The Royal Microscopical Society Names Goodhew as President

In September 1994, Peter Goodhew (University of Liverpool) was named president of the Royal Microscopical Society (RMS). He believes that RMS should make a particular effort to reach out to the general public to show the many types of microscopes now available can be both "delightful and useful." A project which especially attracts his support is RMS's campaign to ensure that every primary school has a simple high-quality light microscope. Society needs a more scientifically literate population, he says, and fascination with the visual aspects of microscopy experienced at an early age is likely to develop into a more serious appreciation of the scientific method later in life.

Peter Goodhew has been the Henry Bell Wortley Professor of Materials Engineering at the University of Liverpool since 1990. His early career was spent at the University of Surrey where he was responsible for the development of their electron microscopy laboratory and where he later became a professor in 1986. Goodhew's research has centered on the application of transmission electron microscopy to metals and semiconductors. He has written several books on electron microscopy and takes a special interest in the development of computer-aided methods of teaching microscopy.

Liquid Crystal Institute to Develop High-Speed Flat-Panel Display

Kent State University's Glenn H. Brown Liquid Crystal Institute (LCI) received a $1.93 million, three-year grant from the Advanced Research Projects Agency (ARPA), which it will use to perfect a display. With the production of a reflective, flat-panel display, the advent of interactive, electronic newspapers, magazines, and books whose pages appear on a lightweight, tablet-size viewer could be about three years away, said Roger Fidler, director of Knight-Ridder's Information Design Laboratory. "These tablets represent a new class of computer, blending text, video, audio, and graphics," he said.

The liquid-crystal-based technology also holds promise for displays on handheld computers, pagers, faxes, and other portable devices that are small, light, and energy-efficient, and that produce high-contrast images.

Researchers at the University of Stuttgart, Germany, will assist researchers at LCI in the fabrication of a page-size, prototype display screen with micron-size picture elements (pixels). LCI director, J. William Doane, said that the pixel density of the prototype to be developed—about 4 million pixels per page-size display—will be much higher than current television pictures, and will allow for the high-definition displays needed to make detailed graphics and other information easy to read.

According to the research plan, a high-speed display, produced on a lightweight-but-rugged, plastic material, will be completed by mid-1995. Each page on the prototype screen will appear in a fraction of a second, the equivalent of turning a paper page by hand.

ART Receives Award to Develop Ceramic Reinforcements

Advanced Refractory Technologies (ART) (Buffalo, New York) received an award from the New York State Energy Research and Development Authority to evaluate and develop ceramic reinforcements for metal matrix composites using surface treatment technology developed by Clarkson University. The award is over $100,000 for a one-year term.

The project will combine ART's commercial silicon carbide whiskers (SiCw) and Clarkson's coating technology to develop and test coated SiCw to reinforce aluminum and magnesium for use in things such as automobile engine components. Using ceramic reinforcements like SiCw improves the metal's mechanical properties and decreases its thermal expansion, thereby providing better performance and enabling tighter component tolerances.

Donald J. Bray, director of technology at ART, said, "If these coated whisker materials are successfully used in aluminum for pistons, the resulting piston could minimize unburned hydrocarbons and significantly reduce auto emissions."

Crystalline and Amorphous Polypropylene Rubber Combined with an Oscillating Catalyst

Chemists at Stanford University have found a way to combine the hard and soft forms of polypropylene, resulting in a range of new plastics that have a variety of elasticities. At one end of the scale, chemists can make polypropylene cords that stretch only slightly when pulled. At the other end, they can make cords that stretch easily and snap back as readily as rubber bands.

The catalyst involved is made from metallocene. It consists of a metal atom sandwiched between two flat rings made out of five carbon atoms. To this basic compound, the chemists have attached an additional ring to the side of each of the two original rings. The metal atom is the site where the short propylene monomers are joined to form the long polypropylene molecules. When the two additional rings are both on the same side of the catalyst, it makes the amorphous form of the polymer. When the two rings are on opposite sides, the crystalline form is created.

The two ring groups rotate rapidly around an axis passing through the metal atom. Normally, they rotate much faster than the polymerization process, producing a random mixture of the two types of polypropylene. To control the process, Robert M. Waymouth, assistant professor of chemistry, and Geoffrey W. Coates, a doctoral student, added extra groups of atoms to the rotating rings to slow the rate of rotation until it was close to that at which the polypropylene chains were created. This resulted in a catalyst that oscillates between different configurations and therefore creates polymers that alternate in structure along the chain. This enabled the scientists to control the lengths of the crystalline and amorphous sequences created on the polypropylene strands by varying the pressure and temperature of the reaction. In this fashion they have been able to vary the percentage of crystallites in the materials from zero to 30 percent.

Polypropylene rubbers may replace more expensive natural rubber and synthetic elastomers in applications that range from automobile bumpers to clothes fibers. Polypropylene rubbers also have a significant environmental advantage. They can be readily recycled, and, unlike rubber bands, they can be melted and reused.

Waymouth and Coates announced the production of elastic polypropylene in *Science* (January 13).

European Synchrotron Radiation Facility Begins Operation

The European Synchrotron Radiation Facility (ESRF) in Grenoble began experimental operation in September 1994. The 12 countries participating are France, Germany, Italy, Great Britain, Spain, Switzerland, Belgium, the Netherlands, Denmark, Finland, Norway, and Sweden. These countries have cooperated to build an electron storage ring with a circumference of 845 m, which will produce brilliant x-rays and provide a number of experiment areas in which this "light" will be utilized for conducting research into the structure of matter.

As the lengths of the electromagnetic waves at these energy ranges of x-rays are roughly equivalent to the atom spacings in solid particles and particularly in crystals, scientists are able to gain vital information when their interactions with matter are "illuminated." The x-ray light quanta or photons are deflected and scattered in a specific way, and from the spectra it is possible to calculate the arrangement of the atoms. In the ESRF storage ring, the x-ray beams are produced by forcing electrons into circular orbit moving at almost the speed of light. This deflection is the physical equivalent of an acceleration and these charged particles radiate electromagnetic waves, ranging— depending on the acceleration energy— from visible light to the very "hard" x-rays. The most important criterion in synchrotron radiation is the intensity, or the number of photons per cross-sectional unit, since the greater the intensity, the smaller the target objects may be. Similarly, high intensities allow exposure times to be shortened—important with highly sensitive organic-biological substances—and facilitate the monitoring of each step of the fast dynamic processes generated. Compared to traditional x-ray tubes, which produce a similar photon spectrum, the intensity of the ESRF is one hundred million times greater.

—From the *German Research Service Special Science Reports.*

Drexel Opens Thermal Spray Technology Applications Center

Drexel University's Center for the Plasma Processing of Materials (CPPM) opened its Thermal Spray Technology Applications Center (TAC) in December 1994. Designed for industrial "problem-solving" the TAC provides short- and intermediate-term thermal spray coating solutions for industrial problems. TAC is employing the results and expertise developed by the CPPM during 10 years of industrial research as its chief resources.

TAC initiatives include coatings to replace chromium plate, tool and die coatings for component life extension, aqueous corrosion-resistant coatings, polymeric corrosion-resistant coatings, automotive coatings, and new wear-resistant materials.

Edward Haig Nicollian, Distinguished Professor of Electrical Engineering and Engineering Science at the University of North Carolina—Charlotte (UNC) and a valued member of the Cameron Center research community, died unexpectedly on December 17, 1994.

He was a pioneer in the field of silicon microelectronics. His contributions spanned a 26-year career at Bell Laboratories in Murray Hill, New Jersey and an 11-year tenure as a professor at UNC. He contributed to the development of the industry by obtaining a detailed, penetrating, and critically useful understanding of the behavior of the silicon/silicon-dioxide/metal capacitor. This device forms the heart of the silicon field effect transistor, and it was Ed Nicollian who cleared the path forward as the industry encountered and surmounted an endless series of obstacles to the fabrication, mass production, and miniaturization of these devices. In the process, he published many important papers in the scientific literature, was awarded eight patents for invention of microelectronic devices, and wrote a seminal text "MOS Physics and Technology" which has become the standard reference in the field. He built upon his understanding of this field throughout his life and continued to invent useful applications for the Si/SiO_2 system. At UNC he developed methods for using MOS capacitors to characterize semiconductor silicon that were embodied in commercial instruments. He followed this development with the creation of a commercial venture company, Pielco (Piedmont Electronics Company), that was the receptacle for his inventiveness. He invented and developed a computer program that integrated his own expert knowledge of the Si/SiO_2 interface to make it possible for the uninitiated to use his knowledge. At the time of his death, this development was undergoing evaluation at a major semiconductor manufacturer. At UNC, he entered into a collaboration with Raphael Tsu, with whom he conducted extensive studies of the effects of quantum confinement in silicon microcrystals embedded in a SiO_2 matrix.

This work commanded his attention not only because of its intrinsic beauty, but also because it promised an increase in the functionality of silicon transistors. Ever mindful of the potential for engineering progress in his work, Ed Nicollian disclosed several inventions based upon quantum confinement in the year prior to his death.

Those of us who were privileged to know and work with him lost a wise, supportive, and enthusiastic colleague, a model of critical passion and integrity, a generous friend.

HARRY J. LEAMY

Researchers Use Many-Body Theory to Describe High-Temperature Superconductors

Scientists at Stanford University and the Massachusetts Institute of Technology collaborated in a series of experiments on six high-temperature superconductors. Their data may provide an empirical basis for developing a more general theory than the current band theory of electron transport that can describe how electrons can move within materials like high-temperature superconductors, where the current theory breaks down.

Zhi-Xun Shen (Stanford University), William E. Spicer (Stanford University), David M. King (Stanford University), Daniel S. Dessar (Stanford University), and Barry O. Wells (MIT) published their paper in the January 20 issue of *Science*, reporting the results of the most detailed studies of high-temperature superconductors yet performed by photoemission spectroscopy, which provides direct information about electron movement within such materials.

"In materials like the new superconductors, the electrical and magnetic interactions between electrons appear to be so strong that the one-electron approximation of band theory no longer works," says Shen.

Instead, he and his colleagues argue that a fundamentally different approach will be necessary, called many-body theory. It explicitly takes into account the electrical interactions between large numbers of individual electrons. Electron interactions are directly related to the phenomenon of superconductivity. The only known way that electrons can move through a material without colliding either with the atoms or each other—and so achieve electrical movement without resistive losses—is by moving in pairs.

To measure the binding force between the superconducting electron pairs, the researchers looked at the differences in the energy and direction of the electrons emitted when a material is in a normal and a superconducting state.

In all the high temperature superconductors that they tested, the scientists found that this binding force is stronger in one direction, relative to the material's lattice, than in another. This provides an important clue to the origin of this force. In conventional superconductors, the binding force is the same in all directions. But theories that propose a magnetic source for the superconducting electron binding force predict that it will be stronger in some directions than in others and are consistent with these observations.

In Situ Technique Developed for Direct Probing of Gas Molecule

Pratibha L. Gai and Edward D. Boyes from DuPont Central Research and Development (Wilmington, Delaware) have developed an *in situ* technique for directly probing interactions between gas molecules and solid surfaces on the atomic scale, especially for studies in catalysis and in materials science. Boyes and Gai began this project with a study of atomic structures of surfaces directly under reaction conditions of high temperatures and gas pressures. This required the development of an environmental cell in a Philips 300 kV high resolution transmission electron microscope. One of the first applications studied by the group using this technique was understanding surface structure modifications of complex vanadyl pyrophosphate catalysts used industrially for the oxidation of n-butane to maleic anhydride. By studying the solid catalyst surface-gas reactions *in situ*, it was possible to propose a model for the alkane activation. The method may eventually allow scientists to engineer material and catalytic surfaces.

Klein and Cheng Receive DHPP Awards

The American Physical Society (APS) Division of High Polymer Physics (DHPP) awarded Jacob Klein of the Weizmann Institute of Science the 1995 High Polymer Physics Prize "for his pioneering experiments on diffusion and interfacial structure of polymers." The prize is sponsored by the Ford Motor Company. DHPP awarded Stephen Z.D. Cheng of the University of Akron the 1995 Dillon Medal "for outstanding productivity in research on semicrystalline, liquid crystalline, and high performance polymers." The winners will be honored at the APS March Meeting in San Jose.

SBIR Update

Advanced Refractory Technologies, Inc. (ART) (Buffalo, New York) was awarded Phase I SBIR funding from the Department of Defense to study component development for improved pulse power batteries. The award amounts to approximately $75,000 for a six-month technical feasibility demonstration effort. ART is to develop thin, porous aluminum nitride separator plates for improved Lithium-Metal Sulfide (LiMS) batteries.

High-Temperature Superconductor to be Used in Transformer

A transformer containing high-temperature superconductors (HTS) will be designed and built by ABB Secheron Ltd. (Switzerland), with technology and components developed by American Superconductor Corporation (Westborough, MA).

The HTS transformer replaces the copper wire coils in traditional transformers with nearly lossless HTS wire. Liquid nitrogen is used not only for cooling the HTS coils, but also to act as a dielectric around the coils, replacing the dielectric oils used in conventional transformers. The use of liquid nitrogen is preferable since it is a nonflammable, environmentally friendly substance.

The project is supported by Electricite de France; SIG, the electric utility of Geneva, Switzerland; a research consortium of the Swiss electricity supply utilities industry; and the Swiss Department of Energy. Upon completion in late 1996, the prototype HTS transformer will be tested in the electric power grid in Geneva.

The team will design, manufacture, and test a 630 kVA transformer. This is the first step toward the development of larger transformers using high-temperature superconductors. Utilities and industrial users of electricity employ transformers to increase or decrease the voltage of power systems.

Laser Processing of Teeth Reduces Formation of Cavities

Scientists from the University of Rochester and Eastman Dental Center found that treating teeth with short pulses of low-energy laser light boosts resistance to cavities. The technique has been tested only on extracted teeth in the laboratory; the scientists say more studies are needed before dentists can apply the technique. The technique works by instantaneously melting and then fusing a tooth's enamel coating, making the enamel more chemically resistant to the acids that cause cavities. Scientists liken the technique to the annealing process used to strengthen steel and glass. When the laser technique is used in conjunction with a fluoride treatment, one experiment showed, cavities were completely stopped.

John Featherstone, chair of the Department of Oral Sciences at Eastman Dental Center and associate professor at the University, Wolf Seka, a laser expert at the University's Laboratory for Laser Energetics and associate professor at the Institute of Optics, Daniel Fried, assistant professor at Eastman Dental Center, and senior technicians Richard Glena and Sandra McCormack studied the effects of various laser wavelengths on teeth. They found that a pulsed carbon dioxide laser tuned to either 9.3 μm or 9.6 μm is almost completely absorbed by the enamel, preventing the light from traveling farther into the tooth where it would cause damage.

The team uses about 25 100 ms pulses to heat the surface of the enamel (the outermost 5 μm) up to 1000°C in a fraction of a second. The heat momentarily melts the crystalline structure, knocking out some of the decay-prone carbonate molecules. When the enamel fuses, it is 70–85% more resistant to acids.

The project is funded by the National Institute of Health. □

Recently Announced CRADAs

Oak Ridge National Laboratory (ORNL) (Oak Ridge, Tennessee) and **DELTA M Corp.** (Oak Ridge, Tennessee) are jointly developing mineral-insulated cables for use in experimental fusion reactors where the performance of normal diagnostic cables tends to deteriorate. DELTA M is primarily responsible for fabricating the mineral-insulated cable designs using various new material combinations. DELTA M will produce samples of the mineral-insulated cables using alumina, mullite, and cordierite powders. ORNL will provide DELTA M with the new material combinations, and will evaluate the performance of the cables.

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