K.C. Taylor Receives Olin Corporation's Garvan Medal

The 1989 Garvan Medal, presented annually by the American Chemical Society (ACS) for distinguished service in chemistry, will be awarded April 10 to Kathleen C. Taylor, head of the Physical Chemistry Department at General Motors Research Laboratories and former president of the Materials Research Society.

Sponsored by Olin Corporation, the award will recognize Taylor's contributions to basic and applied research on the composition, properties, and performance of noble metal catalysts, widely used in catalytic converters. Her service to scientific societies and national organizations also contributed to the selection.

The Garvan Medal was established in 1936 by Francis P. Garvan, president and founder of Research Corporation and a philanthropist dedicated to science education. It honors contributions to chemistry from any discipline by women who are U.S. citizens.

Taylor, who received an AB with high honors in chemistry from Douglass College at Rutgers University, and a PhD in physical chemistry from Northwestern University, also attended the University of Edinburgh for two years as a postdoctoral research fellow.

At GM, her original research dealt with heterogeneous catalysis, especially with reductive processes involving nitric oxide on ruthenium and noble metal catalysts, and elucidated reductive processes in such systems. Applications of this research by her group led to an understanding of catalytic conversion of nitrogen oxides in automobile exhaust and to a book, *Automobile Catalytic Converters*, published in 1984. Currently, she oversees the following areas at GM: catalysis, surface chemistry, surface coatings, corrosion, combustion, batteries, fuel cells, and chemical processes. She has more than 20 other publications to her credit and gives presentations on a regular basis.

Taylor has served in several capacities with the Materials Research Society, including five years as Treasurer; one term each as Second Vice President, First Vice President and Past President; and chair of several committees. She is currently serving her third term as Councillor. She is also chairman of the Materials Research Advisory Committee for the National Science Foundation. She has been elected to four positions with ACS's Division of Industrial & Engineering Chemistry and three with the Michigan Catalysis Society. In addition, she was an NSF Exchange Fellow in Novosibirsk, USSR in 1974, and in 1986 was the Francois Gault Lecturer in Catalysis of the Eurocat Group of the Council of Europe, a lectureship established to recognize work in heterogeneous catalysis.

A. Wolfenden Named Fellow of Texas Engineering Experiment Station

Alan Wolfenden was selected recently as a 1988-1989 Texas Engineering Experiment Station (TEES) Fellow at Texas A&M University. The award recognizes significant and sustained contributions made in research to enhance the national reputation of the College of Engineering and the University.

Wolfenden, who received his DSc from the University of Liverpool in 1986, was also promoted to the position of area leader of the Materials and Manufacturing Area within the Mechanical Engineering Department.

Wolfenden's research has focused on experimental determinations of elastic modulus and damping at high temperatures for advanced materials such as metal matrix composites, thermoelectrics, aluminides, and carbon-carbon.

Pulsed Neutron Source Gets New Uranium Target

An upgrade of the Intense Pulsed Neutron Source (IPNS) at Argonne National Laboratory now provides the country's most powerful pulsed neutron beams for examining the structure of materials.

The new target contains a high percentage of uranium-235 and provides two and one-half times the number of neutrons previously produced. This provides a much brighter light for examining the structure of matter.

The machine has been used to examine, among other things, the structure of alloys, the myelin sheath that surrounds nerve cells, the hardness of tooth enamel, catalysts for refining petroleum, and the new high temperature superconductors. The facility is used by research teams from universities, industry, and both foreign and national laboratories.

Four pulsed neutron facilities exist, two in the United States and one each in England and Japan. The Argonne machine was the first of these available for use by the research community and has remained the most reliable and broadly used, according to Bruce Brown, IPNS director.

In the IPNS, hydrogen atoms are stripped of their electrons to produce protons that are given a push along a magnetically ringed metal tube. They are quickly accelerated to a high speed using an electrical energy of approximately 500 million eV.

In just a few thousandths of a second the accelerator surges the protons into a 50-foot-long "sausage-shaped cloud" moving at three-quarters the speed of light. At that moment a magnetic gate is opened for 100-billionths of a second and the hurdling sausage is released from the confines of its magnetic race track to smash into its target.

The splash of neutrons shaken loose from the uranium by the force of this impact is channeled into beams and directed at the material to be analyzed. As many as 13 neutron beam lines can be operating at once in the Argonne machine, with a different sample at the end of each one.

Most of the neutrons pass through the sample material, but a small percentage will encounter an atomic nucleus and bounce off. Sensitive instruments detect this and the pattern of the bounces reveals the underlying atomic structure.

In building the world's first IPNS, Argonne refitted an obsolete synchrotron to accelerate the protons to a speed sufficient to knock neutrons free of a target material. In doing so the laboratory saved the government $50 million. The entire IPNS machine was put together in 1980-1981 for only $9 million.

As long as the research results are to be published in open literature Argonne makes no charge for the use of the IPNS, which operates 24 hours a day. The cost is covered by the U.S. Department of Energy's Office of Basic Energy Sciences. If the machine is used by a private company and the results are to be kept for its own use there is a charge of $3,500 a day.

Argonne Set to Build 7-GeV Advanced Photon Source

Argonne National Laboratory is designing and preparing to build a new synchrotron radiation source, the 7-GeV Advanced Photon Source (APS), that will provide the world's most brilliant x-ray beams for research.

The APS will produce x-rays for materials research, condensed-matter physics, chemistry, and biological and medical research by industry, universities, and other national laboratories. Potential results include improved understanding of materials—their structures and behavior—that could lead to better processes and materials for catalysts, computers, superconductivity, and biotechnology.

The APS consists of two principal parts:

1. The linear accelerator/booster synchrotron system accelerates positrons to energies of 7 GeV and higher.

2. The positrons are injected into a storage ring, an evacuated aluminum pipe more than half a mile in circumference, where they circulate around the ring and emit beams of energetic synchrotron radiation, or photons. The photon beams emerge along tangent lines from the ring for use in experiments.

At the APS, experimental data will be gathered by directing x-rays from a beam line onto a specimen to observe how they interact. The facility will eventually support 100 beam lines for users. As more radiation strikes a small area of the specimen, more detail can be observed in complex systems and fast-moving events.

The crux of the APS design is its optimization for the inclusion of special magnet arrays called "insertion devices," which manipulate the positron beam to generate brilliant, energetic, highly directional x-rays. Placed in straight sections of the storage ring, these devices make the positron beam wag from side to side, emitting synchrotron radiation with specially tailored properties. "Wiggler magnets" generate intense radiation over a wide range of energies, while "undulator magnets" yield radiation of selected energy at high brilliance—ten thousand times more brilliant than is available from present sources.

Likely benefits of the APS include:

- Real-time observation of the chemical reactions in coal combustion, leading to cleaner ways to burn coal or convert it to other fuels.
- Ability to study samples 200 times smaller than with existing x-ray sources, which could provide new information about zeolites and other catalysts and lead to more efficient industrial processes (petroleum cracking, for instance).
- Detailed, nondestructive studies of complex polymer structures, strains, and defects in semiconductors, and structural changes in steel during heat treatment.
- With its unique ability to image reactions taking place in billionths of a second, the APS could also be a major new tool for protein engineering and chemical analysis.

Current plans call for construction to begin in 1989, taking about five to seven years for completion. When operational, the facility will require about 300 scientists, engineers, and support staff. The APS is expected to attract more than a thousand users every year from industry, universities, and other national laboratories around the country.

For further information about the APS project, call David Moncton, Interim Associate Laboratory Director for the APS, at (312) 972-7950, or Argonne's Office of Public Affairs at (312) 972-5581.

New Cold Source in Grenoble Doubles Neutron Yield of Highest-Flux Reactor

Researchers at the Laue-Langevin-Institute (ILL) in Grenoble, France expect to double the production of slow "cold" neutrons after initiating a new cold source in the facility's highest-flux reactor.

Using deuterium as a coolant to decrease the speed of electons propelled from the reactor, scientists are better able to draw conclusions about the structure of objects they are studying. Normally, these particles are propelled from the device at an average speed of 2,200 m/s, which is roughly equal to kinetic energy at a temperature of 27°C. Shock reactions with liquid hydrogen at -253°C are employed to cool the electrons so that they travel only 645 ms. This process has already been applied using an initial cold source at ILL. The new "brake system" now functions with deuterium, a hydrogen variant. Deuterium's atomic nuclei are twice as heavy and make the cooling process much more effective, because far fewer of the inflowing electrons are "fully braked" in the cold source.

The cold source project at ILL—in which the Federal Republic of Germany is represented by the Karlsruhe Nuclear Research Center-will cost DM20 million.

Source: The German Research Service, Special Science Reports, Vol. IV, No. 10/88.

American Superconductor, Oak Ridge to Collaborate on Superconductor Manufacturing Process

Oak Ridge National Laboratory (ORNL) and American Superconductor Corporation (ASC) recently announced a collaborative venture for the development of manufacturing processes that will improve the current-carrying capacity of high-temperature superconducting oxides. The agreement between ORNL and ASC, of Cambridge, Massachusetts, is part of the Superconductivity Pilot Center Program established in September by the U.S. Department of Energy (DOE) to aid American industry in the development of high temperature superconducting materials for commercial applications.

DOE established Pilot Centers at Argonne and Los Alamos National Laboratories as well as at ORNL. [See the January 1989 MRS BULLETIN, p. 10, for a related article on Argonne National Laboratory.] Anthony Schaffhauser is director of the Oak Ridge program, which will be funded by both ORNL and ASC. It is the first of many such actions planned by DOE to foster greater collaboration between industry and the national laboratories.

The ASC/ORNL program includes proprietary and nonproprietary components that involve systematic studies of the effects of materials processing on the current-carrying capacity of the new materials. The proprietary portion of the program will focus on ASC's patented process for manufacturing composites of superconducting oxides and noble metals by the oxidation of metallic precursors. Massachusetts Institute of Technology has given ASC an exclusive license for the newly patented technology. The process was invented by MIT professors John Vander Sande and Gregory Yurek.

Swedish Researchers Develop New Instrument for High Resolution, High Sensitivity XPS and XPS Imaging

Combining a unique and powerful monochromatic x-ray source with completely new electron optical and electronic components, scientists at the University of Uppsala, Sweden have collaborated with Scienta Instrument AB to develop a new instrument for use in x-ray photoelectron spectroscopy (XPS) and electron spectroscopy for chemical analysis (ESCA).

The invention, ESCA 300, differs from more conventional instruments in which the x-ray radiation is not monochromatized, limiting the energy resolution and sensitivity of the chemical surface/interface analysis. According to the Swedish research team, led by Ulrik Gelius, the introduction of an x-ray monochromator in such instruments has, until now, severely increased the time it takes to record useful spectra.

ESCA 300, however, represents a breakthrough in high intensity, high resolution ESCA analysis with monochromatic x-ray excitation. Not only can ESCA 300 analyze surfaces/interfaces with a better sensitivity and a higher energy resolution than other instruments, it can perform such analyses on very small areas, down to one millionth of a square inch—an achievement previously considered impossible. In the future, it will even be possible to simultaneously register the spectra of up to 100 such tiny surface elements along a line. This will dramatically reduce the time necessary to record ESCA images. Such images will measure the distribution of the chemical composition over a surface/interface.

German Collaboration Designed to Improve Strength of Synthetic Materials

A government-financed collaboration between a West German chemical company and the University of Hamburg has, as its goal, the development of synthetic materials with strength approaching that of metals.

The Federal Republic of Germany's Ministry of Research and Technology has funded the project, a joint venture which represents for that country a completely new approach to the improvement of the mechanical properties of synthetic materials. Due to their specific characteristics, such as moderate density, easy malleability, good insulation properties, and high corrosion resistance, synthetics have superceded traditional building materials in many ways. However, the strength associated with metals, necessary to so many areas of application, can only be generated in high-performance composite materials produced using expensive processing technologies.

Rather than using fibers, as in the past, German scientists have employed small amounts of stiffly warped micromolecules to strengthen the materials. These micromolecules must be compatible with the synthetic product to be reinforced.

Source: The German Research Service, Special Science Reports, Vo. IV, No. 10/88.

Los Alamos Computer Predicts Migration of Hazardous Waste

A computer model developed at Los Alamos National Laboratory can help predict how fast and how far hazardous wastes will migrate through soils.

Although the model doesn't give absolute answers, researchers in Los Alamos's Environmental Science Group say it's a good tool to evaluate migration of organic hazardous wastes—carbon-based solvents and fuels—through the subsurface.

Many of the model's predictions are based on the tendency of most hazardous wastes (gasoline, trichloroehelyne, and other fuels and solvents) to vaporize in the soil. Because vapor can diffuse 100,000 times faster than liquid (moving, for example, about one-fifth of a mile in 20 years), earlier computer models using water movement as a basis for predictions may have overlooked an important contaminant pathway.

The scientists enter data into the computer such as soil conditions, amount and location of the waste, and when it was deposited. The three-dimensional model then uses up to 80,000 different reference points to calculate the prediction. One test case simulated an area about 2,000 ft long by 1,000 ft wide by 1,000 ft deep. The computer predictions will be cross-checked with actual chemical-migration patterns being researched in a laboratory setting. Computer capacity and computational speed are the only real limitations of the model, say researchers, who soon will begin working with the Air Force to predict the potential migration of solvents and fuels, such as JP-4 jet fuel, from storage sites.

The computer model complements other research at Los Alamos, where groups are working on hazardous waste problems such as in-place measurement technology, biological effects, and treatment.

Krypton-Fluoride Laser Exceeds Performance Expectations at Los Alamos

Los Alamos National Laboratory has achieved a major milestone in exceeding performance expectations for its new krypton-fluoride ultraviolet laser, confirming the promise of using it for fusion experiments.

An experiment conducted December 13 using Los Alamos's newly integrated 96-beam Aurora laser exceeded a kJ-level of energy. Output from the laser's final amplifier reached 2.5 kJ in 96, five-nanosecond beams. That's equivalent to the power produced in a fraction of a second by about 400 typical electric generating plants.

Researchers say this development increases confidence in krypton-fluoride lasers like Aurora, considered to be strong candidates for inertial-confinement fusion drivers because of their short wavelength, high efficiency, and potentially low cost. Until now, however, no integrated krypton-fluoride laser system has demonstrated appreciable output energy in short, optically multiplexed pulses.

During the December 13 experiment, the Aurora laser produced 2.5 kJ in the 96, five-nanosecond beams from the final amplifier, and delivered 0.78 kJ in 48 beams to the laser-fusion target chamber. In this initial experiment, the additional 48 beams weren't transmitted to the target chamber for economy reasons.

To accomplish the task, the Aurora laser team developed the ability to take 500-nanosecond pulses and split them through a process called optical multiplexing. The split beams are then sent through a series of mirrors and delays so that they can be perfectly timed to reconverge—or demultiplex—and hit the laser's energy detectors in a shower of synchronized five-nanosecond pulses.

For the December test, researchers used a downsized laser beam to extract energy from the final amplifier. For a later test, they expect to install a full-sized final amplifier mirror, resulting in expected laser energies from the final power amplifier in the range of 4 to 7 kJ. □