Blue-Green Laser Announced by 3M, Purdue/Brown

In separate studies, researchers at the 3M Company and a team from Brown and Purdue Universities have announced success in producing semiconductor lasers that emit blue-green light, a long-sought goal. Traditional semiconductor lasers produce red or infrared light. The shorter wavelength of blue-green light means up to four times more data can be stored. The new material, based on the II-VI compounds, is constructed one atomic layer at a time, using molecular beam epitaxy, eliminating earlier defects that hindered electrical properties.

The 3M laser team led by Charles Walker, corporate scientist in charge of the company's Photonics Research Laboratory, made its announcement this past summer, while Purdue, in collaboration with Brown University, presented their device in September at the Fifth International Conference on II-VI Compounds in Japan.

The new laser is designed to be integrated with GaAs. Currently, the crystal emits only a pulsed blue-green beam of light. Robert Gunshor, professor of microelectronics at Purdue, said further engineering developments are necessary to eliminate the pulsing and make the laser operate continuously. "I wouldn't be surprised if in a year's time this would be a more practical device, one that could be incorporated into consumer and high-technology electronics," he said.

The development holds potential for several applications:

- Blue-green laser technology could aid laser imaging in medical diagnostics and also may speed the use of plastic, instead of glass, in fiber optics.
- Blue-green light, because it travels easily underwater, can enhance submarine-to-submarine communications.
- Full-color, flat televisions and computers could benefit from the superior efficiency of the light-emitting diodes made possible by the laser.
- Compact and computer disks could hold more information because a blue-green laser can "read" more finely.

Two-Dimensional Polymers Form Sheets

Working with colleagues at the University of Illinois Materials Research Laboratory, Samuel I. Stupp has produced two-dimensional polymers that can be described as molecular sheets with properties normal polymers do not have.

The new molecular structure is made by chemically joining long one-dimensional monomers at two different points on the molecule. A hydroxyacid with a strong dipole moment is incorporated near the center of the molecule and one end is terminated with a p-pentoxy biphenyl, causing the chains to self-align and bond. "By connecting small molecules self-organized into layers at two different positions, molecular sheets form," Stupp said. "We are taking elongated molecules and sewing them together in a double stitch. The result is a two-dimensional polymer."

The sheets have a natural tendency to stack up with each other, making possible layered membranes to filter chemicals, for example. Other applications could include the reinforcement of normal polymers by dispersing molecular sheets through them, use of the new polymer's stable nonlinear optical properties (infrared light beamed through the polymer sheet doubles its frequency, shifting it to green), and pollution cleanup because of the material's ability crumple and uncrumple, thus engulfing particles.

"These polymers are more stable over time and temperature—in every way—than normal polymers. This is an intriguing approach to materials chemistry for the next century," Stupp said.

University of Pittsburgh to Establish National Materials Research Center

The University of Pittsburgh was awarded $5 million by the U.S. Air Force to establish a national materials research center for developing advanced materials.

"Researchers will be designing entirely new substances from the molecular and atomic levels up," said Pitt President J. Dennis O'Connor. Research spinoffs are expected to lead to new high-performance materials, including alloys for use in severe environments, optical and electro-optical nonlinear devices, biological and chemical sensors, new catalysts and fuels, and drugs to enhance learning and memory.

"We anticipate eventual breakthroughs in a variety of material processes crucial to the scientific, technological, and military competitiveness of the United States in the global arena," said O'Connor. And because Congress also included a requirement for technology transfer to industry, said O'Connor, he sees the center as a major resource to a broad spectrum of industry not only in western Pennsylvania, but thoughout the United States.

Co-directors of the new center, chemistry professor Sanford Asher and engineering professor Fred Pettit, say that research will focus on four areas:

- High-Performance Structural Materials. This area includes new metal alloys and polymers with higher strengths, able to withstand very high temperatures and having coating resistant to corrosion and erosion;
- Electro-Optical Systems. Already under way are the development of eye protection against lasers and the production of faster switching systems in computers. These efforts will be expanded and new laser systems will be developed.
- New Catalysts. Applications will range from catalysts to produce synthetic fuels to those to destroy nerve gas.
- Biotechnology. The aim is to develop biological and chemical sensors and also drugs to enhance learning and memory.

GE, Ford Create Large, Gem-Quality Carbon-13 Diamonds

Teaming with Ford Motor Company, GE R&D scientists have synthesized large gem-quality diamonds composed almost totally of the isotope carbon-13. The two collaborators—GE as a diamond synthesizer and Ford as a materials characterizer—produced a diamond of unsurpassed purity and higher atomic density at room temperature than any other solid, surpassing natural diamonds. Ford experiments showed that increasing the carbon-13 concentration decreased interatomic spacing slightly (by 1.5 parts in 10,000), as would be expected theoretically.

The diamonds are composed of 99% carbon-13, while natural diamonds are 99% carbon-12, and only 1% carbon-13. They are produced by a two-step process employing chemical vapor deposition (CVD) followed by high pressure.

Methane gas is used as the carbon source for a low-pressure CVD, producing aggregates of small diamonds. A unique aspect of the GE process is its ability to produce diamonds of any isotopic composition, limited only by the purity of the methane. The value of the purest available carbon-13-enriched methane is 99%, and GE is exploring ways to improve the isotopic concentration of both carbon-12 and carbon-13. After deposition of the diamond aggregates, high-pressure technology dissolves and recrystallizes them into gem-quality diamonds a carat or more in weight.

In 1990, GE announced the synthesis of 99.9% "isotopically pure" carbon-12 diamonds, which turned out to be excellent heat conductors useful for the electronics industry. As for the synthesized carbon-13 diamonds, scientists speculate that they will be harder than natural diamond, useful for abrasive applications such as machining, grinding, sawing, and drilling.

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The GE-Ford collaboration has been expanded to include other experimental and theoretical studies of both isotopically modified and impurity-doped diamond.

Frontier Research Program in Japan Begins Phase Two

The Frontier Research Program, established by Japan's RIKEN (Institute of Physical and Chemical Research) in 1986 to carry out long-term fundamental research based on new ideas, has begun a second phase of study in advanced materials, plant homeostasis, and glycobiology. The program welcomes to laboratories in Japan researchers from a wide range of scientific fields under an internationally open and flexible system extending beyond the framework of traditional research systems.

The second phase of the materials program focuses on research into novel materials at the nanometer level. New techniques for precisely controlling the assembled states of constituent atoms or molecules of semiconductors, metals, polymers, and biomaterials (proteins) at the nanometer level will be developed to create novel functional materials applicable in electrô-and photo-active devices for information science and technology. Properties will be analyzed from a quantum mechanical viewpoint.

Fundamental research will be carried out in three major materials fields—quantum materials based on the atomic level control of inorganics, organic photonics materials based on the functional construction of organic molecules, and exotic materials based on the low dimensional assemblies of organic and inorganic materials. Three research laboratories are involved in this program: the laboratory for nano-electronic materials, the laboratory for nano-photonic materials, and the laboratory for exotic nano-materials.

Highly qualified researchers from Japan and abroad are invited to engage in a variety of scientific fields in intensive research for definite periods. Some 100 researchers, a third of whom come from abroad, have now participated in the system. Since one objective is to organize a wide-open research system, the program is specifically planned for easy access for foreign researchers.

Bazant to Head International Association of Fracture Mechanics of Concrete Structures

Zdenek P. Bazant, Walter P. Murphy Professor of Civil Engineering at Northwestern University, has been elected president of the newly formed International Association of Fracture Mechanics of Concrete Structures (IA FRaMCoS).

According to Bazant, the Association's overall goal is to promote research on fracture mechanics and to introduce fracture mechanics concepts into the design practice of concrete structures. Its principal activity will be to organize periodic international conferences on fracture mechanics, he said. The first international IA FraMCoS conference, organized by Northwestern University, will be held June 1-5, 1992, in Breckenridge, Colorado.

The first election of officers of the Association took place June 19 in Noordwijk, the Netherlands. Also elected to the IA FraMCoS governing body were Secretary, B.I.G. Barr of University College, Cardiff, Wales, and Coordinator, Folker Wittman, Swiss Federal Institute of Technology, Zürich. IA FraMCos headquarters will be in Evanston, Illinois.

Cohen to Receive Mehl Award

Jerome B. Cohen, dean of the McCormick School of Engineering and Applied Science at Northwestern University, has been selected to receive the Robert Franklin Mehl Award, presented annually to honor an outstanding scientific leader. As awardee, Cohen will deliver a lecture on "The Early Stages of Solute Distribution Below a Transition Temperature," at The Minerals, Metals & Materials Society's annual meeting to be held next March in San Diego.

Cohen received SB and ScD degrees in metallurgy from the Massachusetts Institute of Technology. He was Fulbright Scholar and studied with A. Guinier at the University of Paris. He has been a faculty member at the McCormick School of Engineering since 1960 and became dean in 1986.

Cohen's research interests span residual stress, thermodynamics, ordering, clustering, local order, phase transitions, x-ray diffraction, defects in oxides, polymers, catalysts, alloys, and ceramics. He has coauthored over 300 papers and three books.

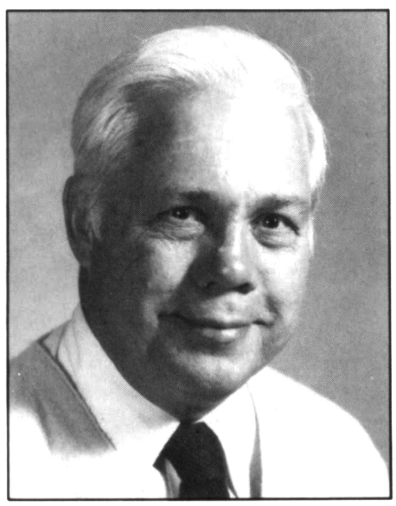
Apelian Awarded Mathewson Gold Medal

Diran Apelian, provost and Howmet Professor of Engineering at Worcester Polytechnic Institute, will be recognized as the Champion H. Mathewson Gold Medal Award recipient at The Minerals, Metals & Materials Society 1992 annual meeting, March 1-5 in San Diego. The award is given for a paper or series of papers that represent a notable contribution to metallurgical science. Apelian's recognition stems from a series of three papers published in *Metallurgical Transactions B* on the plasma processing of materials and near net shape casting.

Apelian received his BS degree in metallurgical engineering from Drexel University and PhD in materials science and engineering from the Massachusetts Institute of Technology. His research interests are in materials processing and, specifically, solidification processing.

He was awarded the Howard Taylor Gold Medal in 1987 by AFS and the Howe Medal in 1990 by AIME for the best paper in *Metallurgical Transactions.* He has over 190 publications to his credit and has coedited four books. As a member of the Materials Research Society, he has organized several symposia at spring and fall meetings.

Walter Brown Honored for Service, Leadership at AT&T



Friends and associates gathered at AT&T's Murray Hill, New Jersey, research center on October 5 to celebrate Walter Brown's commitment of more than 40 years of service to Bell Labs and his contributions to science and technology. Brown, formerly head of the Radiation Physics Department, is now head of the Thin Film Metal and Dielectric Research Department.

A committee comprised of scientists originally hired by Brown organized the day-long event at AT&T's Arnold Auditorium. Committee members included John Poate, Len Feldman, Raju Ragharan, Lou Lanzerotti, and Gunther Wertheim.

Research Vice President Arno Penzias delivered the first of the day's 14 lectures, each of which combined science updates with personal anecdotes of associations with Brown over the years.

Physicist Franz Saris said, "I met Walter Brown at a symposium 25 years ago and I've followed whatever he has done ever since. What he has been doing has always told me what I should be doing."

Brown's personal assistant, now retired, Walter Augustyniak, said, "Walter Brown is a very unselfish person who has been a father image to an awful lot of people. He's the type of person who is involved in everything—who wishes he were 10 people—but who never seeks out glory for himself. That's why this day is so important."

"This event is really a tribute to Bell Labs, and to the quality of the people that we have here," said Brown.

Brown, who has been active in the Materials Research Society since 1978, served as Councillor, Symposium Organizer, Fall Meeting Chair, and as a Principal Editor of *Journal of Materials Research.* He is presently Editor-in-Chief of *Journal of Materials Research* and the newly established *JMR Abstracts.* In 1984, Brown received the Von Hippel Award of the Materials Research Society for his pioneering studies on semiconductor surface states, semiconductor radiation detectors, and the application of particle/solid interactions to the study of materials.

Technology Extension Services Expand in Germany and Japan

Germany's successful technology extension service is rapidly expanding in an effort to transfer promising technologies to the eastern part of the country. Since reunification, the federal government has opened 19 new Fraunhofer Institutes in the east, at a cost of almost $300 million, the American Embassy in Bonn reports.

Before unification, there were 35 Fraunhofer Institutes, funded in part by the federal government. These Institutes encourage German companies to introduce new technologies into their processes and products. Pre-unification West Germany was spending approximately $500 million a year in technological outreach to small and medium-sized firms, primarily through the Fraunhofer Institutes.

The Institutes receive about one-third of their operating revenues from the federal government and the remainder from user fees. "A measure of the success of the Fraunhofer Institutes is that they are able to survive on the open marketplace," says a recent report from the U.S. Embassy in Bonn. "Indeed, not only have they survived, but by all accounts they are prospering."

Some of the new institutes set up in the east include the following:

- Institute for Software Techniques and Systems Technology, Berlin;
- Institute for Applied Polymer Research, Brandenberg;
- A Manufacturing Operations and Automation center, Saxony-Anhalt; and
- An Optics and Precision Mechanics center in Thuringia.

Five institutes in Saxony will be set up, including:

- Electron Beams and Plasma Physics (the former Manfred von Ardenne Institute);
- Materials Physics and Lamination Technology;
- Ceramics and Sinter Materials;
- Molding Technology; and
- Machine Tools.

The Fraunhofer Society also plans 10 smaller branch units of Institutes operating in western Germany.

Japan also has an extension program aiming to orient small and medium-sized companies to technological advances. The technological extension centers in Japan, so-called Kohsetsushi, exist in every prefecture and have a cumulative annual budget of $606 million.

There are 172 Kohsetsushi centers located throughout the country. They employ 6,713 professionals, 5,129 of whom are engineers and researchers. In 1988, these centers handled 472,000 cases of providing technological assistance. Technical advisory teams were sent to companies on 72,400 occasions. The centers provided testing and analysis services in 922,000 cases. And small and medium manufacturers used the facilities at the Kohsetsushi in 63,500 cases. The centers maintain lists of 4,000 consultants.

The average annual budget for each center is $3.5 million. They work closely with Japan's federal government, but most of the funding is provided by local governments. The centers are paid for by MITI, user fees, and local governments.

Nothing on the German or Japanese scale exists in the United States. The U.S. spends more than $1 billion a year on its agricultural extension service, but nowhere near that amount on technology extension programs, many of which are new. "The Kohsetsushi are eminently successful in bringing technological service to small and medium enterprises," say U.S. Embassy science and technology personnel. "By stressing technological upgrading, they seem to be adapting to current needs."

Excerpted from an article by Richard McCormack in *New Technology Week* 5 (43) (1991) p. 3.

Roy Selected for International Science Lectures

Rustum Roy, Evan Pugh Professor of the Solid State at Pennsylvania State University, delivered the first of an International Lecture Series entitled, "New Materials: Fountainhead for New Technologies and New Science" at the National Academy of Sciences in Washington, DC, in September. He was selected by the Academy's Commission on Mathematical and Physical Sciences to deliver the lectures at sister

◆ New Materials Development
◆ New Characterization Methods
◆ New Process Technology

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◆ Technical Program

- A: Amorphous Silicon Technology - 1992
- B: Chemical Surface Preparation, Passivation and Cleaning for Semiconductor Growth and Processing
- C: Advanced Metallization and Processing for Semiconductor Devices and Circuits - II
- D: Photo-Induced Space Charge Effects in Semiconductors: Photoconductivity, Spectroscopy and Electro-Optics
- E: Defect Engineering in Semiconductor Growth, Processing and Device Technology
- F: Mechanisms of Heteroepitaxial Growth
- G: Electronic Packaging Materials Science VI
- H: Materials Reliability
- Ia: Materials Interactions Relevant to Recycling of Wood-Based Materials
- Ib: Materials for Energy Technologies
- Ic: Materials for Separation Technology
- J: Materials Issues in Art & Archaeology III
- K: Materials Modification by Energetic Atoms and Ions
- L: Microwave Processing of Materials
- M: Novel Forms of Carbon
- N: Better Ceramics through Chemistry V
- O: Chemical Processes in Inorganic Materials: Metal and Semiconductor Clusters and Colloids
- P: Aerosol Precursors to Materials
- Q: Intermetallic Matrix Composites II
- R: Submicron Multiphase Materials
- S: Layered Superconductors: Fabrication, Properties, and Applications
- T: Defect Structures in Crystalline Electronic Oxides
- U: "Smart" Materials Fabrication
- V: Macromolecular Host-Guest Complexes: Optical and Optoelectronic Properties and Applications
- W: Computational Methods in Materials Science
- X: Frontiers of Materials Research
- Y: Materials for Micro-Electro-Mechanical Systems

◆ Job Placement Bulletin Board

A Job Placement Bulletin Board for MRS Spring Meeting and Short Course attendees will be open Tuesday through Thursday during the Meeting. Contact Jane Stokes at MRS Headquarters to request application forms and/or information: (412) 367-3003; FAX (412) 367-4373.

◆ Symposium Aide Opportunities

Graduate students who plan to attend the Spring Meeting and who are willing to assist in the symposium presentations to earn a waiver of entry fees are encouraged to apply for Symposium Aide positions.

◆ Equipment Exhibit

A major exhibit of the latest analytical and processing equipment which closely parallels the nature of the technical symposia will be located in the Yerba Buena Ballroom, San Francisco Marriott Hotel, convenient to the technical session rooms. For show booth information, contact: Bob Finnegan, MRS Show Manager, American Institute of Physics, 335 East 45th Street, New York, NY 10017; Telephone (212) 661-9404; FAX (212) 661-2036.

◆ Short Course Program

Courses on advanced materials characterization, preparation, and processing/diagnostic techniques have been designed for scientists, engineers, managers, and technical staff who wish to update their knowledge and skills in the research, development and processing of materials. These up-to-date courses are at the forefront of science and technology and complement Spring Meeting symposia. Class sizes are limited. Early preregistration is encouraged.

◆ Proceedings

Many of the MRS symposia will be publishing proceedings. For a complete list of MRS publications and prices, contact Materials Research Society, Publications Department, 9800 McKnight Road, Pittsburgh, PA 15237; Telephone (412) 367-3012; FAX (412) 367-4373.

◆ Preregistration

Preregister by telephone, (412) 367-3003, or FAX (412) 367-4373, with your VISA, MasterCard or Diners Club card. Ask for Meeting Registration and your preregistration will be completed for you. Telephone preregistrations are accepted between 8:00 a.m. and 5:00 p.m. EST, Monday through Friday. Confirmations will be mailed within 10 working days.

To request detailed 1992 Spring program, short course, or symposium aide information, contact:

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The 1992 MRS Spring Meeting will serve as a key forum for discussion of interdisciplinary leading-edge materials research from around the world. Various meeting formats - oral, poster, roundtable, forum and workshop sessions - are offered to maximize participation.

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institutions worldwide as a means of stimulating international collaboration.

The International Science Lecture Series is sponsored by the Office of Naval Research. Last year, Walter Munk of Scripps Oceanographic Institution delivered the lectures in oceanography on his Heard Island work. This year, materials research is at the forefront of national policy attention and the Academy's recent report stressed opportunities in materials synthesis.

Roy's lecture drew on his experience at Pennsylvania State University's Materials Research Laboratory, where he has been involved in materials synthesis and process development for more than 40 years.

Roy cautioned against overstating the properties of new materials since they are often near physical limits, and emphasized the role of serendipity and careful observation in synthesis. Based on his research, Roy said he foresees a family of materials in the new nanocomposite field, but also believes economic and social constraints will increasingly guide the materials scientist of the future.

Roy also presented the lecture in Tokyo in October, and will do so again in India, the United Kingdom, Scandinavia, and the Soviet Union early in 1992.

Polymers Used to Synthesize Forsterite, Make Glass Ceramics

Cornell University scientists have used polymers to help synthesize pure forsterite, a ceramic mineral able to emit laser light at the optimal frequency for fiber-optic transmissions. The researchers have also used the new method to make glass ceramics of potential interest to the electronics industry and say their approach offers significant advantages over existing methods of manufacturing these substances.

The method uses methacrylates, linear organic polymers, and (in this case) silicon to form inorganic glasses and ceramics. The polymers provide a matrix for inorganic elements and then their organic constituents are baked away. Depending on experimental conditions, the results can be either a noncrystalline glass or a crystalline ceramic.

Glass-ceramics are ideal for containing integrated circuits and their silicon substrates. The ceramics have mechanical strength, they don't expand or contract much when heated, and their electrical resistance is high, making them a good medium for insulating electronic devices from one another.

Synthesis of forsterite, a major constituent of the Earth's crust, is significant because the product is pure and may be amenable to formation as a thin film for use in electronic devices. In 1988, scientists found that forsterite doped with minute amounts of chromium forms a tunable, solid-state laser. Furthermore, forsterite lases in the near-infrared, a region attractive for optical communication. Laser output from chromium-doped forsterite is greatest at 1,235 nm, very near the 1,276 nm wavelength at which the capacity of the cable to carry information can be exploited to the fullest.

In the new process, polymers are cross-linked into a three-dimensional array just before heating. Timing is critical in the process because if the cross-linking occurs too quickly, the material becomes intractable. If it's too slow, the product does not form properly. The process can be carried out at 900°C—well below the 1200 to 1300°C normally required for making such materials.

The researchers' next steps include pursuing the synthesis of forsterite in an optically pure form suitable for lasers and expanding on their new route to ceramic glasses.

Volkswagen Foundation to Provide Scientific Aid for Eastern Central Europe

The board of trustees of the Volkswagen Foundation, Hannover, Germany, has agreed to launch development projects to promote science in Eastern Central Europe, including funds for science libraries in five countries. Funding will also be provided for scholarship programs to Polish humanities and sociology students, and for grants to institutions in the former German Democratic Republic. Last year, the foundation provided a total of DM203 million (about $124 million) for the promotion of science and technology. □

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