NKK Catalyst Provides Nontoxic, Cost Efficient MDI Production

Nippon Kokan (NKK), Japan's second largest steelmaker, has developed a noncorrosive catalyst for the high performance, cost efficient production of methylene diphenyl isocyanate (MDI). MDI is a raw material used in the production of polyurethane resins.

The catalyst will be used in an MDI production process developed through a yearlong joint research and development program with Catalytica Associates Inc. (a U.S. firm) and Haldor Topsoe A/S (a Danish engineering company). The process uses carbon monoxide gas that is brought to direct reaction by the catalyst, eliminating the use of toxic phosgene gas. Because the new process is less complex and because the noncorrosive catalyst does not require costly equipment, the process is cost efficient.

NKK has applied for patents in major countries and is planning commercial production of the catalyst.

University of Illinois to Establish Center for Cement Composite Materials

The University of Illinois at Urbana-Champaign will use a grant from the U.S. Air Force to establish a Center of Excellence in Cement Composite Materials. The grant, part of the DOD-URI program, is for $1,120,000 for the first two years and $650,000 for the third year. The center will be directed by J. Francis Young, professor of civil engineering, and Richard L. Berger, professor of ceramic engineering.

The new center will use a multidisciplinary approach to explore the potential for new materials based on cementitious matrices. Research will be concentrated in the following areas: (1) optimization of properties through control of composition microstructure and processing; (2) creation of ductile materials by fiber reinforcement; (3) development of new cement chemistries; and (4) synthesis of novel cement-polymer composites.

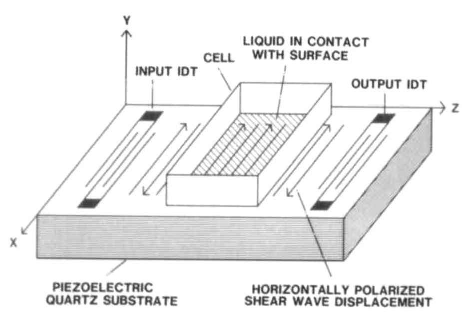
Fourteen faculty members are participating in the center's programs. They represent eight different departments: civil engineering, ceramic engineering, metallurgy and mining, chemical engineering, chemistry, mechanical engineering, geology, and theoretical and applied mechanics.

For further information, contact Prof. J. Francis Young, Director, Center for Cement Composite Materials, University of Illinois, 105 South Goodwin Avenue, Urbana, IL 61801; telephone (217) 244-6210.

Acoustic Wave Sensor Can Measure Viscosity of a Single Drop

A new kind of solid-state sensor that can measure the viscosity of a single drop of liquid has been developed at Sandia National Laboratories. The microelectronic device's small size—only 1 inch by $\frac{1}{2}$ inch but currently housed in a larger test case—could allow *in situ* measurements of the viscosity of fluids in places now largely inaccessible to such measurements.

The device, an acoustic wave viscosity sensor, propagates a horizontally polarized shear wave (HPSW) along the interface between the surface of a crystal and the liquid. The oscillation of the HPSW is in the plane of the surface and is perpendicular to the wave's direction. The more viscous the fluid, the more energy it absorbs from the wave. Comparison of the strength of the signal before and after the wave passes through the fluid gives a measurement of viscosity.



Invented by Antonio J. Ricco and Stephen J. Martin, the device has a quartz piezoelectric substrate 0.03 inches thick. On either end is a transducer consisting of an interleaved pattern of microscopic electrodes. An oscillating electrical potential applied to one transducer generates the HPSW, which propagates along the length of the sensor to the other end, where the other transducer converts the acoustic wave into an electrical signal.

In addition to the advantages offered by its small size and the tiny volume of liquid required, the sensor can measure the viscosity in a 50-nm-thick layer of liquid adjacent to the surface. This unique feature, says Martin, is advantageous for studies of surface layer properties, such as the measurement of the near-surface viscosity of liquid crystals, widely used in electronics.

Tanury Establishes Foundation for Thin Film and Interface Technology

Tanury Industries (Lincoln, RI), in conjunction with the National Science Foundation, Brown University, University of Rhode Island, and the U.S. Department of Commerce, is organizing an industry-sponsored basic, applied, and developmental research foundation to fund projects at a new Thin Film and Interface Research Institute. The new institute will be located on the Brown University campus in Providence, RI, and will be run by Brown and the University of Rhode Island.

In 1986, Tanury began an initial research project in thin film and interface technology with Brown University. Tanury and Brown's emphasis, unlike much university research, has been on commercialization and market-driven technology. "Corporate R&D dollars are precious and managers are under pressure to sponsor projects that produce results. We've learned that our methodology for conducting research and development works," said Thomas Tanury, president of Tanury Industries.

"Universities are recognizing the needs of industry," said Michael P. Lauro, director of research and development at Tanury, "and are contributing significantly by understanding our desire to produce commercially viable technologies."

As managing general partner of the Foundation for Thin Film and Interface Technology, Tanury Industries is garnering general partners from a wide range of industries with an interest in thin film and interface technology. The foundation and the research institute that it will support are designed to maximize the potential for technology transfer to member companies, who will provide funds for research projects relevant to their own businesses. Microelectronics, petroleum refining, and cryogenics are just a few of the potential industrial applications.

ASME Award Cites ORNL Fusion Device

The American Society of Mechanical Engineers (ASME) presented its Energy Resources Technology Award to Oak Ridge National Laboratory (ORNL) researchers, citing the Advanced Toroidal Facility (ATF) as "one of the most outstanding examples of advancing mechanical engineering in energy-resource-related technology."

In nominating the ATF for the award, engineer Robert Sadlowe noted that "with the possible exception of some work associated with the Strategic Defense Initiative, no other device within the last five years has so challenged and extended the technologies associated with the field of mechanical engineering."

The ATF, currently under construction at ORNL, is one of a family of fusion devices known as stellarators. It will allow researchers to evaluate the stellarator concept for use in future fusion power reac-

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tors. It will also be the largest device of its kind and, unlike most other present-day fusion devices, it will operate steady state.

Stellerators are similar in appearance to tokomaks, a leading fusion design, but differ from tokamaks in the design of the electromagnetic fields used to hold the plasma. The name "stellarator" generally describes the designs in which the magnetic coils spiral around the plasma. The ATF consists of two helical field coils, three sets of vertical coils, a vacuum vessel to confine the plasma, and a doughnut-shaped structural shell to support the magnetic loads.

The design and manufacture of ATF components have approached or advanced the limits of present-day mechanical engineering technology in several areas, including the development of special precision tools, the use of highly sophisticated manufacturing techniques, and the adaptation of precision hardware and computer codes to allow alignment of device components to an accuracy of 0.005 inch.

Martin Marietta Energy Systems engineers and fusion researchers have been involved in the design and construction of the ATF for the U.S. Department of Energy for several years. (Martin Marietta operates ORNL for the Department of Energy.) ORNL's ATF program, a world leader in stellarator research, has involved the collaboration of researchers in the USSR, Japan, West Germany, and Spain. The ATF is expected to go into operation later this year.

Vanderbilt University to Develop Free-Electron Center for Biomedical and Materials Research

Vanderbilt University (Nashville, TN) has been awarded a $6.65 million dollar grant by the U.S. Office of Naval Research to develop the Vanderbilt University Free-Electron Center for Biomedical and Materials Research. The free-electron laser (FEL), the object of intense research the past five years, offers great promise in both biomedical and materials studies.

The FEL is unique in its ability to produce a high intensity tunable light source over a broad wavelength range, allowing great selectivity in applications. Applications are anticipated to range widely, from production of materials not found in nature, to fundamental studies in physics, chemistry, materials science, electrical engineering, molecular and cellular biology, through clinical applications in surgery, opthamology, diagnostics, neurology, radiology, neurosurgery, and otolaryngology.

The new research center is expected to have a major impact on the expansion of existing glass and ceramics research programs at Vanderbilt. Current research programs cover radiation effects on the optical, mechanical, electrical, and magnetic behavior of glasses. Current programs also focus on space radiation effects, including erosion and charge storage resources.

The Vanderbilt research team includes Drs. Tolk, Haglund and Edwards of physics, Drs. Kinser, Weeks and Pitz of engineering, and Drs. Carroll, Ossoff and Fleischer of medicine. The development of physical facilities, construction, and testing of the FEL will take place in 1987 and 1988, with research operations beginning in 1989. In addition to funding from the Navy, Vanderbilt will contribute internal funds to the development of support facilities, technology, and staff.

Five MRS Members Elected to NAE

Five members of the Materials Research Society were among the 82 engineers recently elected to membership in the National Academy of Engineering (NAE). Total U.S. membership in the Academy stands at 1353, with 117 foreign associates.

Election to the National Academy of Engineering is the highest professional distinction that can be conferred on an engineer. Academy membership honors those who have made "important contributions to engineering theory and practice, including significant contributions to the literature of engineering," or those who have demonstrated "unusual accomplishment in new and developing fields of technology."

MRS members elected to the Academy are:

• Herbert H. Johnson, professor of materials science and engineering, Cornell University, Ithaca, NY, "for pioneering research on hydrogen embrittlement of metallic alloys and for leadership in the management of interdisciplinary materials research."
• William D. Nix, professor of materials science and engineering, Stanford University, Stanford, CA, "for outstanding research on experimental and theoretical aspects of high temperature creep and creep-rupture behavior of solids."
• Della M. Roy, professor of materials science, Pennsylvania State University, University Park, PA, "for internationally recognized contributions to the applied science and engineering of cement and concrete."
• Ben G. Streetman, professor of electrical engineering, University of Texas, Austin, TX, "for outstanding contributions to ion implantation of semiconductors and to engineering education through teaching and authorship of a widely used basic text."
• James C. Williams, dean, Carnegie Institute of Technology, Carnegie Mellon University, Pittsburgh, PA, "for pioneering research and development of aerospace alloys, and for contributions to materials policy and education."

Stir Casting and Rapid Solidification Used for Zinc-Based Composites

Stir casting and rapid solidification were used to develop new zinc-based composites in two ILZRO projects conducted by separate contractors in the United Kingdom. ILZRO, the International Lead Zinc Research Organization, Inc., is a not-for-profit company that manages research for 32 smelters, miners, and refiners in 13 countries. Its 1987 research budget tops $3.1 million.

Objectives of the project carried out by the University of Aston in Birmingham were to modify existing stir-casting equipment to make it suitable for incorporating nonmetallic materials into a rheocast (semisolid) slurry and to produce and test composites based on zinc alloy 3.

According to the final project report, stir casting the No. 3 alloy with graphite or molybdenum disulfide, followed by post compaction in a heated die, allowed production of a composite with high-volume fractions of particulates. The particulates were incorporated as irregular distributions of nonwetted particles, concentrated into films and pockets in the inter-solid areas of the solidified slurry. The distribution was fixed at the stir-casting stage; compaction merely reduced the porosity level.

Wear testing of the composites showed that incorporation of a solid lubricant had a beneficial effect on lubricated wear behavior but reduced mechanical strength so drastically that most of the wear pins sheared during testing and tensile strength was too small to measure. Wear results on one casting suggest that the amount of included material needed to give a large improvement may be very small. Results from this work will be incorporated into a new project at Massachusetts Institute of Technology. The new project will examine the wetting behavior of zinc with various additives.

The objective of the project carried out by Osprey Metalș, Ltd. in West Glamorgan was to determine if a Zn–15% Cu–5% Mn alloy could be made in wrought form by using rapidly solidified material as a starting billet. Initial results indicate that even with rapid solidification, yielding a grain size of 20 microns, the material could not be made so that it could be rolled.

In the work to date, samples of strip, nominally 150 mm wide by 300 mm long

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and 1.5–4.0 mm thick, were produced by spray deposition. The strips had a higher level of porosity than desired. They were reduced by about 12.5% in hot rolling to assess workability. The best results were obtained with the highest temperature (425°C), but it is still uncertain if further temperature increases in rolling can improve workability to an acceptable level.

Change of Address

ILZRO has moved its headquarters from New York City to Research Triangle Park, North Carolina. The new address is:
ILZRO, Inc.
2525 Meridian Parkway
P.O. Box 12036
Research Triangle Park, NC 27709-2036
Telephone (919) 361-4647
Telex 261533
Facsimile (919) 361-1957

Wayne State Physicists Announce Superconductivity at 240 K

On March 27, Wayne State University physicists Lowell E. Wenger and J.T. Chen, adjunct professor Eleftherios M. Logothetis of Ford Motor Co., and graduate students Charles J. McEwan and Winston Win reported verification of superconductivity at 240 K (−27°F) in a newly fabricated material. The composition of the material was not revealed, but it does contain yttrium and is similar to what other researchers have been testing.

The scientists used an unconventional technique to verify the 240 K superconductivity phase. The technique, an inverse process of the well-known ac Josephson effect, uses a radio frequency-to-constant current (rf-to-dc) conversion effect. The scientists believe the method is a more direct test of superconductivity than other techniques used.

In the rf-to-dc conversion, rf current is used to produce a dc voltage in a superconductor. Such an effect was first observed in low temperature superconductors near the transition temperature by Brookhaven National Laboratories scientists (Myron Strongin and co-workers) in 1975, and used more recently by researchers (S.R. Ovshinsky and co-workers) at Energy Conversion Devices Inc. to study superconductivity in co-deposited films. Using this effect, the Wayne State and Ford researchers verified the co-existence of the two superconducting phases at 90 K and 240 K in the same material.

The superconductivity project at Wayne State is supported by the Wayne State University Institute for Manufacturing Research and by Ford Motor Co. The Institute for Manufacturing Research was established in 1986 under the direction of Dr. Robert L. Thomas to foster collaborative research between the university and Michigan industries.

K.A. Jackson Named TMS Fellow

Kenneth A. Jackson, head of the Optical Materials Research Department at AT&T Bell Laboratories, Murray Hill, NJ, has been named a Fellow of The Metallurgical Society. One of three individuals to be so named in 1987, he was cited for "numerous advancements in the fundamental knowledge of crystal growth kinetics and morphology, constitutional supercooling, solid-liquid interface behavior, and predictions of eutectic phase formation."

With Bell Laboratories since 1962, Jackson has conducted extensive research in the theory of crystal growth, crystal growth morphology, the structure of interfaces, the use of computer simulation to study these processes, the growth of single crystals, crystalline defects, segregation and precipitation effects, and the solidification of metals.

Jackson is a member of TMS, APS, ASM, AAAS, AACG, and the Materials Research Society. A member of the 1972 Founding Committee of the Materials Research Society, he has long promulgated the interdisciplinary pursuit of materials science. He was president of MRS in 1978, served as Councillor from 1979-1981, and has also served on many MRS committees.

D.M. Roy Elected to NAE

Della M. Roy, professor of materials science at the Pennsylvania State University, has been elected to the National Academy of Engineering (NAE). Cited "for internationally recognized contributions to the applied science and engineering of cement and concrete," Roy is the first person selected from this field of materials. She also joins only two other women from universities ever elected to the Academy. Of the Academy's 1353 members this year, only 550 members were drawn from university faculty.

Roy's research achievements cover several fields. She was the first to produce extremely strong cements, demonstrating that such low temperature materials could achieve the same strength as more costly high temperature ceramics. In the 1970s, Roy converted calcium carbonate to calcium phosphates without disturbing the microstructure and while improving the strength. This has given rise to a family of synthetic "bones" and "teeth," patented by Penn State and now entering commercialization. Her most recent research has been in radioactive waste solidification and disposal.

Author of 250 research papers and holder of three patents, Roy has been the recipient of several national awards and other recognitions. She is the founding editor of the journal *Cement and Concrete Research* and an active researcher, having built the largest cement research group in any U.S. university. She is a member of the Materials Research Society and has been a symposium organizer and proceedings editor for the MRS Fall Meeting symposia on Fly Ash and Coal Conversion By-Products in 1985 and 1986. She is a proceedings editor and symposium committee member for the symposium on Fly Ash and Coal Conversion By-Products to be held at the 1987 MRS Fall Meeting in Boston, MA, November 30 to December 5, 1987.

Superconducting Ceramic Formed into Wire

Researchers at Argonne National Laboratory have formed one of the new superconductors into the shape of a wire about six mils (0.01 inch) in diameter. Ability to shape the superconducting material into wire is a key advance toward its use in electrical motors and other small electrical and magnetic devices.

"The next step will be to fire the wire to fix its shape and then test it to see if it can carry current," said Roger Poeppel of Argonne. "We've already made cylinders, among other objects, and they were all able to carry current when cooled with liquid nitrogen," he said.

The superconducting ceramic being used is a perovskite containing an oxide of yttrium, barium, and copper. First discovered by researchers at the University of Houston, the material loses all resistance to the flow of electrical current when cooled to 92 K (-294°F).

"We've been able to develop expertise with the material," said Poeppel, because we make it in batches of a pound or more. Most other labs are making it in lots 25–50 times smaller."

Argonne National Laboratory's superconductivity program is the largest among those in U.S. Department of Energy laboratories. Some 50 scientists, engineers, and technicians at Argonne are working on various aspects of the new materials. Their work includes manufacturing and shaping the new superconductors, studying their structures and basic properties, and measuring their abilities to withstand high magnetic fields and to carry current.

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Los Alamos Dedicates Ion Beam Materials Lab

On February 27, 1987 Los Alamos National Laboratory dedicated a $1.7 million Ion Beam Materials Laboratory. The laboratory will be operated by the Los Alamos Physics Division and is under sponsorship of the Los Alamos Center for Materials Science (CMS).

"This is a world-class lab," said Joe Tesmer of the Physics Division. Tesmer, a member of the Materials Research Society, coordinated the physical assembly of the ion beam laboratory and will continue to manage its operations.

The laboratory has two specialized particle accelerators used for developing and analyzing exotic new metals, ceramics, crystals, and plastics. Although the accelerators operate at relatively low energies by physics standards, they are well suited for materials research, said Tesmer.

The commercially manufactured 200,000 volt ion implanter, similar to those used in manufacturing semiconductors for computers, was modified for research at Los Alamos. It can perform surface ion implantation, creating a matrix ranging from a few atoms to thousands of atoms thick.

The 3-million-volt tandem accelerator, also manufactured commercially, will be used for implanting heavy ions deep into the surface of materials. Researchers will also use it to study how implantation changes materials, as well as to analyze other unusual materials.

NAS Elects Officers and Councillors

The National Academy of Sciences (NAS) re-elected noted geophysicist Frank Press for a second six-year term as president. Peter H. Raven, director of the Missouri Botanical Garden, was elected NAS home secretary, and the following four Academy members were elected to the governing Council:

• Mildred S. Dresselhaus, Institute Professor and professor, Department of Physics, Massachusetts Institute of Technology;
• Roald Hoffmann, John A. Newman Professor of Physical Science, Cornell University;
• Kurt J. Isselbacher, Mallinckrodt Professor of Medicine at Harvard University, and chief of the gastrointestinal unit at Massachusetts General Hospital; and
• Phillip A. Sharp, professor and director of the Massachusetts Institute of Technology Center for Cancer Research.

A member of the NAS since 1958, Press began his term as president in 1981. In his dual role as NAS president and chairman of the National Research Council (NRC), Press is credited with initiating several major science policy studies (including the current Materials Science and Engineering Study) and with broadening financial support for such studies. His other accomplishments include streamlining the NRC's organizational structure and shortening the time required to complete NRC studies. Also, during Press's first term, the NAS and the National Academy of Engineering began construction of the Beckman Center in Irvine, CA and an additional facility in Woods Hole, MA.

Peter Raven, who begins his term as home secretary on July 1, 1987, became an Academy member in 1977. As home secretary, Raven will oversee membership affairs of the 1500-member Academy, and will serve as principal administrative officer for the NAS Council. Raven currently serves as chairman of the NRC Committee on Research Opportunities in Biology. In addition to his position as director of the Missouri Botanical Garden, a post he has held since 1971, Raven is Engelmann Professor of Botany at Washington University. He is chairman of the National Museum Services Board, and president of the Organization of Tropical Studies.

The U.S. Congress created the National Academy of Sciences in 1863 as an independent membership organization to advise the federal government on scientific and technical issues. Today, some 800 committees comprising nearly 8,000 scientists, engineers, and other professionals provide their advice to the nation under the Academy's charter.

Molded Dessicant Foam Traps Moisture and Provides Structural Support

A new type of foam that can be molded into strong, solid shapes and that traps water vapor and other gases has been developed at Sandia National Laboratories, Livermore, CA. Called molded dessicant foam, the closed-cell material is made by combining polyurethane resins and a zeolite powder. The foam works by adsorption, attracting vapor to the pores of the zeolite powder dispersed throughout the foam cells.

Charles B. Frost of Sandia's Exploratory Chemistry Division developed the foam to protect components inside a weapons system, but he believes the automotive and electronics industries will find the foam useful in spaces where both drying and reinforcing are needed.

The material is easily formed into precise shapes by injecting it into a mold right after it is mixed, while the foam is still fluid. It also has strong adhesive properties when molded directly into a part.

Varying the amount and type of zeolite will give different drying and adsorption capabilities. Drying capability can be up to about 18% of the foam's dry weight; adsorption can range from low molecular weight liquids to gas molecules up to about 10 Å in diameter. It is the zeolite powder, however, that apparently reinforces the foam at all densities and makes it more stable at higher temperatures.

The dessicant foam has much higher density than rigid foams used in thermal insulation or laminated core structures—50 versus 2 lb/ft^3. Compared with a control polyurethane foam without zeolite filler, the dessicant foam has a heat distortion temperature almost 100°F higher and has more than double the compressive strength.

Says Frost, "Even though we designed the new foam primarily for its drying capability, we were fortunate to formulate a dessicant foam that is even stronger than common polyurethane foams, especially at high temperatures. In my opinion, its real potential is as a dual-purpose material—a dessicant that also reinforces a weak structure."

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