

polarization-resolved mode and Fabry–Perot oscillations in a reflection geometry with a Fourier transform IR setup. The variation of the refractive index in this setup is found to be six to seven orders of magnitude higher than in bulk Si lattice. To verify that the birefringence of the anisotropically nanostructured Si layers has a dielectric nature and is not induced by stress, the pores of the samples were inundated with various dielectric liquids, and the ratio of the perpendicularly polarized light to the parallel polarized light was measured. The researchers found that the result supported the dielectric explanation of the birefringence in anisotropically nanostructured Si layers.

CLAUDIU MUNTELE

### Soft Chemistry Method Developed for Synthesis of Cubic Boron Nitride

A team of researchers from Shandong and Beijing Science and Technology Universities and the Chinese Academy of Science have synthesized cubic boron nitride (cBN) at low temperatures and low pressures. As reported in the August issue of *Chemistry of Materials*, they used a solvothermal method to obtain nanocrystalline powders.

Cubic boron nitride is an attractive material for many applications due to its hardness, high thermal conductivity, and high-temperature stability. Unfortunately, the conventional synthesis of cBN from hexagonal BN requires extremely high temperatures and pressures (1200–2000°C and 2.5–7.5 GPa), which limits the possible batch sizes.

“But theory predicts that cBN should be stable at temperatures below 1300 K and pressures below 2 GPa,” said D.L. Cui, a professor at Shandong University. So his group investigated soft chemistry methods for the low-temperature and low-pressure synthesis of cBN.

Their process utilizes an anion exchange reaction between  $\text{BBr}_3$  and  $\text{Li}_3\text{N}$ , using benzene as a solvent. The mixtures were heated for 8–12 h in a stainless steel autoclave at 480°C. The product was filtered, washed with water to remove the LiBr, and dried under vacuum at 80°C.

Transmission electron microscopy showed particles of nearly cuboidal shape and sizes of ~30 nm. Characterization by x-ray and electron diffraction and Fourier transformation IR spectroscopy revealed that the samples consisted of a mixture of different BN phases, with the cubic phase as the major one. Some hexagonal and orthorhombic BN were observed along with the cBN. The extracted lattice constants were in good agreement with liter-

ature values. The sample stoichiometry of B:N was confirmed by x-ray photoelectron spectroscopy. No oxide impurities could be detected.

Graduate student X.P. Hao said, “We are still trying to improve our synthetic methods. By now, we can prepare almost pure cBN at even lower temperatures, around 200°C, and pressures of 0.3–0.5 MPa.”

CORA LIND

### Resorcinarene Promotes Self-Assembled Arrays of 2D Gold Nanoparticles

Chemists from Purdue University have developed a macrocyclic surfactant that enables gold nanoparticles in the mid-nanometer-size (10–200 nm) range to self-assemble into two-dimensional (2D) hexagonal close-packed arrays. As reported in the August 15 issue of the *Journal of the American Chemical Society*, the work demonstrates that particles as large as 170 nm can be dispersed at the air-water interface and organized into well-ordered monolayers when coated with resorcinarenes, a macrocycle with several hydrocarbon chains.

“Many nanostructured materials with mid-nanometer length scales have useful optical or magnetic properties, but are difficult to work with because of strong interparticle forces,” said researcher Alexander Wei, an assistant professor in the Department of Chemistry. “The resorcinarenes provide us with greater synthetic control for harnessing these materials into periodic structures with size-tunable properties.”

Wei’s research group has illustrated this point by measuring the arrays’ optical extinction properties, which were shown to vary dramatically as a function of periodicity. The arrays also exhibit strong and size-tunable surface-enhanced Raman scattering (SERS), the details of which will be published in *ChemPhysChem* later this year. The researchers are currently investigating the arrays for their potential as chemical sensors.

YUE HU

### Organic LED Utilizes Flrpic for Efficient Blue Electrophosphorescence

A research team led by S. Forrest at The Center for Photonics and Optoelectronic Materials (POEM) at Princeton University has engineered an organic thin-film light-emitting device that will emit blue light using endothermic instead of conventional exothermic energy transfer. In order to create the energy transfer, the researchers used a 4,4'-N,N'-dicarbazole-biphenyl (CBP) conductive host

molecule doped with iridium(III)bis(4,6-difluorophenyl)pyridinato-N,C<sup>2'</sup>)picolinate, Flrpic. The researchers report in the September 3 issue of *Applied Physics Letters* that, “[t]o our knowledge, this is the first report of efficient blue electrophosphorescence.”

Although the researchers had prior success with red and green electrophosphorescent devices, they encountered a materials selection challenge due to the higher energy requirements of blue electrophosphorescence. Typically, the electrophosphorescence occurs when an exciton moves from a high energy state of the host molecule to a lower energy state on the phosphor, giving up energy in the process. However, the energy difference between the preferred host molecule and blue phosphors is not sufficient for luminescence via this conventional exothermic energy transfer. When investigating other potential host molecules, they found that a potential dichotomy existed between host materials with suitable high energy triplet states and host materials with appropriate energy level alignments with the other materials in the organic light-emitting devices (OLEDs). Consequently, the researchers pursued endothermic energy transfer in which the combination of applied current and existing thermal energy pushes excitons from the host molecule to the phosphor. They likely would not have achieved the same results without using a host molecule characterized by a very slow decay of its exciton.

The researchers grew OLEDs on a glass substrate precoated with a ~130-nm thick indium-tin-oxide (ITO) layer. Using a degreased and UV-ozone ambient cleaned glass/ITO substrate, the researchers grew the organic and metal cathode layers without breaking vacuum using an *in vacuo* mask exchange mechanism. After depositing the organic and metal cathode layers, the researchers encapsulated the device using a UV-epoxy resin under a nitrogen atmosphere. When describing the process, the researchers noted that, “[m]aintaining vacuum throughout the entire process is critical to attain high efficiencies.”

The researchers were able to achieve high photoluminescent efficiencies in several materials. However, to achieve the blue emission they sought, they had to introduce fluorine atoms and replace one of the ligands. Although the blue light emitted is not yet an exact match to the National Television Standards Committee (NTSC)-recommended blue for use in video displays, their ability to achieve wavelength shifts by creatively interchanging materials indicates that this material has the potential for an exact