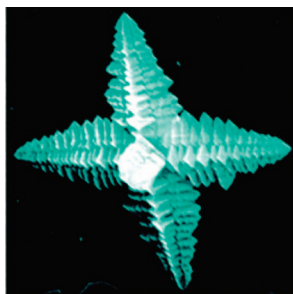


Mesostars on the Horizon

■ The assembly of materials and structures from nanoparticle components is an attractive focus for current research efforts with the potential for numerous applications, such as new optical devices, chemical sensing, and medicine. Since the constituent nanoparticle sizes, shapes, and morphologies determine the properties of the larger materials, researchers are experimenting continually with novel nanoparticles and assembly methods to understand the propensity of the nanoparticles to form hierarchical mesoscale structures.



In a new study, Bardhan *et al.* (p 266) showcase the capacity of novel Au nanorice particles to assemble into hyperbranched micrometer-scale mesostars. The researchers subjected an aqueous suspension of the particles, made of prolate hematite cores surrounded by a thin Au shell, to a 5 V potential difference between two platinum electrodes. Over the next 24 h, the nanorice particles amassed into distinctive and novel mesostar formations, with the final structures averaging 650 nm in length and

380 nm in height. Scanning electron micrographs taken over this formative period suggest that the electrolysis initially etches the Au shell and partially converts the hematite into FeOOH nanocrystals. The resulting modified nanorice particles then align preferentially along their axis, forming mesostars with FeOOH nanocrystals branching from each arm. By varying the voltage, the researchers found that 5 V was preferential for optimizing the yield of well-formed mesostars, with voltages lower or higher producing fewer mesostars or malformed structures. The authors suggest that examining this unusual assembly process could yield insight into other hierarchical nanostructures.

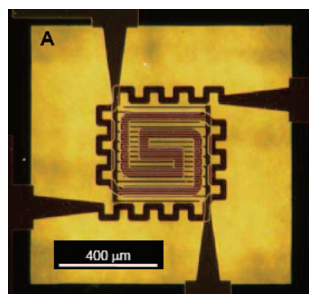
New Spin(coat) on Graphene Chemical Sensing

■ The unusual properties of graphene, including high carrier mobility at room temperature, have stimulated interest into both basic and applied research on this system. Until recently, deriving single sheets of graphene large enough for device measurements has presented a challenge; however, researchers have recently shown that chemical methods can generate device-quality graphene flakes. This typically involves chemical oxidation and exfoliation of graphite to graphite oxide, then subsequent reduction to graphene.

Fowler *et al.* (p 301) took advantage of chemical methods to create chemical sensors that rely on single-layer graphene. The researchers used anhydrous hydrazine as a reducing agent for graphite oxide in

solution, spin-coating the hydrazinium graphene solution onto interdigitated planar electrode arrays. This formed well-dispersed flakes large enough for device

testing (~10 μm × 10 μm). Testing their sensor on low concentrations of NO₂ and NH₃, the researchers recorded respective decreases and increases in resistance that were reliable and significant in these devices, even without further optimization. The chemical sensors also proved effective at detecting low concentrations of

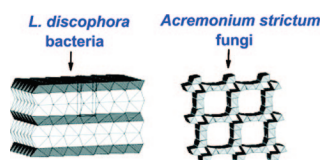


dinitrotoluene (DNT), a volatile analogue of the explosive trinitrotoluene (TNT). Fowler *et al.* found that response and response time in their chemical sensors varied with tem-

perature, with larger, slower responses at room temperature, and smaller, faster responses at higher temperatures. Sensors incorporating a micro hot plate resulted in rapid response times, but at the expense of sensitivity. Current *versus* voltage data suggested that charge transfer between the analyte and the graphene is the primary mechanism for chemical response. The authors are currently investigating how to enhance the performance and scalability of these effective chemical sensors.

Nanophase Materials in Microorganisms

■ Though researchers continue to develop novel nanoscale structures, nature has long been a prolific producer of nanophase materials. An often-used example of such natural nanomaterials is the microorganism-assisted oxidation of water-soluble metal ions into insoluble oxides, a process that leaves its ubiquitous signature in sediments on the ocean floor and in soil on land. To understand how microorganisms form these nanophase materials, it is instructive to know the atomic-scale structures of the products. Recently, researchers have made progress in determining the structures of synthetic nanophase materials



using a nontraditional approach involving a combination of high-energy X-ray diffraction and atomic pair distribution function analysis.

In a new study, Petkov *et al.* (p 441) employ this same approach to investigate the structures of nanophase manganese oxides produced by *L. discophora* SP-6 bacteria and fungi from the *Acremonium strictum* family. The researchers found that both biogenic materials are built up from interconnected Mn–O₆ octahedra, though their long-range ordering differed greatly. The bacterial manganese oxide structure

forms a triclinic lattice with water residing in interlayer regions, suggestive of the aquatic habitat of these microorganisms. In contrast, the fungal manganese oxide forms a monoclinic lattice with a significantly lower water content, reflecting the fact that it is produced in a drier medium. In addition to academic interest, the authors suggest that this structural diversity in biogenic materials may have technological applications, such as the use of microorganisms as factories to build nanophase materials of a preferred structural type.

Published online February 24, 2009.
10.1021/nn900082s CCC: \$40.75

© 2009 American Chemical Society