

## Cover Story


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## CHEMISTRY HIGHLIGHTS 2002

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## SUPRAMOLECULAR CHEMISTRY

**STU BORMAN, C&EN WASHINGTON**

The field of supramolecular chemistry "is advancing very rapidly," UIUC's Steven C. Zimmerman tells C&EN. "Clearly there are many underlying principles and design rules yet to be discovered ... but the knowledge gained thus far has allowed some remarkably sophisticated and effective systems to be developed."

For example, a zeolite-like metalloporphyrin that adsorbs and desorbs compounds with high selectivity for their size, shape, and functional group was developed by a UIUC team led by Kenneth S. Suslick [*Nat. Mater.*, **1**, 118 (2002)]. Zimmerman, Suslick, and coworkers at UIUC also used molecular imprinting to build individual shape-selective cavities within dendrimers [*Nature*, **418**, 399 (2002); [C&EN, July 29, page 9](#)]. Both techniques are potentially useful for separations, isolations, and catalysis.

A team led by Omar M. Yaghi of the University of Michigan, Ann Arbor, created porous "isoreticular metal-organic frameworks" that have densities lower than those of any previously reported crystalline materials and the highest methane storage capacities ever measured [*Science*, **295**, 469 (2002); [C&EN, Jan. 21, page 8](#)]. The structures could be useful for gas storage.

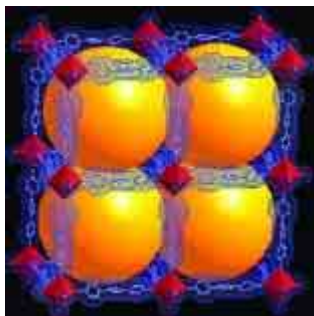
A group led by Shinji Inagaki of Toyota Central R&D Laboratories, Nagakute, Japan, created a benzene-silica hybrid structure that self-assembles into a crystalline mesoporous material in which orderly layers of benzene rings are linked to alternating layers of silicate chains [*Nature*, **416**, 304 (2002); [C&EN, March 25, page 8](#)]. The rings can be functionalized, suggesting that materials with tailored properties may be possible.

Crystals of the macrocycle calix[4]arene were found to have the ability to trap volatile molecules like methane and confine them tightly, even at high temperatures [*Science*, **296**, 2367 (2002); [C&EN, July 8, page 27](#)]. Jerry L. Atwood and coworkers at the University of Missouri, Columbia, anticipate applications in gas separation and purification, fuel storage, and medical imaging. And in a study with implications for solid-state dynamics, Atwood and coworkers discovered the first-known case in which a host-guest complex is formed by solid-state diffusion of guest molecules through a nonporous crystal of the host, in the absence of host dissolution or fractionation [*Science*, **298**, 1000 (2002); [C&EN, Nov. 4, page 8](#)].

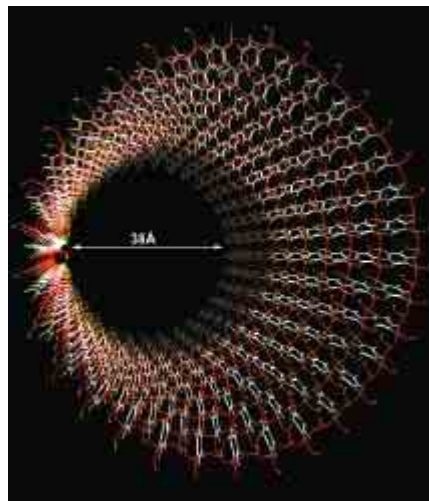
ITQ-21, a new zeolite with enhanced catalytic performance for petrochemical processing, was developed by Avelino Corma of Polytechnic University of Valencia, Spain, and coworkers [*Nature*, **418**, 514 (2002); [C&EN, Aug. 5, page 12](#)]. "ITQ-21 has one of the highest void volumes in zeolites and allows fast diffusion of reactants and products, resulting in enhanced catalytic performance for petrochemical processing," Corma says.

And Cameron J. Kepert of the University of Sydney, Australia, and coworkers designed a

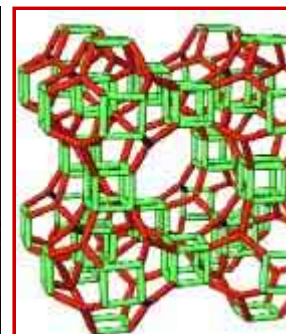
nanoporous host-guest system in which the guest affects the spin state of the host framework [*Science*, **298**, 1762 (2002); [C&EN, Dec. 2, page 30](#)]. The switchable host-guest lattices could be useful in molecular sensing.



**SPACE AVAILABLE** In metal-organic framework material synthesized by Yaghi and coworkers, 91% of the crystal volume is open space (orange spheres). IMAGE BY NATHANIEL ROSI



**TUNNEL VISION** Inagaki and coworkers created this unique crystalline mesoporous framework based on benzene-silica units. © 2002 NATURE



**GET CRACKING** ITQ-2 zeolite with potential for catalytic petroleum cracking, was developed Corma and coworkers. POLYTECHNIC UNIVERSITY OF VALENCIA

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