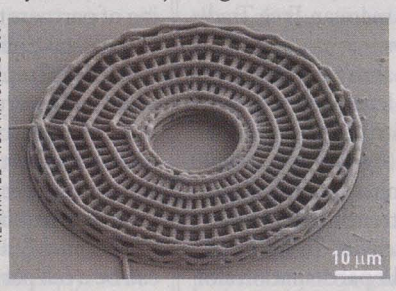
CONCENTRATES

Writing 3-D structures

The "writing" methods for microfabrication are generally confined to two dimensions or plagued by wetting and spreading problems. Jennifer A. Lewis, professor of materials science and engineering at the University of Illinois, Urbana-Champaign, and graduate students Gregory M. Gratson and Mingjie Xu have come up with a method that allows them to write 3-D microperiodic structures directly by using concentrated polyelectrolyte inks [*Nature,* **428,** 386 (2004)]. The inks are made of nonstoichiometric mixtures of polyanions, such as polyacrylic acid, and polycations, such as polyethylenimine. Adjusting the ratio of the cationic and anionic groups allows the team to vary the ink viscosity (and net charge) to allow deposition through microcapillary nozzles. The inks coagulate in an alcohol/water reservoir to form self-supporting filaments or rods that can be patterned layer by layer into periodic lattices and arrays with submicrometer features (shown). The structures can be fabricated in about five minutes. And by making inks from biologically, electrically, or optically active polyelectrolytes, structures could be developed for a variety of applications, such as scaffolds for tissue engineering or for directing electrostatic layer-by-layer assembly.



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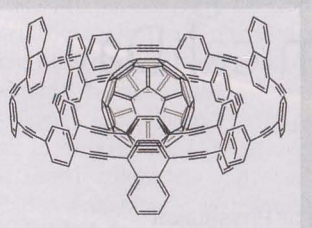
Rings around the fullerene

By surrounding a buckyball with two different-sized "carbon nanorings," chemists from Osaka University, in Japan, have made supramolecular double-inclusion complexes composed of three synthetic molecules [*Angew. Chem. Int. Ed.,* **43,** 1722 (2004)]. Takeshi Kawase, Masaji Oda, and coworkers prepare the Saturn-like complexes (a stereoisomer of one complex



COURTESY OF TAKESHI KAWASE

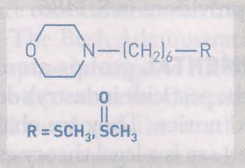
is shown) from C_{60} and cyclic structures based on *p*-phenyleneacetylene. Previous examples of double-inclusion complexes were made by surrounding a metal ion with two synthetic molecules. Kawase and Oda's group hopes to gain a deeper understanding of "the novel nature of fullerenes and other curved π-electron systems" by studying the complexes and other related substances.

Putting color in homocysteine detection

An elevated level of homo-cysteine in the blood is a risk factor for Alzheimer's and cardiovascular diseases. Chemistry professor Robert M. Strongin of Louisiana State University and his colleagues describe two colorimetric methods for the detection of homocysteine using inexpensive, commercially available materials that are selective for homocysteine over the structurally related thiols cysteine and glutathione [*J. Am. Chem. Soc.,* **126,** 3400 (2004)]. When colorless solutions of methyl viologen are heated with cysteine, homocysteine, and glutathione, only the solution with homocysteine changes color. The researchers also report a room-temperature method for homocysteine detection in which thiols are mixed with fluorone black in the presence of phosphine, leading to significant absorbance changes in response to homocysteine but only insignificant changes in response to other thiols and amino acids. These rapid methods require five minutes at most and produce color changes that can be observed visually or with UV-Vis spectrophotometers. Strongin would like to see these methods eventually used as a diagnostic method in clinical settings.

Odorless and greener sulfur oxidations

Dimethyl sulfide and di-methyl sulfoxide are useful reagents in industrial metal-free oxidation reactions to convert alcohols to aldehydes and ketones, although working with the sulfur compounds can be an unpleasantly stinky experience. Chemistry professors Kiyoharu Nishide and Manabu Node and coworkers at Kyoto Pharmaceutical University, in Japan, have developed odorless alternatives by attaching the sulfur functional groups to morpholine via an alkyl chain spacer [*Green Chem.,* **6,** 142 (2004)]. In earlier work, the researchers had noted that dodecyl methyl sulfide and sulfoxide are odorless, owing to the compounds' low volatility. But oxidations with these compounds require chromatographic separation of the products, which is not practical on a large scale. The researchers then hit on the idea to attach the alkyl groups to morpholine, which allows for the products to be separated by aqueous extraction. The sulfide and sulfoxide morpholine derivatives (shown) were tested in Corey-Kim and Swern oxidations, respectively, to prepare aldehydes and ketones in high yields. The Kyoto researchers have filed for a patent in cooperation with Wako Pure Chemicals.



Sensor based on pathogen's enzyme

Concern about traces of β-lactam antibiotics in food and in the environment is spurring the search for simple, specific, sensitive, and rapid methods of detection. Chemists at Hong Kong Polytechnic University and the University of Cambridge have designed a sensor based on a class of β-lactamases, which are enzymes secreted by pathogenic bacteria to destroy antibiotics. The sensor works on the principle of gross conformational changes in the enzyme when it binds its substrate. Kwok-yin Wong, Yun-Chung Leung, and coworkers attached an environment-sensitive fluorescent molecule to a flexible loop close to the enzyme's active site. When the enzyme binds a β-lactam antibiotic, the loop moves, changing the environment of the probe and causing the probe to fluoresce strongly [*J. Am. Chem. Soc.,* **126,** 4074 (2004)]. The sensor responds only to β-lactam antibiotics, Wong says. It can detect penicillin G at nanomolar levels.