current densities and early times," said the researchers. "We are hopeful that this technique will help us to better understand some of the fundamental issues associated with electromigration."

Silver in Hybrid Membranes Facilitates Separation of Ethene and Ethane

Researchers at the Osaka National Research Institute in Japan have achieved good selectivity of ethene against ethane in separation processes using inorganic–organic hybrid membranes containing silver(I) ions. The organic poly(*N*-vinylpyrrolidone) (PVP) part increased the flexibility of the inorganic network and immobilized the silver ions, which can function as olefin carriers. The membranes showed higher selectivity at higher temperatures, as thermal energy enhances the decomplexation rate of the silver olefin complexes.

Separation of paraffins and olefins is usually carried out by cryogenic distillation. Among the alternatives that were investigated to replace this energy-intensive process, the use of facilitated support membranes containing Ag^+ ions seemed to be promising. While supported liquid membranes and ion-exchange membranes require saturation of the feed gas with solvent, silver polymer membranes can be used to separate paraffins and olefins without water. The limitation of these membranes to low temperatures has now been overcome by replacing the pure polymer membrane with an organic–inorganic hybrid membrane as reported in the March issue of the *Journal of the American Ceramic Society*.

The hybrid membranes were prepared via a sol-gel route using tetraethoxysilane, propyl triethoxysilane, water, and HNO_3. After several hours of stirring, PVP and later $AgBF_4$ were added. Membranes were produced by dip-coating on a porous aluminum tube. Two membranes containing ~10 wt% PVP, one with and one without silver, as well as a membrane containing ~20 wt% PVP and silver ions, were prepared. Fourier transform infrared spectrophotometry measurements suggested that the silver ions were bound to the amide group of the PVP segments. The silica matrix gave the membranes enhanced thermal stability; the PVP made the inorganic network more flexible and nonporous. While the membrane without silver ions showed little selectivity for ethene, both of the silver-containing membranes gave $P_{C_2H_4}/P_{C_2H_6}$ ratios that increased with increasing temperature. At 423 K, values of 1.9 and 2.3 were observed for the membranes containing 10 wt% and 20 wt% PVP, respectively.

The researchers said that selectivity of the membranes could be improved by, "(1) raising the temperature to increase the decomplexation rate of C_2H_4 from Ag^+ and (2) increasing the PVP content." The researchers attribute the latter effect to the ability of the PVP to increase the flexibility of the inorganic framework and the immobilization of Ag^+ in the polymer segments.

CORA LIND

Mesoscopic Hollow Titania Spheres Functionalized on Inner Surface with Silver Nanocrystals

Mesoscopic hollow spheres have potential applications in the fields of catalysis, drug delivery, and coatings. The preparation of hollow titania mesospheres with interior surfaces functionalized with silver nanocrystals was recently reported by Younan Xia and co-workers from the Departments of Chemistry and Materials Science and Engineering at the University of Washington—Seattle. The materials were formed by decorating the surfaces of polystyrene (PS) spheres with nanocrystals and then using the modified spheres as templates for the sol-gel synthesis of titania (see figure). This method allows for facile synthesis of large quantities of hollow spheres with precisely controlled void size, shell thickness, and inner surface functionalization.

As reported in the April issue of *Chemistry of Materials*, commercially pur-

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chased PS beads were functionalized with a submonolayer of 10–20-nm-diameter silver nanoparticles using a commercially available electroless silver-deposition kit. The beads were poured into a cell consisting of two glass substrates spaced 10–70 μm apart. Titanium (IV) isopropoxide in isopropanol was then added to the cell, and the assembly was exposed to air to hydrolyze the titanium isopropoxide to amorphous titania. The PS beads were then dissolved in toluene, and the remaining hollow titania shells were released from the glass substrate by sonication.

The researchers demonstrated the versatility of this method for the titania shell/silver-nanocrystal system by preparing hollow shells with void sizes of 0.38 μm and 1 μm by using PS beads with different diameters. The shell thickness was also varied from 30 nm to 170 nm by increasing the concentration of the isopropoxide precursor. The void sizes and shell thicknesses of the hollow spheres were confirmed by transmission and scanning electron microscopy. These micrographs also showed that the silver nanocrystals were securely embedded in the walls of the spheres. The spheres were found to be robust enough to maintain their shape throughout the templating and post-treatment processes.

The researchers believe that this synthetic method can be extended to prepare functionalized hollow spheres having a large variety of core materials and inner surface microstructures. Also, hollow spheres with voids in the walls could be prepared by removing the functionalities through wet etching or calcination. The researchers said that a particularly exciting application involves decorating the inner surface with a catalyst and using the wall of the hollow sphere to control the diffusion of substrate and product species of the catalytic process.

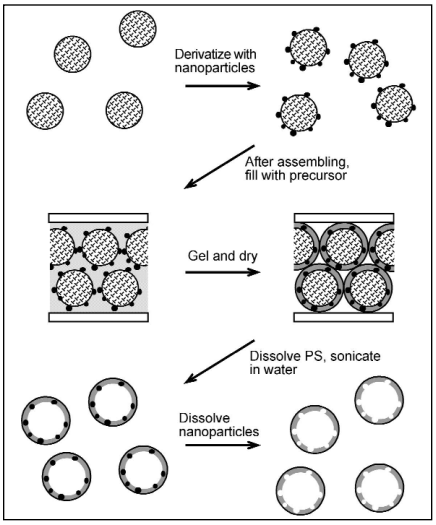

Figure. Schematic outline of the experimental procedure: The polymer template could be either dissolved with a solvent or burnt out through calcination at elevated temperatures. Reproduced with permission from Chem. Mater. ***13*** *(2001) p. 1146. Copyright 2001 American Chemical Society.*

GREG KHITROV

Electromagnetically Induced Transparency Observed in Raman Studies of Nitrogen-Vacancy Color Centers in Diamond

Diamond has been found to have potential for use in electromagnetically induced transparency (EIT) applications. In the March 15th issue of *Optics Letters*, experimental results were presented by researchers from the Hanscom Air Force Research Laboratory, Massachusetts Institute of Technology, and Texas A&M University, showing Raman-excited spin coherences in the nitrogen-vacancy (N-V) color center in diamond. This material was chosen because of its large optical oscillator strength (~0.1), its relatively long spin-coherence lifetimes (1–100 μs range), and its previous exhibition of Raman heterodyne signals. The diamond sample had ~30 parts in 10^6 N-V color centers.

A magnetic field was applied in the (111) orientation of the N-V centers as laser beams at different frequencies were focused into the crystal. The beams originated from one dye laser output that had been shifted with the use of acousto-optic frequency shifters. A nondegenerate four-wave mixing (NDFWM) signal was generated and analyzed as a function of Raman laser-beam intensities in order to determine the saturation curve. The linewidth was then measured at intensities well below the saturation limit. The ~5.5 MHz linewidth indicated that the signal was due to the Raman process.

By reducing the intensity of one beam and using it as a probe, and increasing the intensity of another beam to its maximum intensity and using it as a coupling beam, EIT was observed in the sample. The NDFWM beam was blocked during this experiment. A maximum transparency of 17% was reached, which corresponds to about 70% of what is possible, considering that only one out of four N-V centers are oriented in the (111) direction. A fit to the EIT spectrum gives a Rabi frequency of ~160 MHz.

ERIN CARTER

News of MRS Members/Materials Researchers

Zdeněk P. Bažant, Walter P. Murphy Professor of Civil Engineering and Materials Science at Northwestern University, has been awarded the **honorary degree Doctor of Science h.c. from the University of Colorado—Boulder** for his substantial contributions to structural engineering and solid mechanics worldwide.

Angela M. Belcher, assistant professor in the Department of Chemistry and Biochemistry at the University of Texas—Austin, has received a **2000 Presidential Early Career Award for Scientists and Engineers,** recognizing her pioneering research in combining organic and inorganic substances to produce new materials.

Clifton Draper has accepted a position on the executive team at Sensors Unlimited Inc., in Princeton, New Jersey, where, as liaison between manufacturing and research and development, he will provide key product analysis and assessment, advancing the quantity and variety of fiber optic components that Sensors can deliver to the marketplace. Draper will be retiring from Lucent Technologies, bringing to his new position 23 years of experience in optical-fiber and semiconductor device manufacturing research, as well as fundamental research in the field of laser interactions with materials.

Mary Lowe Good, Founding Dean of the College of Information Science and Systems Engineering at the University of Arkansas at Little Rock and President of the American Association for the Advancement of Science, has been awarded the **2001 J. Herbert Hollomon Award of *Acta Materialia*** in recognition of her outstanding contributions to understanding relations between materials technology and society, and/or contributions to materials technology that have had a major impact on society. The award will be presented at the Fall Meeting of The Minerals, Metals & Materials Society during the ASM International Awards dinner on November 6.

John B. Goodenough, professor of engineering at the University of Texas—Austin, has received the **Japan Prize from the Science and Technology Foundation of Japan** in the category of "Science and Technology of Environment Conscious Materials" for his discovery of lithium manganese oxide, lithium cobalt oxide, and lithium iron phosphates that have been critical to the development of lightweight and high-energy-density rechargeable batteries. Goodenough was honored during a prize ceremony in Tokyo in April.

Ru-Ling Meng, a researcher with the

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