U.S./Japan Expand Efforts to Cooperate in Scientific Research

NSF to Play Major Role

Consistent with an agreement signed June 20 in Toronto, Canada, by President Ronald Reagan and Japanese Prime Minister Noboru Takeshita, the United States and Japan are expanding efforts to cooperate in scientific research. The expanded efforts will place more U.S. scientists in Japanese government, university, and industry laboratories for research visits typically lasting from six months to one year. The first scientist to benefit from the new cooperative activities has already arrived in Japan.

In the United States the National Science Foundation will play a major role in the cooperative venture. The NSF has added four new U.S.-Japan activities, each coordinated with a different Japanese government entity, and a special 1988 Japan Initiative. Japan, which has also instituted new programs for cooperation, will contribute funding in addition to access to government, university and industry laboratories and other world-class facilities with state-of-the-art equipment.

- To help implement a policy for "internationalization" of Japanese science, Japan's Ministry of Foreign Affairs has provided $4.8 million to NSF. The funds will be used to send 75-100 U.S. researchers to Japanese university, government, and industry laboratories primarily through new and previously existing NSF agreements with Japanese technical agencies.
- A cooperative program sponsored by the Japanese Science and Technology Agency will provide research opportunities in non-university Japanese national laboratories, including many associated with other ministries. Approximately 50 U.S. scientists, 35 years old and younger, will be selected. NSF will select 20 scientists; the U.S. National Institutes of Health (NIH), five; other U.S. federal agencies, a total of 10; and Japanese government laboratories, the remaining 15. NSF will coordinate the visits with the Japanese agency.
- Through another new program, the Japan Society for the Promotion of Science will send 50 young scientists to Japan each year for one-year stays in laboratories funded by the Ministry of Education, Science and Culture. Among the laboratories are the world-class National Laboratory for High Energy Physics and the Okazaki National Research Institutes. Twenty-five candidates will be nominated by NSF and five by NIH; the remaining 20 will be directly invited by Japanese professors.
- Under a third program, a joint effort by NSF and Japan's Mininiry of International Trade and Industry (MITI), up to 30 NSF-selected scientists will go to Japan for research stays at institutes of MITI's Agency of Industrial Science and Technology (AIST). Positions will be available at the Electrotechnical Laboratory and the Fermentation Research Institute among others. Both NSF and AIST will support the program. NSF will pay living and travel expenses and a stipend. AIST will provide facilities and equipment, offering U.S. researchers the same opportunities available to Japanese scientists in AIST laboratories.
- NSF's recently launched Japan Initiative is supported by a fiscal 1988 budget of $800,000. The funds will support about 50 Japanese language-study fellowships, the development of curricula and course materials for teaching technical Japanese, and additional research visits to Japan. (See related article in the June 1988 MRS BULLETIN, p. 7.) The initiative will also support U.S. survey teams that will report on progress in Japanese research laboratories and identify additional opportunities for U.S. scientists to perform research there.

For more information, contact: U.S.-Japan Cooperative Science Programs at NSF's Division of International Programs; telephone (202) 357-9558.

Los Alamos Borehole Device "Sees" Two Miles Down

A new borehole televiewing device developed by Los Alamos National Laboratory (LANL) researchers allows geologists and scientists to study features in unfriendly high-pressure, high-temperature underground environments more than two miles down. The borehole acoustic televiewer (BAT), a rugged, real-time, sonar viewing device, transmits and receives sound waves and can operate at temperatures in excess of 500°F. The sound waves recorded by BAT are digitized and relayed by cable to the earth's surface, where researchers can watch a live TV picture of the borehole as the device is lowered.

The heart of BAT is a palm-sized lithium niobate crystal that functions as a transmitter and receiver. It is energized electrically to transmit 526 sound pulses each second while rotating 360 revolutions per minute. BAT's second key component is a tiny downhole heat-resistant computer that preliminarily analyzes the sound-wave information before relaying it to surface equipment. Developed in LANL's Earth and Space Sciences Division to study features in geothermal wells, the BAT also has potential for oil exploration and oceanographic research.

SBIR Program Funds Five Proposals for Advanced Epitaxy Research

Five advanced epitaxy technology proposals submitted by Emcore Corporation under the U.S. federal government's Small Business Innovation Research (SBIR) program will receive Phase 1 research funding from the Strategic Defense Initiative Organization (SDIO), the Defense Advanced Research Projects Agency (DARPA), the U.S. Army Laboratory Command, and the U.S. Air Force. All awards center on work in advanced epitaxy processes that produce complex structures on III-V compound semi-conductors using metal-organic chemical vapor deposition (MOCVD) technology.

In the SDI project, Atomic Layer Epitaxy (ALE) will be used to produce device-quality GaAs materials for device and integrated circuit applications. The most critical aspect of the work is the ability to demonstrate that top quality GaAs materials and structures can be ALE-grown at faster rates than have been achieved to date.

The U.S. Army award calls for Emcore to use advanced MOCVD to uniformly and economically produce GaAs/AlGaAs and GaAs/InGaAs structures for high electron mobility transfer wafers. One Air Force project will study the use of hydrogen in MOCVD. The research is intended to improve the quality of III-V materials growth, thus opening a door to enhanced performance of semiconductor and optoelectronic devices.

The work for DARPA involves developing a viable process to closely monitor MOCVD growth *in situ*. *In situ* monitoring could drastically increase the yield to specifications of MOCVD runs and also enhance materials quality.

Livermore Lab Begins Experiment to Measure Neutrino Mass

An experiment has been designed and built at the Lawrence Livermore National Laboratory (LLNL), California, to make the most accurate measurement to date of the mass of the neutrino. Physicist Wolfgang Stoeffl is in charge of the $3.5 million neutrino experiment.

According to most theories, the neutrino has little or no mass, but in 1980 Russian researchers claimed to have measured a relatively large mass for the neutrino—34 eV. However, despite the efforts of more than a dozen research groups, this finding has not been duplicated. Analysis of a large neutrino burst from a supernova de-

https://doi.org/10.1557/S0883769400064356 Published online by Cambridge University Press

tected in 1987 indicated a neutrino mass of less than 18 eV.

The LLNL experiment will observe the range of energy carried by an electron ejected from tritium when it decays into helium-3. The decay produces two new particles—an electron and an antineutrino, an antimatter particle with the same mass as a neutrino. Both new particles together carry off the 18,605 eV of energy produced by the process. In most cases, the particles share the energy nearly equally, but in a very few cases—about one in every 10 billion tritium decays—the electron takes nearly all the energy. The mass of the neutrino—if it has any—can be inferred from accurately measuring the energy of these electrons.

The key to the LLNL measurements is careful design to minimize any uncertainties and distortions. Design features include: the use of gaseous tritium rather than solid tritium, to avoid distorting the energies of the electrons caused by the collision of atoms in a solid material; location of the experiment in a building made of nonmagnetic materials to have uniform magnetic fields; and adjustment of computer-controlled power supplies to cancel the effects of variations in the earth's magnetic field.

R.J. Brook Awarded Order of the British Empire

Prof. R.J. Brook has been awarded the Order of the British Empire for services in his field. Until recently, Brook was the professor of ceramics at the University of Leeds, United Kingdom. Prof. Brook, who chaired the 1988 E-MRS Spring Meeting Symposium on Ceramic Materials Research in Strasbourg, has recently accepted a chair at the Max Planck Institut für Metallforschung in Stuttgart, West Germany.

Supercomputer Performance from Parallel Processing on Smaller Computers

Scientists at Sandia National Laboratories (Livermore, California) have developed a supercomputer capability from their existing network of 14 VAX computers made by Digital. The system, known as "SUPERNET," uses parallel processing to achieve Cray-like performance. Developed jointly by Sandia Scientific Computing Associates (SCA), and Yale University, SUPERNET links three VAX processors at Sandia Livermore with 11 VAX units in Sandia's Albuquerque facility, a distance of more than 1,100 miles. SUPERNET's software, known as LINDA, enables users to develop applications for parallel computers without having to be concerned with the underlying computer architecture. The user can concentrate on designing, while LINDA coordinates the various parts of the computation.

SUPERNET is not suitable for all types of computations. In some tests, like the rocket plume simulation analysis tested at Sandia, it ran twice as fast as Sandia's Cray 1 supercomputer. In other applications, however, it ran much slower than the Cray. Nevertheless, the object of SUPERNET is not to exceed supercomputing performance, but to achieve similar or equal capability by fully utilizing existing minicomputers. The additional computer capacity obtained through SUPERNET is projected to save many hundreds of millions of dollars nationwide.

David M. Goodman, deputy director, N.J. Commission on Science and Technology (third from left), meeting at EMCORE with (left to right): Bernard Gallois of Stevens Institute of Technology, EMCORE president Norman E. Schumaker, and Bernard H. Kear of Rutgers University.

University/Commercial Partnership to Research Growth of Thin Film High T_c Superconductors

The New Jersey Commission on Science and Technology recently gave a $116,000 superconductor research grant to a research partnership formed by two New Jersey universities, Rutgers University and Stevens Institute of Technology, and EMCORE Corporation, a commercial producer of epitaxy systems. The partnership will study the use of metalorganic chemical vapor deposition (MOCVD) in growing thin film high T_c superconductors. Stevens is the prime contractor, and Rutgers is the subcontractor. EMCORE is providing matching funds and is contributing materials and facilities, bringing the total funding to more than a quarter-million dollars for an initial one-year effort.

Expected benefits include the development of an as yet unproved technique for the growth of high T_c superconductors. Applying large area thin films of high T_c superconductor materials on ceramics and key substrates, like gallium arsenide, is a necessary step for semiconductor applications. The research will be conducted at EMCORE's facilities in Somerset, New Jersey. A graduate student from each school will take sample wafers back to their university labs for further analysis with other academic researchers.

Northwestern Honors M. Meshii and M.E. Fine

Northwestern University recently honored two materials science and engineering professors: Masahiro Meshii and Morris E. Fine. Prof. Meshii was designated a John Evans Professor. Named after the founder of Northwestern, the Evans Professorships are awarded to two or three Northwestern professors each year "to provide recognition for our best faculty."

"Fine Day," a one-day symposium, was held in Fine's honor on May 26 to celebrate his 70th birthday. Eighteen of his former graduate students returned to speak about significant aspects of their professional lives since leaving Northwestern, attesting to Fine's success as a university professor. Fine helped to found Northwestern's Department of Materials Science and Engineering and served as its first chair from 1954 to 1960. A Morris E. Fine Research Professor Chair was also established in his honor. Fine is currently a Walter P. Murphy Professor and is also the director of the Northwestern/AISI Steel Resource Center.

Both Meshii and Fine are members of the Materials Research Society.

Argonne Tests New Nuclear Fuel Electrorefining Process

A new electrorefining process, designed to separate fissionable material from other spent nuclear fuel for recycling and electricity production, is being perfected for use at Argonne National Laboratory's Experimental Breeder Reactor II (EBR-II) in Idaho. Electrorefining will be a key part of the Integral Fast Reactor (IFR) technology featured in the EBR-II facility, resulting in a safer type of nuclear power plant. Tests of the electrorefining process have been carried out near Chicago, at Argonne's IFR Engineering-Scale Electro-refining Facility.

Testing is currently being done using natural uranium, which behaves the same as the highly radioactive uranium fuel that would come from a commercial reactor for processing and recycling. Separation of uranium in 20-lb lots is being routinely achieved. This is about one-third the capacity needed to process the core of a commercial-sized, 1,400-MW IFR reactor. The next step in the development will be to build a similar spent fuel refining facility at the Idaho site, which would complete the demonstration of all elements of the IFR concept.

As shown during the last two years of experimentation at the Idaho EBR-II site, the core of an IFR nuclear power plant will not melt during an accident. In addition, three critical elements enhance the overall safety of the facility. First, it has a pool-type, sodium-cooled reactor. The core and other major components are submerged in a pool of molten sodium which provides passive protection against overheating. Second, the IFR uses a new metallic fuel that transmits heat rapidly. This limits heat build-up and enhances core cooling. Third, the IFR fuel electrorefining process is conducted in a facility at the power plant site, making it more economical. And because the fuel materials are too radioactive to handle without heavily shielded remote systems, unauthorized fuel diversion is eliminated.

ARCO Solar/SERI Announce Record Photovoltaic Efficiency

ARCO Solar, Inc., in cooperation with the Solar Energy Research Institute (SERI) of the U.S. Department of Energy (DOE), announced they have achieved an 11.2% sunlight-to-electricity conversion efficiency in large-area, photovoltaic thin-film modules. The record-breaking accomplishment is expected to have important implications for the use of photovoltaics in the production of economic electrical power in the 1990s.

In making its breakthrough, ARCO used a copper/indium/gallium diselenide (CIGS) based solar cell in a one-foot square module. Solar cells in calculators and other solar-powered consumer products have a 3-5% conversion efficiency. More costly single-crystal solar modules being developed for advanced space needs have about 18% efficiency. Therefore, achieving more than 10% efficiency in a practical module using the low-cost thin-film design approach is considered a near-term breakthrough in the effort to reach 15% efficiencies for these types of photovoltaic panels. In addition to the new efficiency record, the material used in the module was also found to be extremely stable in an outdoor environment.

The achievement resulted from a three-year DOE/SERI initiative involving four industrial companies. Its purpose is to develop a technology base for low-cost, high-performance, thin-film photovolataic modules. Similar research initiatives have

https://doi.org/10.1557/S0883769400064356 Published online by Cambridge University Press

produced progress in other thin-film cell and module technologies, including amorphous silicon, polycrystalline silicon, and cadmium telluride-based materials.

Sandia Reports New Source of Coherent Vacuum Ultraviolet Light

Sandia National Laboratories has announced the development of a tunable and efficient new laserlike source of coherent vacuum ultraviolet light (VUV) suitable for applications ranging from SDI hardware to chemical analysis. The new device will generate coherent ultraviolet radiation at 130 nm, with almost a thousandfold improvement in efficiency over previous designs, and is tunable over the 120-140 nm range.

Built by Spectra Technology, Inc. (Bellvue, Washington), the VUV device maximizes conversion efficiency by using a sum-frequency mixing technique in which optical beams of different wavelengths are mixed in mercury vapor. This has produced efficiencies of 6%, considerably higher than the 0.01% efficiencies typically observed. The coherent light is virtually identical to that of a laser even though the process involves no population inversion and no stimulated emission. The device has generated 800 μJ of radiation at 130 nm, a record for this wavelength. The nearly 1 mJ of energy achieved so far is released in short pulses of about 1 ns resulting in powers of about 1 MW. The technical feasibility of scaling up to the 1-J level and beyond has also been demonstrated.

A 1-J light source emitting at 130 nm would excite oxygen atoms in the air. This is an application being studied for producing ionization channels for possible SDI uses. Other uses for tunable, bright sources able to operate in this area of the spectrum include laser spectroscopy to study basic chemical processes, photolithography to make microelectronic circuits of submicron line width, and possible diagnostic use in detecting oxygen impurities in tokamak fusion machine plasma.

Materials Researchers Receive Superconductivity Tech Transfer Award

Two Los Alamos National Laboratory (LANL) materials researchers received the Special Award for Excellence in Technology Transfer for their help in developing a joint research program in high temperature superconductivity between the Public Service Company of New Mexico (PNM) and LANL. The award was presented to James Smith and Terry Wallace by the Federal Laboratory Consortium, a national group that promotes the commercialization of technology developed in federal laboratories.

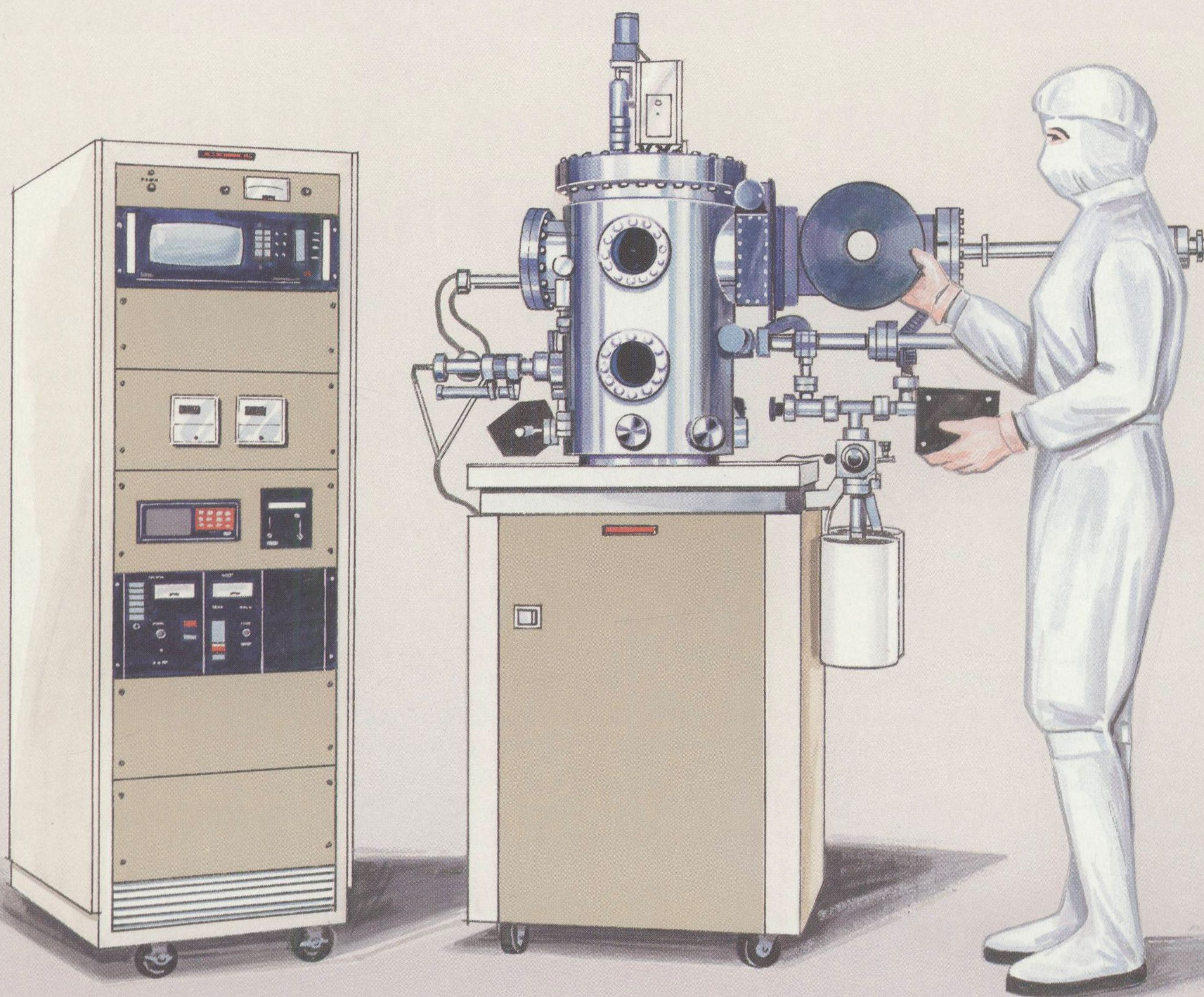
The LANL/PNM collaboration, titled "Advanced Study Program in High Temperature Superconductivity Theory," is designed to help establish the theoretical base for high temperature superconductivity. It was established in November 1987 by Nobel laureate Robert Schrieffer through a $570,000 grant by PNM to LANL. Many of the theorists already supported by this program will be in attendance at a three-week Los Alamos workshop in August, focusing on theories explaining why materials become superconducting at the atomic and electronic level.

The U.S. Department of Energy recently designated Los Alamos as a Superconductivity Pilot Center to promote collaborative efforts in the field between research institutions and industry.

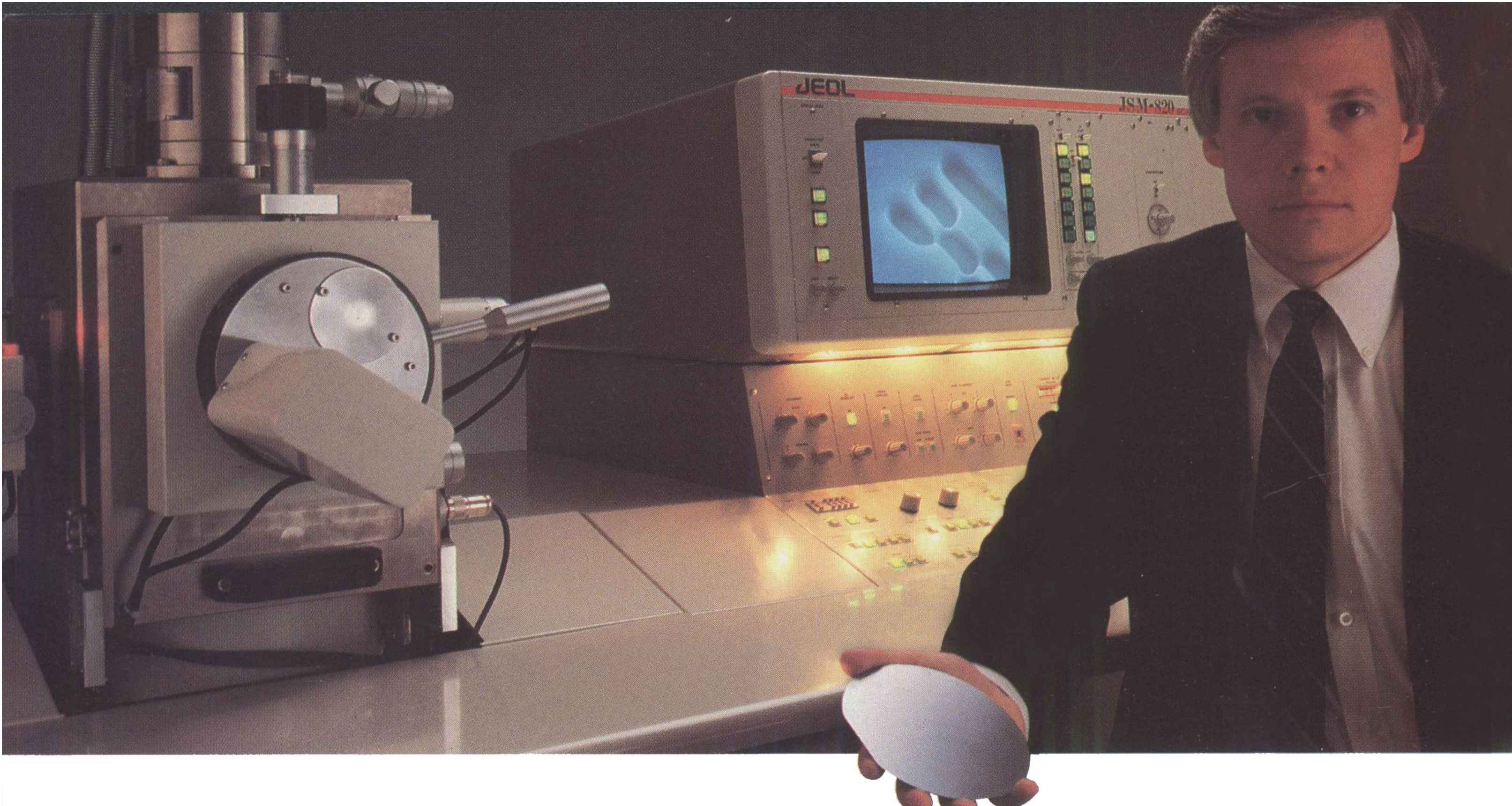
Brimrose Awarded SBIR Contracts

Brimrose Corporation of America (Baltimore, Maryland) was recently awarded $1.3 million in six different Small Business Innovation Research (SBIR) contracts: two Phase II awards from the Strategic Defense Iniative Organization (SDIO), totaling $1.1 million, for follow-up work to the development of a single-element GaP two-

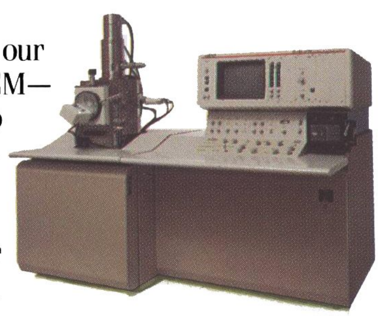
https://doi.org/10.1557/S0883769400064356 Published online by Cambridge University Press



https://doi.org/10.1557/S0883769400064356 Published online by Cambridge University Press

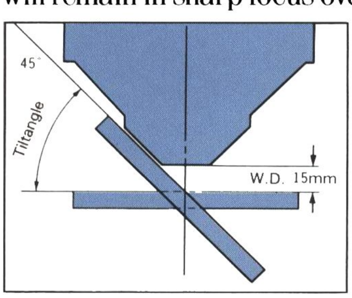


Any Way You Look At This, You Get Sharp Images.



When you put a specimen into our high performance, imaging SEM—the JSM-820—you are going to get bright, clear, sharp images with an absolute minimum of operator effort.

Its large specimen chamber accepts specimens up to 6″ in diameter. And with its motor-driven eucentric stage, you can examine those specimens, quickly and easily, at a wide variety of orientations, and they will remain in sharp focus over a wide range of operating conditions.



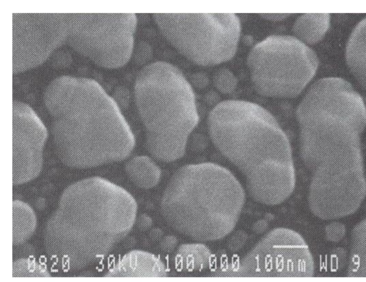
The small conical pole piece of the "mini lens" permits large specimens to be viewed at large tilt angles.

Images are sharp because the JSM-820 is equipped with computer controlled electron optics, a corrected field (C-F) mini lens and a zoom condenser system.

As the name "mini lens" suggests, the pole piece of the objective lens is physically small and conically shaped so that large specimens may be highly tilted even at short working distances.

And the "corrected field" feature of the mini lens means the electron probe size is minimized at all working distances and accelerating voltages. That will bring you sharp images for metal coated and non-conductive samples, even at low accelerating voltages—e.g. from 0.3 KV.

With the "zoom condenser," the focus point on the specimen stays the same as the spot size is altered, and, therefore, images remain sharp over a wide range of operating conditions.



The C-F mini lens and precision electron optics system give extraordinary resolution.

And with "computer control," the JSM-820 makes all of the interactive adjustments which accompany changes in operating conditions. In fact, with the instrument's auto focus, auto contrast/brightness and astigmatism monitor, even a novice operator can get sharp images every time.

The JSM-820 SEM is available with a full complement of options including a backscattered electron detector, EDS and WDS X-ray spectrometers, EBIC and voltage contrast, and it comes complete with installation, documentation, user training, applications assistance, warranty and field service.

For literature or a demonstration, call PEABODY, MA (617) 535-5900 or PALO ALTO, CA (415) 493-2600. Or write JEOL U.S.A., Inc., 11 Dearborn Road, Peabody, MA 01960.

JEOL
Serving Advanced Technology

https://doi.org/10.1557/S0883769400064356 Published online by Cambridge University Press

dimensional acousto-optic (A-O) laser beam deflector, and the development of a mirrorless A-O beam steerer. The company also received four Phase I awards, totaling $225,000, for work on materials growth, materials characterization, and nondestructive testing and evaluation of II-VI infrared materials and of high energy density solid propellants.

The Phase II follow-up to last year's design and fabrication of a laser beam deflector involves developing a 16-bit twin acoustical axis device, including the design of an optical programmable logic array and a global interconnect network. The latter devices provide increased parallel processing with fewer devices. The second Phase II contract involves developing a mirrorless A-O high efficiency 10.6 micron laser twin acoustical beam steerer from tellurium (Te) that will be able to handle higher optical powers.

One of the Phase I contracts involves the growing of device-grade CdZnTe crystals for the U.S. Army's Night-Vision Lab. The crystals will be used as substrates for HgCdTe epitaxial film layers because HgCdTe has been found to be superior defector material for wavelengths in the 3-5 and 8-14 micron IR range atmospheric window.

Prototype of Advanced Photon Source Undulator Tested

A new undulator, a key component in the 7-billion-electron-volt Advanced Photon Source (APS) to be built at the Argonne National Laboratory, has successfully passed its first tests. The device is the prototype for a magnet array that will be used to help produce highly focused x-rays, 10,000 times brighter than currently possible. When constructed, the APS is expected to yield practical advances in basic materials research in areas such as petrochemicals, medicine, metallurgy, plastics, electronics, and coal.

The undulator is used to jiggle a speeding beam of charged particles, causing them to emit intense beams of x-rays. It was designed by Argonne scientists in collaboration with Cornell University (Ithaca, New York) and Spectra Technology, Inc. (Bellevue, Washington), who built the prototype.

Tests at the Cornell High Energy Synchrotron Source (CHESS) gave scientists a glimpse of what the new generation of synchrotron radiation facilities might achieve. Test x-rays were used to:

- make a flash photograph (one ten-billionth of a second) of protein crystals that would have taken days using existing facilities;
- determine the precise positions of nickel atoms in a high temperature superconductor;
- measure ultralow concentrations of elements in meteorites and geological samples; and
- determine the structure of ultrathin organic films widely used in optic and microelectronic applications.

APS Prototype Undulator	
Length	2 m
Brilliance	1.7×10^{15} photons/s/ 0.1% B W/mrad^2/mm^2
Period (wave length)	3.3 cm
Vacuum chamber gap	1.4 cm
Undulator aperture	1.3 cm
Magnets (neodymium-iron-boride)	244
Poles	122
Periods	62

The undulator (see table) contains more magnets than any array of its kind ever built for a synchrotron x-ray source. It uses permanent neodymium-iron-boride magnets to cause the particle beam to bend 122 times over its 6.5-foot length, thereby producing high-energy x-ray beams. The undulator uses robotics to adjust the gaps between magnet pole pieces for more precise tunability of x-ray energies.

When built, the APS will accelerate bunches of positrons to nearly the speed of light and store them in a circular ring about four football fields in diameter. Arrays of powerful magnets (undulators and wigglers) will vibrate the positrons in flight, causing them to emit beams of intense, highly focused x-rays. The design and construction of the APS is funded by the U.S. Department of Energy's Office of Basic Energy Sciences.

G.L. Geoffroy Named Penn State Department Head

Gregory L. Geoffroy, a professor of chemistry at the Pennsylvania State University, was named head of the Department of Chemistry, effective July 1. He succeeds Frederick W. Lampe, head of the department since 1983, who returned to full-time teaching and research at the university.

Geoffroy joined the Penn State chemistry faculty as an assistant professor in 1974, the same year he earned his doctorate at the California Institute of Technology. He was made an associate professor in 1978 and a full professor in 1982. A specialist in organometallic chemistry and catalysis, Geoffroy has been honored with Guggenheim and Sloan Foundation Faculty Fellowships, and with the Dreyfus Teacher-Scholar Grant for outstanding ability as a chemical educator and researcher.

Geoffroy is a member of the Materials Research Society and the American Chemical Society, and currently serves as secretary of the latter's Division of Inorganic Chemistry. A 1968 graduate of the University of Louisville, he was honored there recently with the Louisville Engineering and Scientific Societies' Council Award for the most outstanding senior science or engineering major.

Industrialist Named Provost of University College London

Derek Roberts, the current deputy managing director of the General Electric Company (GEC), was named the new provost of University College London, effective April 1989. In making the announcement, the College cited Robert's extensive accomplishments in both the academic and industrial worlds. He is a graduate of the University of Manchester, a visiting professor of physics at the University of Lancaster, a member of the BBC's Science Consultative Committee, and an ex-president of physics and mathematics, as well as engineering in the British Association for the Advancement of Science.

In the 1960s, Roberts expanded the small semiconductor group at Plessey into a 150-person research organization. He became director of the 400 person Allen Clark Research Center, and in 1967 was appointed managing director of the Microsystems Division. He joined GEC in 1969 as director of research and formed GEC Research, Ltd. with a staff of 2,000. In 1980 he became a Fellow of the Royal Society. He assumed his present GEC position in 1985.

New Materials Institute Formed in United Kingdom

A new Federation of Materials Institutes was formed in the United Kingdom in June 1988 to coordinate and consolidate the activities of professional bodies and learned societies in materials applications, engineering, and science. The purpose of the new Federation, which presently consists of the Institute of Ceramics, the Institute of Metals, and the Plastics and Rubber Institute (PRI), is to provide unbroken coverage of the entire field and to promote a wider understanding of engineered materials.

The present body will be governed by a council consisting of the presidents and other representatives of the founding societies. Offices will be located at the PRI. Additional information is available from the secretary of the Federation, Sir Geffrey Ford, c/o Institute of Metals, 1 Carlton House Terrace, London SW1Y 5DB, United Kingdom. □