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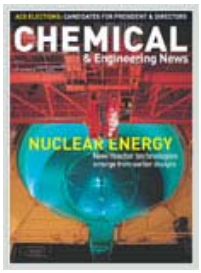

September 13, 2004
Vol. 82, Iss. 37
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Latest News

September 13, 2004
Volume 82, Number 37
p. 9

MATERIALS SCIENCE

SHAPE-SHIFTER

Molecular assemblies change their form depending on temperature

BETHANY HALFORD

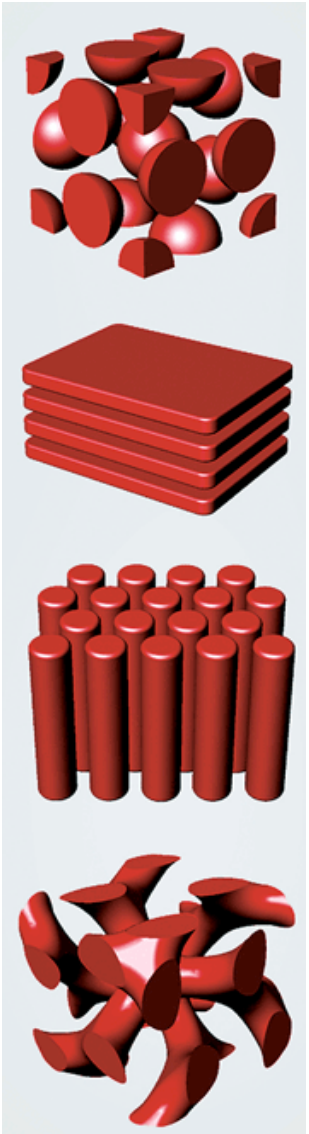
In what could be called a case of chemical crossbreeding, scientists at Cornell University have built a molecule that's part dendrimer and part block copolymer. Depending on the temperature, these hybrid molecules self-assemble into a variety of different supramolecular structures called mesophases--an attribute that could be capitalized on to make switches in nanostructured materials and devices [*Science,* **305,** 1598 (2004)].

"What's really new about this work is that we used these two polymer classes, which have very specific phase behaviors, and we combined them into a novel architecture that's a composite of both," explains materials science professor Ulrich Wiesner, who spearheaded the research.

Wiesner, along with coworkers Byoung Ki Cho, Anurag Jain, and Sol M. Gruner, found that the molecules assemble themselves into structures that are characteristic of dendrimers, such as columns and micelles, and into a gyroidlike continuous cubic mesophase that is characteristic of block copolymers. Wiesner explains that the combination of polymers gives the hybrids a "synergy in the phase behavior that has not been observed before."

The Cornell team also found that when doped with lithium ions, the hybrid molecules exhibit remarkable charge transport when they form the continuous cubic mesophase. "To the best of our knowledge, until now, nobody had been able to show charge transport in these continuous cubic structures," Wiesner says.

This conductivity changes dramatically when the molecules form a different mesophase, the researchers report. And that phase change is sharp. Wiesner tells C&EN that the exact temperature can be



MESOPHASE MORPHING Novel hybrid molecules assemble into (from top) cubic micelles, layered structures, cylindrical columns, and continuous cubic structures.

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fine-tuned, but at around 60 °C, changing the temperature by 1 °C drops the conductivity of the material by three orders of magnitude--a property that could be used to make temperature sensors and switches.

Chemical & Engineering News
ISSN 0009-2347

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