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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