

Workshops and Meetings

Meetings of Neutron Facility Steering Committees

As the Department considers its options for neutron beam science in the future, it has begun the process to develop a roadmap to enable the nation to have the capability commensurate with the scientific and technological opportunities that are apparent now and will be available in the future. These considerations are based in large part upon the recommendations of the Kohn Committee which strongly advocated the construction of the Advanced Neutron Source and the construction of an accelerator-based pulsed neutron source.

To this end, a Pulsed Source Steering Committee (PSSC) was formed and held its first meeting on December 5, 1994, at Crystal City. The PSSC is chaired by Gabriel Aeppli of Bell Laboratories. This Steering Committee was asked to develop the machine parameters which would meet the needs of the scientific community, and to help make the case for a pulsed source. The PSSC decided that it was important to develop a 'road map' to enable neutron-based science to get to the point where it would not be limited by the availability of neutrons to do the science. The PSSC will hold a number of workshops over the next 6 months on instrumentation, industrial uses, and spallation target technology in order to focus on the most important issues that need to be addressed.

Part of the urgency to develop a plan for a pulsed neutron source is the continuing uncertainty of the reactor-based Advanced Neutron Source which has not been approved as a construction project by Congress in each of the past two budget requests by the President.

The National Steering Committee for the Advanced Neutron Source (NSCANS), chaired by Frank Bates of the University of Minnesota, met on December 6 at Crystal City. NSCANS was updated on the state of the ANS design. Many very innovative changes have been developed to enable the ANS to meet the technical goals set by NSCANS using a lower enrichment (40-50%) uranium for fuel instead of the highly enriched uranium which is part of the original design for the ANS.

Council on Materials Sciences to Meet December 15-16, 1994

The Council on Materials Sciences is a diverse working group of experts drawn from the materials research disciplines amongst our customers and stakeholders. The Council offers high level expertise on scientific and technical topics of concern to the Division of Materials Sciences. It will hold its annual meeting with the Basic Energy Sciences/Materials Sciences staff and invited guests from other DOE program offices on December 15-16, 1994, at the Courtyard by Marriott Hotel in Gaithersburg, Maryland.

Relationship of Materials Sciences to DOE Missions to be Shared with Stakeholders

Robert Gottschall of the Office of Basic Energy Sciences/Materials Sciences Division has accepted invitations to speak at two local university colloquia. The talks will be at the University of Delaware's Department of Physics and Astronomy's Seminar on Condensed Matter Physics and Materials on 8 November and at the University of Maryland's Department of Materials and Nuclear Engineering's Colloquium on Materials Reliability and Radiation Effects on November 10. Materials and materials science needs and opportunities in support of the Department's Strategic Plan will be stressed. He will discuss DOE mission requirements in strategic basic science and magnetic fusion, fossil, transportation, industrial process, energy transmission and storage, solar,

environmental and nuclear technologies. Access to, and usage of, DOE national user facilities will also be addressed.

13th International Conference on the Application of Accelerators in Research and Industry

Dr. Albert E. Evans of the Office of Basic Energy Sciences/Division of Materials Sciences has accepted an invitation from the Chairman of the 13th International Conference on the Application of Accelerators in Research and Industry to present a talk entitled "Safety of Department of Energy Accelerators." Dr. Evans will make his presentation at the conference to be held in Denton, Texas, from November 7-11, 1994. Attendees will include accelerator builders, operators, and users from industry, academia, and government institutions here and abroad.

Annual Atomic Physics Contractors Meeting

The annual meeting of nearly sixty university and contractor scientists supported by the Office of Basic Energy Sciences/Chemical Sciences Division Atomic Physics Program will be held at Lexington, Kentucky, on October 14 and 15, 1994. The meeting will be hosted by grantees at the University of Kentucky. A representative from the Office of Fusion Energy and the National Academy of Sciences will be among the attendees. Representatives of other federal agencies have been invited. A program for the meeting is available and a bound set of abstracts of all the projects will also be available at the meeting.

"Engineering of Nanostructured Materials" Symposia

Dr. Helen M. Kerch from the Division of Materials Sciences, Office of Basic Energy Sciences, is co-authoring a talk to be presented at the "Engineering of Nanostructured Materials" Symposia, Materials Research Society Meeting which will be held in Boston, MA, on November 28-30, 1994, entitled, "Microstructural Evolution During the Sintering of Nanophase Oxide Ceramics." Nanophase materials are of technological interest because of their unique mechanical and electrical properties. Using the combined techniques of small-angle neutron (SANS) and small-angle X-ray scattering (SAXS), the microstructure-processing relationships in oxide nanophase materials including TiO_2, ZrO_2, Al_2O_3, and Fe_2O_3 has been derived. The small-angle scattering technique is a premier analytical tool for the investigation of nanophase materials because it enables the quantitative measurement of statistically significant microstructural parameters in the "nanosize" range to be measured non-destructively. Such statistically representative characterization of the undisturbed microstructure is essential for the development of reliable and predictive materials synthesis and processing models.

Dr. Richard D. Kelley Presented Talk at the American Chemical Society National Meeting

Dr. Richard Kelley, Office of Basic Energy Sciences/Division of Materials Sciences, presented a talk on "Materials Chemistry Research Supported by Basic Energy Sciences, Department of Energy" on August 22, 1994 at the National Meeting of the American Chemical Society, J. W. Marriott Hotel in Washington, D.C. The talk is one of a number by federal, industrial, and university research managers. The symposium is entitled "Materials Research at the Crossroads of Physical and Solid-State Chemistries. Identifying Opportunities for Future Materials Research."

Review of Superconductivity Program for Electric Power Systems

Dr. Alan Dragoo of the Office of Basic Energy Sciences/Division of Materials Sciences has been invited to serve as a reviewer for the Superconductivity Program for Electric Power Systems of the Utility Technologies/Advanced Utility Concepts Division at an annual review meeting on July 19-20,

1994. The review will cover projects on the development of high-temperature superconducting materials as wires and for other electric power applications such as motors, current limiters, and coils for magnetic energy storage.

Tailored Microstructures Group Meets

The Office of Basic Energy Sciences/Division of Materials Sciences funded Center of Excellence in Synthesis and Processing of Advanced Materials has identified seven scientific thrust areas where their program has special expertise which could be marshalled to address jointly with industrial partners major technological problems. One of these groups, the thrust group on Tailored Microstructures in Magnetic Materials, met on June 23 in Albuquerque during the annual Magnetism and Magnetic Materials conference. The purpose was to follow through on the plans formulated at the program formation workshop held in April 1994. The issues addressed at the June 23 meeting primarily concerned industrial involvement, materials standards and program organizational questions. The following actions were taken. Implementation of the industrial involvement is to be initiated by a meeting between the laboratory researchers and potential industrial collaborators to be held in Chicago on October 6 and 7, 1994. This meeting will be planned by a team consisting of both national laboratory and industrial members. Points-of-contact for each of the sub-areas to be addressed by the research program were selected and include: mechanical properties, J. Horton, Oak Ridge National Laboratory; synthesis, R. W. McCallum, Ames Laboratory; magnetic properties, L. Henderson Lewis, Brookhaven Laboratory; and characterization, A. Hutten, Lawrence Berkeley Laboratory. Ames Laboratory and R. W. McCallum will serve as the source for baseline samples and materials to ensure uniformity among the investigations. Finally, B. D. Dunlap, Argonne National Laboratory, as the chair for the thrust group, has taken responsibility for tracking and disseminating all of the research results. The group plans to meet at least annually to report and compare research results. Dr. Jerry J. Smith of the Division of Materials Sciences provided guidance at this June 23rd meeting.

Eighteenth Solar Photochemistry Research Conference

The Eighteenth Department of Energy Solar Photochemistry Research Conference was held June 5-9 at the Granlibakken Conference Center in Tahoe City, California. The annual meeting, sponsored by the Office of Basic Energy Sciences' Division of Chemical Sciences, was hosted this year by the Structural Biology Division of Lawrence Berkeley Laboratory. There were 104 participants in attendance, including 54 scientists from the Department of Energy's laboratories; 44 university grantees; as well as Mary Gress, Allan Laufer, and Robert Marianelli of the Division of Chemical Sciences. The program featured a guest plenary lecture by Professor Michael Gratzel of the Ecole Polytechnique Fédérale, Lausanne, who spoke on photoconversion by nanocrystalline films of oxide semiconductors. In addition, there were 29 other formal presentations and 56 posters. The topical sessions included presentations on subjects that will lead to a deeper understanding of natural photosynthesis and biomimetic systems. Copies of the Proceedings are available from the Division of Chemical Sciences.

Basic Energy Sciences Advisory Committee Briefing on the Fuel for the Advanced Neutron Source

A briefing for the Basic Energy Sciences Advisory Committee and the Executive Committee of the National Steering Committee for the Advanced Neutron Source will be held on July 21, 1994, at the Aerospace Building, 901 D Street, S.W. (near the Forrestal Building). This briefing is to enable the Basic Energy Sciences Advisory Committee to provide advice to the Department regarding the impacts on cost and performance of modifications of the Advanced Neutron Source to accommodate lower enriched fuels in light of nuclear nonproliferation concerns about highly enriched uranium. The National Steering Committee of the Advanced Neutron Source will provide

advice to the Advanced Neutron Source project. Speakers at this briefing include: Richard Stratford, Office of Nuclear Energy Affairs, U.S. Department of State; Bob Bari, Department of Advanced Technology, Brookhaven National Laboratory; and Colin West, Advanced Neutron Source Project Director, Oak Ridge National Laboratory.

Symposium to Focus on Utilizing Ceramics in Adverse Environments

Dr. Helen M. Kerch from the Office of Basic Energy Sciences/Division of Materials Sciences and Dr. Kurt R. Mikeska from E.I. du Pont de Nemours & Co., Inc., Wilmington, Delaware, are organizing a symposium entitled "Ceramics in Adverse Environments" at the 97th Annual Meeting of the American Ceramic Society, April 30 - May 4, 1995, in Cincinnati, Ohio. The objective of the symposium is to provide a forum to present and discuss performance data, testing techniques, characterization, property and design considerations for ceramic materials in adverse conditions including radiation fields and corrosive environments. The performance evaluation of advanced materials such as silicon carbide/silicon carbide composites for clean, energy efficient fusion systems is critical in linking synthesis and processing protocol with design and manufacturing requirements for specific applications. Further information on the symposium may be obtained from Dr. Kerch at 301/903-3428.

Accelerator Safety

Dr. Albert E. Evans of the Office of Basic Energy Sciences/Division of Materials Sciences has accepted an invitation from the Chairman of the Thirteenth International Conference on the Application of Accelerators in Research and Industry to present a talk entitled "Safety of Department of Energy Accelerators." Dr. Evans will make his presentation at the conference to be held in Denton, Texas, from November 7-11, 1994. Attendees will include accelerator builders, operators, and users from industry, academia, and government institutions here and abroad.

Interagency Advanced Power Group Meeting to be Held

Dr. Steve Barnhart (Chemical Sciences) and Dr. Dick Kelley (Materials Sciences) will participate in the Chemical Working Group Meeting of the Interagency Advanced Power Group, June 28-30, 1994. The meeting is being hosted by Transportation Technologies and will be held in Room 6E-069 Forrestal. The Chemical Working Group coordinates research and development in capacitors, fuel cells, and batteries in the Department of Energy, the National Aeronautics and Space Administration, and the Department of Defense.

Annual Combustion Research Meeting Attracts External Participation

The Sixteenth Annual Combustion Research Meeting was held from June 1 through 3 at the Granlibakken Conference Center in California. The purpose of these discussions were to foster communication and collaboration among the principal investigators who are engaged in a broad range of research efforts including theoretical chemistry, chemical dynamics, kinetics, thermodynamics, reaction mechanisms, combustion diagnostics, and reacting chemical flows. Each year a plenary lecturer is chosen from outside the Department of Energy program to provide insight on research needs related to combustion and research activities in industrial laboratories or in other countries. The industrial laboratories are of particular importance because, collectively, they are among the principal customers for the knowledge generated by the Chemical Sciences Division of the Office of Basic Energy Sciences.

This year's plenary lecturer was Dr. William Leppard of the Fuels and Lubricants Department at the General Motor Research and Development Center. Leppard identified several classes of

compounds whose chemistry needs to be better characterized in order to improve design models for the automotive industry. Also, at this meeting ideas are exchanged between the principal investigators and Chemical Sciences Division management on the expected payoffs from the Department's basic research activities related to combustion. Invitations to attend were also sent to the Department of Energy technology offices, research offices within the Department of Defense, research laboratories in Europe, and several U.S. industrial research laboratories. Those whose schedules allowed them to attend included representatives from Exxon, the Gas Research Institute, the Naval Research Laboratory, and the National Science Foundation. Additionally, Professor Carl Lineberger, chair of the Basic Energy Sciences Advisory Committee, attended all of the technical sessions of the workshop and visited with several of the principal investigators.

Industrial Representatives Attend Heterogeneous Catalysis Meeting

The Ninth Biannual Department of Energy's Basic Energy Sciences Conference on Heterogeneous Catalysis and Surface Chemistry was sponsored by the Office of Basic Energy Sciences for Department of Energy researchers. This conference, held in Oconomowoc, Wisconsin, on May 25-27, 1994, was attended by over 90 people representing industry, national labs, academe and government agencies. The research represented a cross section of the Department of Energy's research interests in catalysis. Twenty seven oral and approximately 60 poster presentations were given by participating researchers. The majority of these researchers were supported by the Chemical Sciences and Materials Sciences Divisions of Basic Energy Sciences, and others were supported by the Advanced Industrial Concepts Division and the Biofuels Systems Division in Energy Efficiency and Renewable Energy and the Advanced Research and Technology Development program in Fossil Energy. Dr. David Dixon, a corporate fellow from DuPont's Central Research and Development, gave the after-dinner talk on "Computational Chemistry and Catalysis at DuPont."

Industrial representatives from DuPont, Dow Chemical, General Motors, Universal Oil Products, Benzoil, and 3M were uniformly impressed with the science, especially its relevance and importance to future advances by industry.

Industrial representatives were impressed with the "collection of the forefront of research" and "the depth and cross section of surface chemical issues" covered at the meeting. One industrial representative stated, "I had no idea that DOE had such a broad and vigorous research program in surface science related to catalysis." It was evident that this research closely couples with the needs expressed by industry.

Council for Chemical Research Conference on "Frontiers in Catalysis"

The Office of Basic Energy Sciences was well represented at the 4th New Industrial Chemistry and Engineering Conference which was held May 22-25, 1994, under the sponsorship of the Council for Chemical Research. The subject of the conference, "Frontiers in Catalysis," was mostly addressed by prominent scientists of academe and industry from the United States, with presentations also by scientists from Japan and Germany. Approximately 100 were in attendance. The presentations highlighted industrially important research in catalysis. About half of the speakers are either currently supported by, or have been supported by, the Chemical Sciences Division. Those speakers who currently receive Department of Energy support are Professors Alex Bell (Lawrence Berkeley Laboratory), Gary Haller (Yale University), Lanny Schmidt (University of Minnesota), and Tobin Marks (Northwestern University). Of particular interest was the research on the partial oxidation of methane by Professor Schmidt, which was reported in the Wall Street Journal and the Washington Post. Professor Bell headed up the National Research Council Study on catalysis which was reported as "Catalysis Looks to the Future," published in 1992.

Dr. F. Dee Stevenson of the Office of Basic Energy Sciences/Division of Chemical Sciences attended the conference and met with the organizers who expressed interest in closer coordination with research programs sponsored by the Office of Basic Energy Sciences. Dr. Donald E. Jost is the new Executive Director of the Council for Chemical Research and will visit the department of Energy in the near future.

Basic Energy Sciences Staffer Invited to Speak at Local American Chemical Society Meeting

Dr. Helen M. Kerch from the Division of Materials Sciences, Office of Basic Energy Sciences will present an invited lecture based on her original research entitled "In-Situ Sintering Studies of Amorphous Ceramics" at the 28th Middle Atlantic Regional Meeting of the American Chemical Society which will be held May 25-27, 1994, at the University of Maryland, Baltimore County. The talk will focus on a newly developed monitoring system for ceramics during high temperature processing using neutrons as the probing media. Because neutrons are highly penetrating, they can be used to obtain materials information that is representative of the entire specimen rather than just a small area such as the surface. Microstructural events, including void evolution and crack formation which are critical in the successful fabrication of ceramics, can be followed *in-situ* during high temperature processing using this technique. A better understanding of microstructure/ processing relationships facilitates the design of new materials and hastens their implementation into the market. The talk will outline the utility of neutrons as a premier characterization tool in the optimization of synthesis and processing routes for advanced ceramic materials.

Progress for Electron Beam Microcharacterization Facility Project

Lawrence Berkeley Laboratory's National Center for Electron Microscopy presented their construction plans for their Electron Beam Microcharacterization Facility to members of the Division of Construction Management and the San Francisco Field Office at Berkeley on April 26, 1994. The purpose of this project is to upgrade their National Center for Electron Microscopy with necessary laboratory and visitor space that is critical to satisfying the needs of customers and stakeholders at this active national user facility. About half of the total estimated cost for this $15.9 million upgrade project is for construction. The other half is for unique new electron beam microcharacterization instruments to permit the mapping of the chemical composition of materials at near-atomic-scale lateral spatial resolution and to perform novel experiments on a microscopic scale compatible with many critical processes underlying emerging and new technologies.

Conference Focuses on Laser Processing and Applications

The International Conference on Materials Processing and Advanced Application of Lasers will be held May 1-6, 1994, in Palm Coast, Florida. The Department of Energy will be represented by Dr. Yok Chen (Division of Materials Sciences/Office of Basic Energy Sciences), who will chair one of the sessions and observe the current progress in laser processing of materials. Lasers are being extensively used in applications encompassing a wide variety of materials and products. The materials range from metals, polymers, semiconductors, and superconductors, while the products have applications in industries ranging from the electronic industry to medical applications. This meeting is sponsored by the Engineering Foundation of New York City, and organized jointly by the University of Florida, International Business Machines, and Centre National De Recherche Scientifique (France).

Materials Sciences Presentation to Corporate Research and Development Audience

Robert Gottschall of the Office of Basic Energy Sciences/Materials Sciences Division gave an

invited presentation at a Conference entitled "Materials Technology: The Washington Side of the Equation," held on April 20, 1994, in Washington. The audience included about 40 corporate research and development officials. The Conference was sponsored by Robert Dale Wilson, Managing Partner of Wilson & Wilson and publisher of The Wilson Reports. A number of the industry representatives expressed an interest in learning more about the Materials Sciences Program and requested copies of the program's annual research summary book.

American Chemical Society Colloquium on the Future of Chemistry

An interactive presidential colloquium organized by the American Chemical Society titled "Shaping the Future: The Chemical Research Environment in the Next Century" was held on April 7 through April 9, 1994. The colloquium was attended by Allan Laufer of the Chemical Sciences Division of the Office of Basic Energy Sciences. The approximately 40 invited attendees represented Federal funding agencies, Congressional staff, University researchers, Vice-Presidents for Research of major corporations, Provosts and Deans of several leading research universities and Directors of Department of Energy national labs. Priority issues involving education, alliances for knowledge and technology transfer, marketing and support of university based basic research, demographics and innovation/creativity were developed and openly discussed. A report from the American Chemical Society is expected shortly.

Workshops on Advanced Materials Focus on Areas of Importance to Energy Technology Programs and Industry

The Department of Energy's Center of Excellence for Synthesis and Processing of Advanced Materials is conducting a series of workshops during the months of April and May to formulate collaborative programs in seven critical focus areas. One area, the Mesostructural Engineering of Polymers Workshop has already met in March. The workshops are designed to develop well-coordinated research efforts with DOE technology programs, with substantial industrial participation.

The Center consists of 12 Department of Energy Laboratories encompassing a diversity of unique and highly relevant professional skills, facilities, and instruments. The management of the Center has focussed on multi-institutional interaction and collaboration amongst its member institutions as well as through numerous DOE technology, industry, and academia partnerships.

The schedule of the six other workshops follows:

Workshop	Staff	Dates	Location
Optimized Magnetic Materials	Jerry Smith	April 19-20	ANL
Joining and Welding	Alan Dragoo	April 21-22	Denver
Nanostructure Materials	William Oosterhuis	April 25-26	LBL
Processing for Surface Hardness	Helen Kerch	April 19	Dallas
High Temperature Corrosion Coatings	Helen Kerch	May 2-3	EPRI, Palo Alto
High Rate Metal Forming	Alan Dragoo	May 3-4	LLNL

Center of Excellence for Synthesis and Processing of Advanced Materials to Conduct Workshops for Improved Collaboration and Focus

The Department of Energy's Center of Excellence for Synthesis and Processing of Advanced Materials will conduct a series of workshops during the month of April to formulate collaborative programs in seven critical focus areas. They plan to develop well-coordinated research programs with DOE technology programs and industrial participation.

The Center consists of 12 Department of Energy Laboratories encompassing a diversity of unique and highly relevant professional skills, facilities, and instruments. The management of the Center has focussed on multi-institutional interaction and collaboration amongst its member institutions as well as numerous DOE technology, industry, and academia partnerships.

The Materials Sciences staff will participate in these workshops as follows:

Workshop	Staff	Dates	Location
Optimized Magnetic Materials	Jerry Smith	April 19-20	ANL
Joining and Welding	Alan Dragoo	April 21-22	Denver
Nanostructure Materials	W. Oosterhuis	April 25-26	LBL
Processing for Surface Hardness	Helen Kerch	April 28-20	Dallas
Mesostructural Engineering of Polymers	TBD	TBD	TBD
High Temperature Corrosion Coatings	TBD	TBD	TBD
High Rate Metal Forming	TBD	TBD	TBD

Combustion Researchers Meet to Share Results and Ideas

The annual Combustion Contractors' Meeting will be held this year from June 1-3, at the Granlibakken Conference Center near Tahoe City, California. The meeting affords the opportunity for principal investigators supported by the Office of Basic Energy Sciences to share research experiences and to develop and continue collaborative work. Representatives from other Department of Energy offices, from other government programs with research efforts related to combustion, and from industry are invited to participate. This year's plenary speaker will be William Leppard from General Motors who will describe current research at General Motors related to combustion. The Combustion Research Facility of Sandia National Laboratories, Livermore, will be serving as the local host. It is furthermore anticipated that Professor Carl Lineberger, Chairman of the Basic Energy Sciences Advisory Committee, will be attending as an observer.

Manufacturing Science Program with Industry

A multidisciplinary manufacturing science program with industrial involvement and co-sponsorship has been set up at the Massachusetts Institute of Technology. Bob Gottschall of the Office of Basic Energy Sciences will visit there with Materials Science and Engineering Department Head, Professor Merton C. Flemings, Manufacturing Sciences Program Director and Materials Processing Center Director, Professor Thomas W. Eagar and Manufacturing Sciences Program Deputy Director and Materials Processing Center Associate Director, George B. Kenney on April 8, 1994. This is part of an on-going effort by the Office of Basic Energy Sciences to make its program more responsive to needs and opportunities in manufacturing science and to establish a university-industry grant program.

Opportunities for Research on Advanced Lighting Concepts

On March 15, 1994, Karl Johnson of the Electric Power Research Institute (EPRI) and Alfred Gough of the Lighting Research Institute (LRI) met with Office of Basic Energy Sciences representatives in Germantown to explore options for developing the next generation of lighting devices. EPRI and the LRI are exploring mechanisms to develop the science base to achieve breakthroughs in lighting technologies. Based on our preliminary discussions, Basic Energy Sciences could be an active participant in such an undertaking. We expect to explore this possibility further with EPRI and LRI in the coming weeks.

United States Advanced Ceramics Association to Discuss Industry Needs

Bob Gottschall and Alan Dragoo from Basic Energy Sciences/Division of Materials Sciences have been invited to, and will attend, the United States Advanced Ceramics Association's 1994 Congressional Breakfast Briefing at B338 Rayburn House Office Building on March 17, 1994. United States Advanced Ceramics Association is an association of 26 companies that are manufacturers and/or users of advanced ceramic products utilized for both structural and electronic applications. They promote the commercialization of advanced ceramic technologies and the growth of the United States advanced ceramics industry. Their invitation states that the United States Advanced Ceramics Association will provide an overview of the state of the advanced ceramics industry, the direction industry is headed, and the role they feel the Federal Government must play with respect to their interests. Basic Energy Sciences staff has been participating in the United States Advanced Ceramics Association's activities for many years.

Coordination of Materials Activities Between Sandia and National Renewable Energy Laboratories

The second of an open-ended series of meetings between materials scientists at Sandia National Laboratory and the National Renewable Energy Laboratory took place on January 11-12, 1994, at the Sandia Laboratories in Albuquerque. Action items included individual exchange visits by several materials scientists to establish further collaboration on the quantification of ordering in compound semiconductors by a) transmission electron diffraction, b) x-ray double crystal diffraction, and c) optical techniques. In addition, Sandia's theoreticians will utilize NREL's random structure model to improve the efficiency of their band offset and optical property calculations for disordered semiconductors. Collaborative work will continue on the determination of the effective mass of electrons and holes in a lateral superlattice structure.

The Transfer of ES&H Knowledge to Chemists at Ames Laboratory

During the Basic Energy Sciences Tiger Team Corrective Action progress review and the joint Chicago Operations Office Environmental Safety and Health Appraisal (ES&H) of Ames Laboratory, the following ES&H highlight was noted: "The Ames Laboratory has, in concert with Iowa State University designed and conducts a general ES&H laboratory course (Chemistry 550X) designed for chemists working or teaching in a chemical laboratory or related facility. In 1992, 40 students were enrolled and 1993, 70 students. The 14-lecture series not only aids researchers of the laboratory to more effectively integrate ES&H into research activities, but acts as a transfer-of-knowledge vehicle to American Industry as those students move from the University environment to the industrial workplace."

Increased Collaboration is Central Theme of Annual Neutron Irradiation Effects Contractors Meeting

There were three principal agenda items at this years Basic Energy Sciences/Materials Sciences

Neutron Irradiation Effects Contractors Meeting, which was held in Boston at the site of the annual meeting of the Materials Research Society on November 30, 1993:

1. The large cost of neutron irradiation experiments make clear the compelling and urgent necessity for our investigators working in neutron and gamma irradiation damage to come together, communicate, and collaborate at a level that has not been achieved heretofore. Discussion focussed on multi-institutional collaborative experiments.

2. The fact that the proposed Advanced Neutron Source may become the only facility in the nation with a capability for carrying out neutron damage experiments underscores the necessity for our neutron irradiation effects community to interface, communicate, and coordinate with the design of the Advanced Neutron Source on various issues such as, but not limited to, the control and monitoring of specimen temperature during periodic replacement of the fuel rods. Dr. Colin D. West, Director of the Advanced Neutron Source project, made a very-well received presentation on the planned Advanced Neutron Source facilities and how they will interface with the specific needs of the neutron irradiation effects community.

3. Dr. Louis Mansur of Oak Ridge National Laboratory was elected as the Chairperson of our Neutron Irradiation Effects Contractors Group.

Dr. F. W. Wiffen from the Office of Fusion Energy also participated in this meeting.

Dr. Dragoo to Co-Chair Materials Research Society Session on Silicide Microstructures and Deformation

Dr. Alan Dragoo, of the Office of Basic Energy Sciences/Division of Materials Sciences, will co-chair the session on Silicide Microstructures and Deformation along with Dr. John Petrovic, of Los Alamos National Laboratory, at the 1993 Fall Meeting of the Materials Research Society on November 29, 1993. This session is part of the Symposium on High Temperature Silicides and Refractory Alloys. This session will include presentations on deformation and plastic behavior of single crystals, the mechanical behavior of nanocomposites, microstructural design, the effect of intergranular phases, the effect of reinforcement particles, and the effects of crystallographic slip and grain-boundary sliding on deformation. Silicides such as molybdenum disilicide are of interest as materials for future extremely high temperature applications. These materials have characteristics both of metals and of nonoxide ceramics, such as silicon carbide and silicon nitride. Hence, alloying techniques offer some possibility for property modification; on the other hand, these materials are very hard and refractory.

Workshop Held on Molecular Ecology of Photosynthesis

On October 25-27, 1993, a workshop jointly organized by the Office of Health and Environmental Research and the Office of Basic Energy Sciences was held in Elkridge, Maryland. The objective of the workshop was to bring together researchers representing basic science studies aimed at understanding photosynthesis using biophysical, biochemical and molecular biological approaches and investigators who are involved with ecological studies. The intent was to integrate the different approaches in a manner that would lead to a much deeper and better understanding of what goes on photosynthetically in nature especially as it relates to global climate change, other forms of environmental disturbance, and under natural conditions. One objective was to encourage collaborative activities among investigators with different expertise along with regular exchanges of knowledge and techniques that would yield more rapid and broader understanding of the questions being posed concerning ecological effects.

The principal organizer of the meeting was Dr. Paul Falkowski of Brookhaven National Laboratory who is supported both by the Division of Energy Biosciences and the Office of Health and Environmental Research. Introductory statements were provided by Drs. Ari Patrinos and Robert Rabson at the opening of the workshop. Some of the participants are currently supported by Energy Biosciences or Health and Environmental Research. They and all of the other participants are specialists in their respective fields. Several international participants were involved in the workshop. A workshop summary report is now in preparation and will be distributed after completion so that the information generated will be generally available.

Atomic Physics Program Workshop Held

The fourteenth annual workshop of the Atomic Physics Program of the Office of Basic Energy Sciences was held on Friday and Saturday, October 15 and 16, at the University of Virginia. The workshop is an opportunity for the more than 60 principal investigators in the program, both from universities and from national laboratories, to bring each other up to date on their research progress and plans. The workshop, therefore, not only serves to minimize overlap among the projects but, more positively, to nurture collaborations between researchers who might not otherwise have the opportunity to be aware of each other's work. One such collaboration which developed at this meeting has, within a few days, led to the explanation of unusual laser behavior observed by one of the principal investigators and reported at the meeting. In addition to the principal investigators, the meeting was attended by Joseph Martinez and Allan Laufer from the Office of Basic Energy Sciences, David Crandall from the Office of Fusion Energy, and representatives from the National Research Council and the National University of Mexico.

The National Renewable Energy Laboratory/Sandia Communication Meeting Held

A successful National Renewable Energy Laboratory/Sandia communication meeting was held at the National Renewable Energy Laboratory on September 9, 1993. The purpose was to exchange information on Basic Energy Sciences/Division of Materials Sciences programs and discuss issues of joint interest. The people attending from Sandia were Tom Picraux, Eric Jones, Paul Gourly, and Jeff Nelson. Those from the National Renewable Energy Laboratory included Satyen Deb, Dave Staebler, Alex Zunger, Jerry Olson, and Angelo Mascarenhas. Other National Renewable Energy Laboratory people attended part-time. Many common interests were found in III-V compound semiconductors, where the National Renewable Energy Laboratory's concentration is on the effect of ordering and Sandia's concentration is on the effect of strained layer structures.

Informal collaborations were suggested, including testing theoretical predictions of the effects of strain and composition on the band gap reduction and crystal field splitting in gallium indium phosphide, and magnetic field evaluation by Sandia of the band gap structures of ordered samples from the National Renewable Energy Laboratory. A follow-up meeting at Sandia is being planned.

10th Anniversary of DOE Summer School in Nuclear and Radiochemistry

In response to several national surveys that indicated an impending lack of scientists trained in nuclear and radiochemistry, the Department of Energy agreed in 1983 to fund a summer school focusing on studies in this area at San Jose State University in California and at a second site at Brookhaven National Laboratory in 1989. This program has now completed 10 years in which almost 180 undergraduate students have participated in an intensive 6-week course covering material equivalent to collectively about eight semester credits in health physics, radiological safety, radiochemistry, nuclear and radiation chemistry, and associated topics in nuclear science. A majority of these students have gone on to graduate programs in some aspect of nuclear science or nuclear medicine. The summer school program is jointly funded by the Office of Basic

Energy Sciences/Division of Chemical Sciences and the Office of Science Education and Technical Information.

1993 Annual Department of Energy Aqueous Corrosion Contractors Meeting

Twenty-seven registered attendees, including virtually all investigators funded by the Department of Energy in the topic of aqueous corrosion, participated in the 1993 Annual Department of Energy Aqueous Corrosion Contractors Meeting held on September 16-17, 1993, at the Colorado School of Mines. Many valuable interactions and collaborations have been originated at this annual meeting. It is unique, because there is no single professional society that effectively represents the entire aqueous corrosion community (limited, partial representation occurs at the National Association of Corrosion Engineers, The Electrochemical Society, The American Chemical Society, The American Institute of Chemical Engineers, ASM International, The Metallurgical Society, and The Materials Research Society), so this is the only occasion where the various disciplines that are represented in our aqueous corrosion program can interact amongst themselves. The National Academy of Engineering's Panel Report on Electrochemical Corrosion estimated that the annual economic cost of corrosion damage amounts to 4.25 percent of the Gross National Product.

Two National Laboratories Improved Coordination of Basic Energy Sciences Photovoltaic Programs

The common research interests on III-V compound semiconductors between the two Basic Energy Sciences funded groups at Sandia National Laboratories/ Albuqeruque and at the National Renewable Energy Laboratory resulted in the initiation of collaborations in the theoretical and experimental programs. Sandia was represented by Tom Picraux, Eric Jones, Paul Gourly, and Jeff Nelson, and the National Renewable Energy Laboratory by Satyen Deb, Dave Staebler, Alex Zunger, Jerry Olson, and Angelo Mascarenhas. The first meeting was September 9, 1993, and follow-up meetings are planned.

"Materials Week '93" Provides Opportunity to Obtain Broad Programmatic Perspectives

Drs. Otto Buck, Joe Darby, and John Mundy of the Office of Basic Energy Sciences/Division of Materials Sciences will Participate at the Materials Week '93 in Pittsburgh. Materials Week '93 presents an excellent opportunity for Division of Materials Sciences staff to evaluate research funded by the Division of Materials Sciences against a background of the many other national and international programs. Materials Week '93 also allows the Division of Materials Sciences staff to learn of developments in materials that could prove critical to the advancement of energy production in many areas, including fossil, geothermal, fusion, and fission energy, and also for the improvement of materials used for waste isolation and environmental technology. Dr. Otto Buck is the co-organizer of a two-day symposium on "Nondestructive Evaluation and Materials Characterization" and will present a paper on "Strength, Acoustic Evaluation, and Metallurgy of Diffusion Bonds." Dr. Joe Darby will chair the Deformation and Fracture (Atomistic Simulation) Session of the symposium on High Temperature Intermetallics. Dr. John Mundy will present a paper in the symposium on "Diffusion in Amorphous Materials." The meeting takes place in Pittsburgh, October 17-21, 1993, and is sponsored by The Minerals, Metals and Materials Society (ASM International).

Materials Sciences Staff Participate in Automotive Materials Forum

Drs. Otto Buck and John Mundy will represent the Office of Basic Energy Sciences/ Division of Materials Sciences at the Automotive Materials Forum in Detroit. The many critical challenges associated with the selection of materials for the next generation of vehicle structures, chassis, powertrains, battery systems, and other automobile parts will be addressed by senior representatives of the U.S. car industry at a one day forum in Detroit. Drs. Buck and Mundy will examine those areas where basic research funded by the Division of Materials Science could help in the development of new materials, materials testing procedures, and the improvement of production techniques.

Diversity, HBCU, Etc.

Historically Black College and University Workshop on Materials Sciences Builds Partnerships

A well-attended Historically Black College and University Workshop on the Physics of Materials and Materials Science took place on October 13-15, 1994, in Arlington, Virginia. It was sponsored by Department of Energy/Basic Energy Sciences/Materials Sciences, Morgan State University, and Oak Ridge National Laboratory. There were 127 attendees at this workshop with representatives from 32 Historically Black Colleges and Universities, 6 private industrial organizations, 11 Department of Energy laboratories, 9 other universities, and 7 U.S. Government agencies. Of the 79 participants from the 32 Historically Black Colleges and Universities, 62 represented the scientific or administrative staff, 15 were graduate students, and 2 were undergraduate students. One of the meeting highlights was the post-banquet speech by Under Secretary Curtis on the evening of October 13, 1994.

The objectives of this workshop were: (1) to bring together materials researchers from universities, government, and industrial laboratories that have research programs or interests in selected strategic topics in materials science; (2) to help establish a network among Historically Black Colleges and Universities, government, industry, and other university materials scientists; and (3) to encourage future research collaborations amongst the participants.

The workshop included 12 outstanding scientific presentations and 32 poster exhibits. The latter included staffed displays by 11 Department of Energy Laboratories that provided a point-of-entry contact, an overview of their respective materials research capabilities, and a presentation of unique aspects of their programs such as a one-of-a-kind research facility or a special research capability. The collective intention was to facilitate future research interactions, and to develop increased collaborations with Historically Black Colleges and Universities.

Office of Basic Energy Sciences Women Participated in the Federally Employed Women Training Program in Washington, D.C.

Eight Office of Basic Energy Sciences (BES) women participated in the Federally Employed Women 25th National Training Program held July 18-22, 1994, in Washington, D.C. The theme of this year's program was Making Monumental Strides to the Top. The workshops attended by the BES staff were very beneficial and helped prepare them for changes that will be taking place in the Federal workforce, how to look ahead toward the future, ways to deal with barriers along the way toward achieving a goal, how to achieve career success by accepting change, having a positive attitude, and accepting challenges along the way. The workshop also focussed on personal effectiveness, career development, communication skills, management and leadership skills, and personnel. Those who attended the training were Pat Lake, Tara Long, Sue Ellen Stottlemyer, Cynthia Carter, Kay Etzler, Karen Talamini, Cheryl Fee and Diane Stull.

Meeting at Southern University Builds Trust and Spirit of Support

A proposal from the Science and Engineering Alliance (SEA - Southern University, Alabama A&M, Jackson State University, Prairie View A&M, and Lawrence Livermore National Laboratory) for the construction of a synchrotron radiation beamline on the 'J. Bennett Johnston Sr. Center for Advanced Microstructures and Devices' at Louisiana State University was reviewed, found to be below the threshold for funding, and rejected. None of the principal investigators has experience in using synchrotron radiation. In a pro-active attempt to get this consortium up to speed, the

Materials Sciences Division decided to hold an informal meeting with the principal investigators, and with laboratory experts in the field in order to help these principal investigators develop a more competitive proposal.

On June 6-7, 1994, Jerry Smith and Bill Oosterhuis from the Division of Materials Sciences met with the principal investigators (Robert Gooden/Southern, Paul Ebert/LLNL, Hylton McWhinney/Prairie View, Bob Shephard/SEA, Pradeep Battacharya/Southern University, Calvin Low/Alabama A&M) and with Volker Sailes and John Scott of the Center for Advanced Microstructures and Devices (CAMD) to better understand what the strengths of this group are, and how they might build on these to improve their proposal. They were joined in this discussion by Dr. Ward Plummer/ORNL who has many years of experience in the use of synchrotron radiation. The reviews of the original proposal were discussed, and the principal investigators were encouraged to develop a more focussed proposal building on their strengths. An unexpected development was the discovery that there was beam time available on existing beamlines at the CAMD - about five miles from the Southern University campus - and it was made clear to the principal investigators from SEA that they were very welcome to come and use these facilities. Dr. Plummer and CAMD offered to provide help.

It was agreed that a new proposal be written which would be carried out in three phases:

(1) A research phase in which the PIs would utilize the existing beamline equipment at the Center for Advanced Microstructures and Devices as soon as possible.

(2) An end station phase in which the principal investigators would develop and build experimental stations to be installed on existing beamlines.

(3) A beamline design and construction phase in which the detailed optics could be designed to suit the specific needs of the SEA consortium.

Several things were accomplished by holding the meeting: a much improved proposal will be forthcoming; the PIs know of the opportunity to use existing beamline capabilities at CAMD; the PIs will gather experience as they go along in the phases described above; and we were able to get a much better idea of their research ideas. It is also clear that this kind of a research activity is an excellent avenue for training students. Finally, the principal investigators were encouraged to seek industrial partners where there is a natural fit within their research activities. An improved revised application is anticipated to be submitted in late summer of 1994. This will allow for the proposal to be reviewed and considered for funding in fiscal year 1995.

Reception at Howard University Celebrates DOE Award

The Secretary will be the guest of honor at a reception in recognition of a $9.2 million award to Howard University for the purpose of developing new state-of-the-art instrumentation to be installed on the Advanced Photon Source now under construction at Argonne National Laboratory. This ceremony will take place at the West Campus of Howard University at 2:00 p.m. on Thursday, June 2, 1994. Participants will include Martha Krebs, Director of Energy Research, and Iran Thomas, Bill Oosterhuis, and Jerry Smith from the Divison of Materials Sciences/Office of Basic Energy Sciences where the award originated. Also participating in the ceremony will be leadership from the University of Michigan and AT&T Bell Laboratories as partners with Howard University in the Collaborating Access Team at the Advanced Photon Source, and from Argonne National Laboratory where the APS is being built.

Historically Black Colleges and Universities Workshop on Materials Sciences

An Historically Black Colleges and Universities Workshop on the Physics of Materials and Materials Science will be held October 13-15, 1994, at the Crystal Gateway Marriott Hotel in Arlington, Virginia. This workshop is jointly sponsored by the Division of Materials Sciences/Office of Basic Energy Sciences, Morgan State University, and the Oak Ridge National Laboratory. The purpose of the workshop is to bring together researchers from universities, government laboratories, and industry who have research interests in Materials Physics and Materials Science, and to establish a network among the Historically Black Colleges and Universities, government, industry, and university scientists. Such a network will encourage research collaborations among the participants. Each of the DOE laboratories will be invited to participate so that the Historically Black Colleges and Universities' scientists can be made aware of DOE facilities and potential collaborations with DOE scientists. William T. Oosterhuis will be attending for the Division of Materials Sciences/Office of Basic Energy Sciences. Secretary O'Leary has been asked to speak at the dinner banquet.

Meeting of the National Society of Black Physicists

Drs. Jerry J. Smith and William T. Oosterhuis of the Division of Materials Sciences/Office of Basic Energy Sciences participated in the Annual Meeting of the National Society of Black Physicists at Rutgers University at Newark, New Jersey, on April 21-22, 1994. Dr. Oosterhuis presented an invited talk on New Developments in Synchrotron Radiation while Dr. Smith participated in a multiagency panel discussion on Research Funding. Approximately 100 members of the National Society of Black Physicists attended the meeting.

National Society of Black Physicists to Hear Presentation on Synchrotron Sources

Dr. William T. Oosterhuis from the Office of Basic Energy Sciences/Division of Materials Sciences will make a presentation on "New Developments in Synchrotron Sources" at the Annual Meeting of the National Society of Black Physicists. This meeting will be held at The Rutgers University Campus at Newark, New Jersey, on Thursday, April 22, 1994. He will also participate in a panel discussion on "Research Funding" with representatives from other Federal Agencies on Friday, April 23, 1994. This meeting will bring together leading minority scientists from academic, industrial, and government physics communities as well as undergraduate and graduate students who will present their research results.

Research Collaboration Established Between Los Alamos Radiation Effects Program and Minority Student Program

A successful research collaboration has been established between the Los Alamos Neutron Irradiation Induced Metastable Structures program and the New Mexico Highlands University. This collaboration, which is less than a year old, has already resulted in one article which is ready for submission to the Journal of the American Ceramics Society and an oral presentation of the work which will be given at the annual meeting of the American Ceramics Society. The Neutron Irradiation Induced Metastable Structures program is funded through the Office of Basic Energy Sciences/Division of Materials Sciences. The collaboration was established through the Science and Technology Alliance.

In this collaboration, the New Mexico Highlands University students are responsible for synthesis and processing of samples for neutron irradiation experiments. One of the tasks is to synthesize a magnesium ferrous oxide, also called magnesium ferrite, which is enriched in the natural (nonradioactive) isotope, iron-56. Chemical synthesis techniques are used which minimize the

radioactivity of the irradiated powders. The powders are irradiated with neutrons to determine the amount of disorder induced between the positions of the magnesium and iron ions in the crystal structure of the oxide by the neutron impacts. The results of this study have implications regarding the radiation-resistance of oxide ceramics which may be used in fusion reactors.

The purpose of the Science and Technology Alliance is to increase the representation of Blacks, American Indians, and Hispanics in the fields of science and engineering. Institutions participating in the Science and Technology Alliance are North Carolina A&T State University, New Mexico Highlands University, and the Ana G. Mendez Educational Foundation of Puerto Rico. This program offers students the opportunity to supplement their educational funds while gaining practical work experience in a professional area related to their field of study.

Southern University Advisory Board Meeting on Engineering Research and Education

On March 9 & 10, 1994, Dr. Oscar Manley of the Office of Basic Energy Sciences/Engineering Research Program attended the initial meeting of the Advisory Board held in Baton Rouge, Louisiana. The function of the board is to help guide the development of the engineering education and research activities at Southern University College of Engineering under a grant from NASA and co-funded by DOE. This is a five-year program supported at approximately $1,000,000/year. Except for Dr. Manley, all the Advisory Board members have been drawn from the aerospace community, both government and private organizations. The presentation of the Southern University faculty and administration were limited to plans addressing aerospace interests and needs. Dr. Manley urged the advisory board and Southern University faculty to broaden its interests to include activities within the mission of DOE, e.g. environmental restoration and waste management. They promised to consult more closely with DOE staff and adjust their plans accordingly. The next meeting of the Advisory Board is scheduled for late September 1994.

Southern University Engineering Program Visited

As a follow-up to the recent agreement with NASA to support a Center for Aeronautics Research and Education at the Southern University (Boca Raton, LA), Dr. Oscar Manley, Office of Basic Energy Sciences/Engineering Research Program, visited that University on December 3, 1993. He was received by Dr. T. Henderson, the Dean of Engineering, who introduced him to selected members of his faculty. They in turn took Dr. Manley on a brief tour of the facilities. The tour showed imaginative use of the limited resources provided by NSF equipment grants. The school is an undergraduate institution which is seeking approval and accreditation of a graduate engineering program.