10% Electrical Efficiency Reported for Compact Blue Laser

A compact, efficient source of blue laser light developed by scientists at IBM's Aladen Research Center in San Jose, California is reported to have 10% efficiency in converting electricity into blue light and to be able to produce stable, low-noise output that can be focused to diffraction-limited spots.

The laser device uses frequency doubling to convert infrared light into blue light. It operates so effectively, say scientists William J. Kozlovsky and Wilfried Lenth, because of a specially designed electrical feedback system, which analyzes a small fraction of the infrared light from the diode laser and adjusts the electrical current feeding the diode.

Advances Also Made in Direct Blue Laser

Infrared pumping and upconversion have led to the demonstration of a laser that directly produces blue light with more than twice the frequency of the infrared light used to initiate the laser action.

The laser uses a yttrium lithium fluoride crystal with a 1% "doping" of erbium ions. Under the right conditions of temperature and doping density, pairs of erbium ions can share their energy so that some climb to still higher energy levels while others drop to lower levels. Erbium ions that reach a particularly high energy level can then create blue laser light when they relax.

Low temperature (below 20 K) is currently required for the upconversion laser, but is not believed to be a fundamental limitation. This advance was recently reported by IBM scientists Roger Macfarlane and Wilfried Lenth working with visiting scientists Thomas Hebert from the Fritz-Haber Institut in Berlin and Reinhold Wannemacher from the University of Frankfurt.

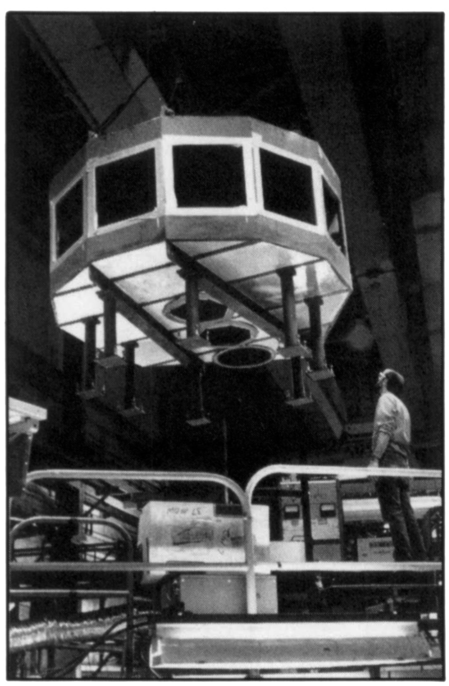
Neutron Diffractometer Measures Structures of Glasses, Liquids

The first neutron diffractometer dedicated to measuring the structures of glasses and liquids is now in operation at Argonne National Laboratory's Intense Pulsed Neutron Source (IPNS). The Glass, Liquid and Amorphous Materials Diffractometer (GLAD) takes advantage of the copious supply of short-wavelength neutrons available at a pulsed spallation source such as IPNS.

According to David L. Price, who headed the Argonne team that built GLAD, "The use of wavelengths as low as 0.1 Å will make it possible to obtain complete diffraction patterns at low scattering angles and avoid the systematic errors due to absorption and inelasticity effects that have plagued many measurements of this kind made to date on conventional instruments."

Data, says Price, can be collected simultaneously over a wide range of scattering vector Q, overlapping with the small-angle region at low Q (0.05 $Å^{-1}$) and extending out to Q values as high as 50 $Å^{-1}$, corresponding to very high spatial resolution in the radial distribution functions. A wide range of sample environments will be available, including low temperature (10 K), high temperature (1500 K) and, eventually, high pressure.

The materials to be studied at GLAD will include metalic, covalent and insulating glasses, polymers, molten salts, liquid metals and molecular liquids, as well as two-dimensional systems, for example, intercalated in graphite. Investigations will extend to crystalline systems with a substantial degree of atomic disorder of different kinds (i.e., quasicrystals, plastic crystals and oxide superconductors). Research at GLAD is expected to lead to advances in communications, nuclear waste storage, advanced batteries, and nuclear fuel processing.



GLAD, the Glass, Liquid and Amorphous Materials Diffractometer, comes in for a landing at Argonne National Laboratory's Intense Pulsed Neutron Source. General users will have access to 25% of the beam time on GLAD.

Funding for GLAD was provided by an the Department of Energy's Division of Materials Sciences through a participating research team from the University of Houston headed by Simon Moss.

Beam time on GLAD is available 25% of the time to general users. Those interested should contact David L. Price, Materials Science Division, Argonne National Laboratory, Argonne, IL 60439; telephone (708) 972-5475; fax (708) 972-3308.

Joint Project to Develop *In Situ* Diagnostics for High T_c Film Deposition

Advanced Fuel Research, Inc. (AFR) of East Hartford, Connecticut and Oak Ridge National Laboratory recently announced a joint cooperative research project to develop *in situ* diagnostic instrumentation to monitor the critical process parameters during laser abalation deposition of high-temperature superconductor films. This instrumentation will then be used to develop a superconductor film IR detector.

The $200,000, cost-shared, one-year effort will develop instrumentation to monitor process parameters, including the gas phase species that deposit on the substrates, the optical properties of the film, and the temperatures of both the substrate and target. The research at AFR will be led by Phillip W. Morrison Jr., and the work at Oak Ridge will be directed by C.H. (Winston) Chen.

According to Morrison, AFR has received a Small Business Innovation Research Phase II contract from the U.S. Army Strategic Defense Command to develop Fourier Transform Infrared (FTIR) spectrometry to monitor the temperature and optical properties of films, substrates and targets during deposition of superconductive films. Oak Ridge will provide expertise and laser ablation deposition equipment, including a mass spectrometer and flourescence spectrometer for *in situ* monitoring of gas phase species. AFR will provide the FTIR spectrometry equipment and expertise required for the *in situ* monitoring of the deposited films.

Department of Energy support is being provided by its Office of Utility Technologies through the High Temperature Superconductivity Pilot Center at Oak Ridge.

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Engineering Academy Honors Top Engineers

The National Academy of Engineering has named Neal R. Amundson and Solomon J. Buchsbaum recipients of the 1990 NAE Founders Award and the Arthur M. Bueche Award, respectively. The awards will be presented on October 2 at an honors program during the Academy's annual meeting.

The NAE Founders Award, established in 1965, recognizes outstanding contributions by an engineer to both the profession and society. Admundson, who is Cullen Professor of chemical engineering and professor of mathematics at the University of Houston, was chosen for "his contributions to the advancement of the discipline of chemical engineering, blending mathematical analysis and practical applications, and for inspiring generations of students to attain leadership positions in academia and industry."

The Arthur M. Bueche Award was established in 1982 in honor of Bueche, who served as senior vice president for corporate technology of the General Electric Co. and as a member for the governing council of the NAE. Buchsbaum, senior vice president, technology systems, AT&T Bell Laboratories, was selected for the Bueche Award "for his leadership in promoting mutual understanding concerning science and technology among leaders in universities, industry, and government and for rendering insightful technical advice to five U.S. presidents."

High T_c Electrical Lead Carries 2,000 A in Tests

A high T_c electrical lead jointly developed by Westinghouse Science and Technology Center, Pittsburgh, and Argonne National Laboratory has carried 2,000 A of current, twice as high as its 1,000 A design rating and nearly 10 times higher than current previously reported for power devices using high-temperature superconductors. In the tests, the lead also reduced boil-off of the liquid helium used to cool superconducting devices by up to 40% compared to conventional leads.

The lead, about 64 cm long and about 7.4 cm in diameter, uses an array of 17 rectangular bars made from a composite of silver and yttrium-barium-copper oxide. Using high-temperature superconducting ceramics in the low-temperature part of the lead gives the lead the potential to reduce helium boil-off. Operating in a temperature range where they are superconductors, the ceramics virtually eliminate resistive heating. Helium boil-off is further reduced because they do not readily transmit heat to liquid helium.

At the 2,000 A level, the current density of the superconductor is reported to be about 250 A/cm^2, and the maximum magnetic field about 180 gauss.

Remote Sensors Use Ultrathin Mirrors, Fiber Optics to Detect Contamination

Adapting commercially available fiber optics, scientists at Sandia National Laboratories have demonstrated remote sensors that can be used for contaminant detection and control. The sensors are part of a suite of environmental technology instruments being developed to help monitor air, water, and soil. Potential applications include monitoring drainage areas around underground storage tanks or waste dumps and monitoring for atmospheric contamination.

The tiny sensors are built by evaporating ultrathin films (100 Å) of nickel, silver, palladium, gold, and other metals onto the cleanly cut ends of thin optical fibers. The coatings, called micromirrors, show changes in reflective quality when exposed to selected chemicals in experiments.

The precise reflectivity of a coating is measured by sending optical signals through the fibers to the micromirrors and then monitoring the strength of the return signal with a photo detector. A solid-state laser or light-emitting diode serves as the light source, emitting rapid pulses of coherent light at 10,000 pulses per second. To date, researchers have successfully detected mercury, oxygen, nitrogen oxide, chlorine, sulfur dioxide, and hydrogen sulfide using the mirrored fibers.

Work is also under way on a polymer-modified micromirror sensor, using a plasma-deposited polymer to detect concentrations of organic pollutants, such as trichloroethylene and other solvents. In these sensors, a clear polymer deposited atop the micromirror coating swells when contacted by organic compounds. This affects the reflection of optical signals to the photo detector.

In laboratory experiments, the micromirror sensors have detected two chemical processes: chemisorption, which quickly reduces the optical thickness of the mirror metal, although by only a few molecular layers; and a slower "bulk" reaction that changes the entire micromirror film into a

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compound of the reacting chemical.

In the polymer-modified sensor, light is reflected by both the metal surface and the end of the polymer coating. Reflected light waves from the two surfaces interfere with one another. The intensity of the light returning to the photo detector thus becomes a measure of the swelling of the polymer film. Difficulties in bonding the polymer to the metal coatings and understanding how to optimize the thickness of the polymer are among the problems still to be overcome.

The remote sensors, although not yet ready for commercial production, have several advantages, including their small size, which could make them easily portable, and the optical data retrieval system. Fiber optic connections would allow the sensors to remain in place in underground or other applications.

Michael A. Butler, Antonio J. Ricco, and Kent B. Pfeifer have been named as co-inventors in a patent application for the micromirror chemical sensor.

Optical Interconnect Combines Microlasers with Planar Optics

An interconnect module now combines what AT&T Bell Laboratories calls the world's smallest surface-emitting lasers (two million fit into a fingernail-size area) with integrated free-space optics in a planar sandwich structure. The module can link electronic chips, planar lenses, and microlasers all on a common substrate.

The interconnect modules are expected to be used in photonic switching applications, for optical VLSI interconnects, and as optical backplanes. The modules are expected to overcome the high cost and low precision problems associated with conventional optical packaging by using photolithographic VLSI techniques to provide submicron alignment precision.

Alignment is achieved with submicron precision during pattern generation by using an electron-beam writer. The optical components can, for example, be implemented as diffractive optical elements with multiple discrete phase levels.

All optical components are fabricated on one side of a planar optical substrate (e.g., quartz glass). The components are coated with a reflective layer after being etched into the glass. The bottom surface of the substrate is also made reflective using a metallic or dielectric coating. The light, which is entered under an oblique angle, hits all the components until it reaches the output window.

For applications in photonic switching, it is of interest to combine integrated free-space optical circuits with optoelectronic components such as light modulators or lasers. Surface-emitting microlasers with low threshold currents show promise for making two-dimensional transmitter arrays with low electrical and thermal loads.

"AT&T looks forward to applying these technological opportunities sometime during the 1990s," said an AT&T source.

Advanced Ceramic Heat Exchanger Could Lead to More Efficient Coal-Burning Gas Turbines

Hague International, South Portland, Maine, is working on a concept that could create high-efficiency coal-burning gas turbines by solving the traditional problems associated with mating a conventional coal combustor, with its hot, impurity-laden exhaust, to the relatively fragile gas turbine.

Hague's concept is to use a ceramic heat exchanger positioned between the coal combustor and gas turbine, serving as a barrier to the impurities of the coal gas while allowing its heat to flow through a stream of clean, high-pressure air. The hot air, in turn, would spin a gas turbine. Unlike conventional metal heat exchangers, which begin to deteriorate when the temperature exceeds 1700°F, the ceramic heat exchanger, if successful, is expected to withstand the furnace-like, 3500°F blast of a coal combustor. Equally important, it will be able to transfer enough heat to raise the air stream temperature to as high as 2300°F, the inlet temperature of a modern-day, high efficiency gas turbine.

The project is a 30-month, $4.2 million effort. The Energy Department is providing $2.2 million, while Hague and a group of industrial sponsors are contributing $2 million.

IBM Supercomputing Competition Winners Announced

Nearly a quarter million dollars was awarded to 14 winners of the IBM Supercomputing Competition from among the more than 170 entries. Contestants were required to submit papers done on IBM 3090 VF supercomputers in one of four research categories: physical sciences and mathematics; engineering; life and health sciences; and social sciences, humanities, and the arts.

First prize in the engineering category went to Stephen B. Pope of Cornell University, P.K. Young of Penn State University, and S.S. Girimaji of Cornell University for their paper on "Stretching and Bending of Material Surfaces in Turbulence."

First prize winners were awarded $25,000, while second and third place winners received $15,000 and $10,000, respectively. Some of the prize money went to university sponsors of first prize papers.

Registrations for this year's contest are due **October 16, 1990**, and papers are due **January 15, 1991.** For information, contact a local IBM branch office or: IBM Competition Administrator, 36 Mill Plain Road, Suite 404, Danbury, CT 06811; telephone (203) 794-1355, fax (203) 792-7507.

ASTM Opens European Office in England

The American Society for Testing and Materials (ASTM) opened its European office on May 1 in Hertfordshire, England. The office will answer questions about ASTM, coordinate symposia and standards technology courses held in Europe, and provide rooms for standards development meetings. Contact: Office Manager, Bill Keeshan, ASTM European Office, 27-29 Knowl Piece, Wilbury Way, Hitchin, Herts SG4 OSX, England; telephone 44-462-437933; fax 44-462-433678.

LaCourse Receives Award for Excellence in Teaching

William LaCourse, professor of glass science at the New York State College of Ceramics at Alfred University recently received a 1990 Chancellor's Award for Excellence in Teaching. This year's Chancellor's Awards were presented to 146 professionals selected from among the teachers, librarians, and professional staff at the 64-campus State University of New York system.

LaCourse was nominated for the award based on his professional achievements, his overall contribution to the progress and goals of the college, and his personal qualifications, Since 1985, LaCourse has taught 12 different courses, ranging from an introduction to the field of ceramics and glass to graduate-level courses and seminars.

A member of the Materials Research Society, LaCourse has presented new theories to the international community on the processing and structure of glass, and has obtained research grants totaling nearly $1 million.

Penn State Heart-Assist Pump Designated International Landmark

The American Society of Mechanical Engineers (ASME) has designated the Penn State heart-assist pump an International Historic Mechanical Engineering Landmark. Since 1976, the pump has provided circulatory support for open-heart surgery patients who could not be weaned from heart-lung machines. It also is used in the transition before cardiac transplant operations and can sustain patients for weeks to months. The device is the first surgically implantable, seam-free pulsatile blood pump to receive widespread clinical use.

An interdisciplinary group from the Colleges of Medicine and Engineering at Pennsylvania State University, led by William S. Pierce, M.D., and James H. Donachy, pioneered the application of fluid mechanics in blood pump development and the use of segmented polyurethane as the blood-contacting material.

Other co-developers of the pump, John A. Brighton, a mechanical engineer, and Winifred M. Phillips, an early collaborator, worked on flow phenomena and pump shape. Gerson Rosenberg contributed to the mechanical design and pump bench evaluation. Additional members of the engineering team included faculty and graduate students from mechanical, aerospace, and chemical engineering and materials science. □

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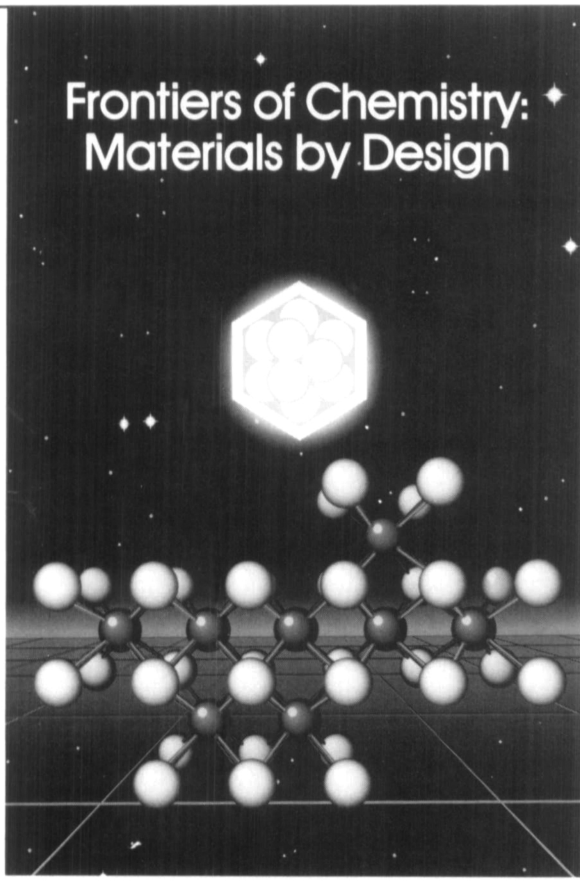

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Banquet speaker is Dr. Peter Bridenbaugh, Vice President of Research and Development for Alcoa. Presenters include Dale Niesz, James Economy, Robert N. Katz, James T. Staley, Anthony G. Evans, Robert O. Ritchie, Albert S. Yee, Matt Tirrell, Terry Michalske, John W. Cahn, Stephen G. Moran, Bernard H. Kear, Karl Spear, Lewis B. Weisfeld, Richard W. Hertzberg, Lance A. Davis, and Leonard C. Feldman.

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If you are interested in presenting a poster session (or would like more information about the materials conference), contact Dr. Robert E. Stobaugh at CAS (614-447-3600, ext. 2196). Telefax: 614-447-3713.

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