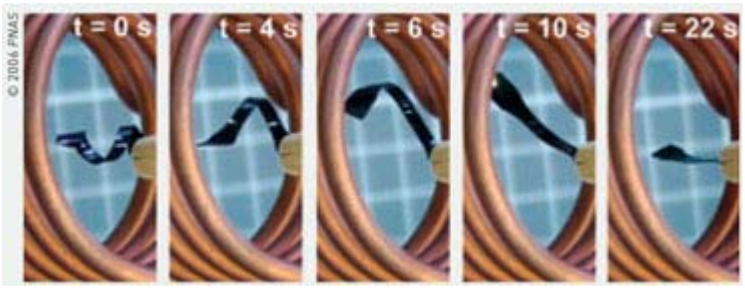
CHEMICAL & Engineering News

Science Concentrates

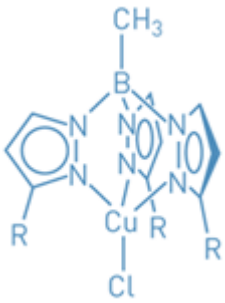
March 6, 2006
Volume 84, Number 10
p. 62

Magnetic shape-shifting

By flecking magnetic nanoparticles throughout a thermoplastic polymer composite, researchers in Germany have created a polymer that changes shape in response to a magnetic field (*Proc. Natl. Acad. Sci. USA*, published online Feb. 28, dx.doi.org/10.1073/pnas.0600079103). The material, created by Andreas Lendlein of the Institute of Polymer Research in Teltow and coworkers, is a new twist on shape-memory polymers. Shape-memory materials can be deformed into a temporary shape and then snapped back into their original predefined shape when exposed to an external stimulus. Heat is typically used to stimulate the material's shape-shifting, but for certain applications, such as medical implants, applying heat directly to these polymers is impractical. The magnetic particles Lendlein incorporated into his group's shape-memory polymer trigger shape changes via inductive heating when placed in an alternating magnetic field (shown). Lendlein says the material could be used to make smart catheters and drug delivery systems.



Copper catalyst paves new way to polyaniline



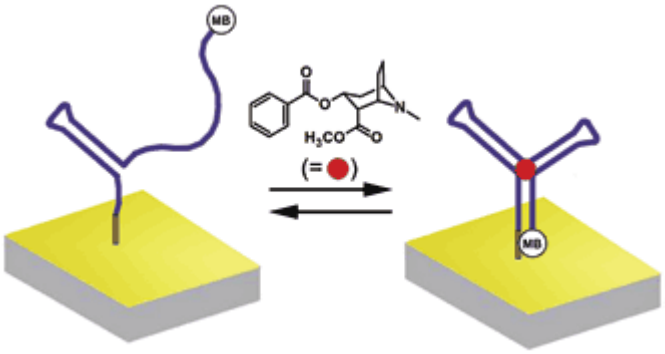
A copper catalyst with a bulky tris(pyrazolyl)borate ligand has been used in combination with hydrogen peroxide oxidant to synthesize the conducting polymer polyaniline under mild conditions (*Chem. Commun.* **2006,** 976). The new synthesis, reported by H. V. Rasika Dias, Ronald L. Elsenbaumer, and coworkers at the University of Texas, Arlington, is a potentially cleaner and more efficient method to make the polymer. Polyaniline's broader use in optoelectronics and other devices has been hampered by its tricky synthesis. The polymer is commonly prepared by using stoichiometric amounts of the strong oxidant ammonium persulfate, $(NH_4)_2S_2O_8$, in conjunction with a strong mineral acid. Copper salts also have been used to make polyaniline, but they tend to overoxidize the polymer. Restricted access to the copper center of the tris(pyrazolyl)borate catalyst (shown, R is mesityl) allows better head-to-tail coupling of aniline dimers and limits cross-linking to provide good-quality polymer under less harsh conditions, Dias notes.

Environment guides reactions

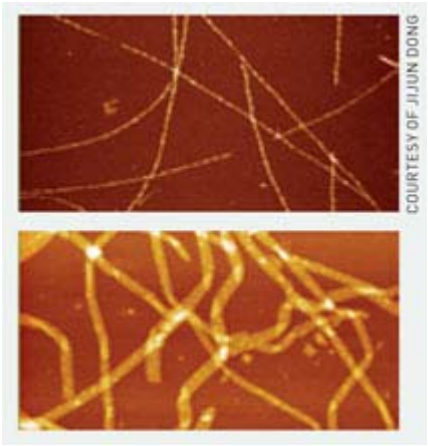
Catalytic reactions can be steered in unusual directions by controlling the catalyst's chemical environment, according to a study conducted at the University of California, Berkeley. Alexander Katz, John D. Bass, and coworkers have shown that by immobilizing primary amines on silica and surrounding the catalytic amine groups with cyano groups, the Henry reaction-a C-C bond-forming reaction that couples aldehydes and nitroalkanes and ordinarily forms olefin products using primary amine catalysts-can instead be used to prepare alcohols with high selectivity (*J. Am. Chem. Soc.*, published online Feb. 24, dx.doi.org/10.1021/ja057395c). The group explains that in the presence of native silanol (SiOH) groups, the reaction forms olefins by way of an acid-base mechanism. In contrast, the polar, aprotic environment associated with cyano groups guides the reaction to produce alcohols via an ion-pair mechanism that was postulated previously for primary amine catalysts but not verified experimentally until now.

Quick cocaine detection

A new electronic, aptamerbased sensor that rapidly and cheaply detects cocaine illustrates the general power of such devices, say creators Kevin W. Plaxco, Alan J. Heeger, and colleagues at the University of California, Santa Barbara (*J. Am. Chem. Soc.* 2006, *128*, 3138). The basic sensor consists of a nucleotide sequence designed by molecular evolution to bind to a specific target. The strand is tagged at one end by the redox indicator methylene blue (MB) and attached at the other end to a gold electrode. In the absence of a target-in this case, cocaine-the aptamer likely remains unfolded. If cocaine is present, the aptamer assembles into a three-armed structure with the cocaine molecule at the center. The MB tag either moves close to or binds with the electrode, thereby causing a change in voltage. The group ultimately found two nucleotide sequences that bind cocaine selectively in biofluid samples even in the presence of contaminants.



Zn determines amyloid shape



A new spectroscopic study may help researchers get a better handle on how metal-ion coordination dictates the assembly and morphology of amyloid fibrils associated with diseases such as Alzheimer's (*J. Am Chem. Soc.*, published online March 1, dx.doi.org/10.1021/ja055973j). Transition metals such as zinc previously have been implicated in the assembly of amyloid fibrils. Now, a team led by David G. Lynn of Emory University has shown that Zn^{2+} binding dictates amyloid morphology, too. The researchers report that different Zn^{2+} concentrations force simple segments of the Aβ peptide of Alzheimer's disease to assemble into different morphologies, including fibrils (top) and ribbons (bottom). They used X-ray absorption spectroscopy to show that differences in the metal ion's coordination environment dictate which amyloid architecture is formed. The characteristic spectroscopic signatures they report can now be used to investigate

metal coordination in full-length Aβ assemblies. Such information may reveal chemical reactivity important for cellular toxicity of Aβ, they note

Chemical & Engineering News
ISSN 0009-2347