CHEMICAL & Engineering News

Science Concentrates

April 24, 2006
Volume 84, Number 17
p. 34

Motorizing the nanocar

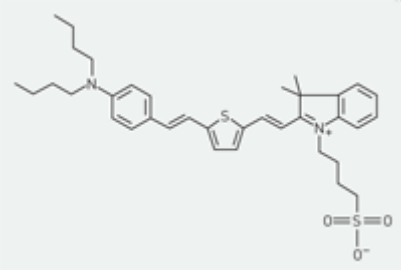
James M. Tour made nanoautomotive history last year, when his lab at Rice University built the world's first single-molecule car (C&EN, Oct. 24, 2005, page 13). But without an engine, this so-called nanocar couldn't go anywhere without being pushed. Now Tour, along with colleagues Jean-François Morin and Yasuhiro Shirai, have taken a light-powered unidirectional molecular motor and attached it to the chassis of a newer model nanocar (shown, *Org. Lett.* **2006,** *8*, 1713). The motor should propel the car forward with a paddle-wheel motion. The Rice team also replaced the fullerene wheels they used in the earlier model of the nanocar with *p*-carborane tires. The motor, they say, was completely inoperative in the presence of fullerenes, probably because of rapid energy transfer from the motor's excited state to the fullerenes. The *p*-

carboranes are spherical enough to operate as wheels, and kinetic studies in solution demonstrate that the motor rotates when irradiated with light. Next, the group hopes to drive the nanocar across a flat surface.

Strategy pegs molecules' protein targets

A new strategy may make it easier to identify the protein target of a small-molecule "hit" from a high-throughput phenotypic screen (*Chem. Biol.* **2006,** *13*, 443). Target identification remains "a significant problem," notes Jeffrey R. Peterson of Fox Chase Cancer Center in Philadelphia. "What particular protein is the small molecule hitting to get that biological effect?" Peterson and colleagues demonstrate their new method with an inhibitor called pirl1, which they identified in a screen for small molecules that block the assembly of actin fibers in cell extracts. The researchers tested whether they could restore actin fiber assembly in pirl1-treated cell extracts by adding back individual fractions of untreated cell extracts. Repeated rounds of fractionation and testing revealed not only pirl1's target (the protein complex Cdc42/RhoGDI) but also another component of the actin-assembly signaling pathway. Thus, the strategy also should find broad utility as a "tool by which to identify multiple components of a signaling pathway mediating a biological process of interest," they note.

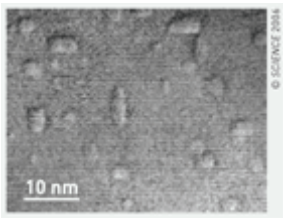
Dyeing hearts deeply



With a growing inventory of light-emitting molecular tags that label specific cellular parts or that respond to specific cellular acts, biologists are visualizing ever more details about cellular anatomy and physiology. Now Guy Salama of the University of Pittsburgh and colleagues there and at Carnegie Mellon University have devised a series of structurally related dyes (example shown) that

respond to the electric fields of heart muscle cells by emitting infrared light (*J. Membr. Biol.* **2005,** *208*, 125). That's important, says Alan Waggoner of CMU, because IR light penetrates tissue. In experiments using excised animal hearts, the researchers have shown that they can use the voltage-sensitive dyes to track electrical activity in cells up to a millimeter into cardiac tissue, not just in surface cells. A primary goal of the work is to develop new imaging techniques for studying how electrical excitations go awry in arrhythmic hearts and in sudden cardiac deaths.

What's behind aluminum alloys' strength



When spiced with silicon and magnesium, aluminum transforms from its soft, pliable self into alloys as strong as steel but only half the weight. Some alloys even take on a welcome but poorly understood "quick-bake hardening" property: They first can be formed into useful shapes such as automotive panels and then strengthened with a 30-minute bake at kitchen-oven temperatures. Using high-resolution electron microscopy, Jianghua Chen and his colleagues in the Netherlands Institute for Metals Research at Delft University of Technology have chronicled in atomic detail what happens inside AlMgSi alloys during this annealing step (*Science* **2006**, *312*, 416). First, pillars of silicon approximately 2 nm long assemble into skeletons on which particles with a rough composition of $Mg_2Si_2Al_7$ form. These nuclei then evolve into nanoscale Mg_5Si_6 precipitates (visible in the micrograph shown). It is these that squelch the kinds of motions within crystal grains that make pure aluminum so soft. "These nanoparticles are dynamic objects in the annealing process," Chen says. This refined scenario of the hardening process could lead to aluminum alloys that are more workable and stronger than existing ones, he adds.

Plants rank foes

Sun-loving plants apparently put more emphasis on protecting themselves from the encroachment of neighboring plants than from herbivores, according to researchers at the University of Buenos Aires and Max Planck Institute for Chemical Ecology (*Proc. Natl. Acad. Sci. USA*, to be published online, dx.doi.org/10.1073/pnas.0509805103). A plant can sense the attack of an herbivore or the advance of competing vegetation that could block sunlight. The plant responds by ramping up its defenses, for instance by increasing the production of unpalatable compounds to fend off an herbivore or by altering the angle of its leaves to catch more sun. What happens when a plant faces both types of threats at the same time? Carlos L. Ballaré and colleagues report that a plant's ability to defend itself from an herbivore is significantly impaired when the plant is also threatened by encroaching vegetation. This information could be used to develop crop varieties that would better withstand hungry insects despite crowded planting conditions.

Chemical & Engineering News
ISSN 0009-2347