

of Central Florida, and their co-workers. As reported in the February issue of the *Journal of the American Ceramic Society* (p. 466, DOI: 10.1111/j.1551-2916.2005.00069.x), these nanostructures with rectangular cross sections and triangular tips result from high-temperature pyrolysis of polyureasilazane in the presence of an FeCl₂ catalyst and N₂ vapor.

A powder precursor formed by curing the polyureasilazane and ball-milling it with the catalyst material was annealed at 1450°C, yielding nanobelts 50–100 nm thick, 400–1000 nm wide, and ranging in length from hundreds of microns to several millimeters. Energy-dispersive spectrum analysis confirmed that the nanobelts consisted only of Si and N. High-resolution transmission electron microscopy revealed that the belts were perfectly crystalline α -Si₃N₄ with both [011] and [100] growth directions. Investigation of the structure using x-ray diffraction verified the presence of α -Si₃N₄, and a broad underlying diffraction peak was interpreted to come from an amorphous precursor that remained under the nanobelts.

The researchers suggest a solid–liquid–gas–solid growth mechanism for the nanobelts. As the amorphous Si–C–N precursor is heated with the Fe catalyst, a Si–Fe–C liquid eutectic forms and becomes supersaturated with Si and C. The supersaturated liquid reacts with N₂ vapor to form stable Si₃N₄ precipitates, which then grow into the nanowires. To account for the rectangular cross sections, the researchers propose that after the Si₃N₄ nucleates within the liquid droplets, the precipitate grows anisotropically due to the nature of the nitride crystal structure. Once the base of the triangular precipitate is the same dimension as the eutectic drop, the width ceases to increase but growth continues along the axial direction. Since other studies have shown that round nanowires can be grown in similar materials systems but at lower temperatures, Yang and co-workers are currently examining a hypothesis that the lower solubility of Si in the eutectic phase at lower temperatures results in smaller droplets, which in turn limits anisotropic growth of the nitride precipitates.

AMANDA GIERMANN

Doped PMMA Used For 3D Multilayered Optical Memory

As reported in the April 1 issue of *Optics Letters* (p. 774), H. Jiu and co-workers at the University of Science and Technology of China use a femtosecond-pulsed infrared laser to sequentially create eight layers of voids, with diameters less than a micrometer, within a block of

doped poly(methyl methacrylate) (PMMA). Their result joins a body of research that uses pulsed lasers to controllably form voids within dielectric and polymer materials. This activity has been prompted mainly by the allure of applications in microfabrication and high-density optical storage.

As a dopant, the researchers chose an easily synthesized rare-earth complex, Sm(DBM)₃Phen, which is highly soluble in PMMA. Compared with pure PMMA, the doped polymer has a lower optical memory threshold, which is due to the strong absorption of DBM (dibenzoylmethane) at 400 nm. A high and uniform concentration of dopant compounds resulted in stability and reproducibility during the subsequent laser etching process.

The group members use a Ti:sapphire laser operating at 800 nm (in the infrared region) to create the embedded voids. Because the polymer is largely transparent at this wavelength, single photons penetrate easily to the desired void depth, tens of micrometers within the sample. Once inside the doped PMMA, the laser beam is focused, and multiphoton absorption then excites a micro-explosion that causes controlled damage to a tiny volume. Each pulse changes one region, or binary data bit, within the material. Electron spin resonance spectra of the sample, taken before and after the laser-induced damage, confirm the photodegradation of PMMA.

Jiu and co-workers then read out these bits, both serially by observing the fluorescence of the structurally altered cavities under illumination by a 514.5 nm argon laser, and also in parallel by imaging the region with a CCD coupled to an optical microscope. Fluorescence in the void regions is strongly enhanced, which the researchers attribute to defects introduced by the scission of bonds of PMMA.

“With our validation of how voids can be arranged and then also detected within this storage medium at room temperature,” said co-researcher Qijin Zhang, “we have demonstrated the basic parts of a 3D, multilayered, read-only optical memory system.”

RICHARD LOUIE

Anthracene Derivatives Used to Form *n*- and *p*-Type OFETs

Organic semiconductors have been widely studied from the viewpoints of their fundamental optoelectronic properties and their potential applications in organic light-emitting diodes (OLEDs), organic field-effect transistors (OFETs), and photovoltaic cells. Novel *p*- and *n*-type organic semiconductors can be produced by introducing electron-accepting or

electron-donating groups as terminal groups into a common core unit (e.g., thiophene oligomers). When the core units consist of acene, pentacene is known to exhibit the highest mobility ($\mu = 3.0 \text{ cm}^2/\text{V s}$) among OFETs. However, poor solubility in common organic solvents and instability in air makes pentacene difficult to modify. S. Ando of the Tokyo Institute of Technology, E. Fujiwara of the Institute for Molecular Science, Y. Inoue of NHK Science and Technical Research Laboratories, and their colleagues have reported anthracene as a preferred candidate over pentacene for its better solubility. The researchers prepared two new anthracene derivatives as semiconductors for FETs to prove the effect of terminal groups on charge transport. The research team believes this is to be the first *n*-type performance of anthracene derivatives.

As reported in the March 22 issue of *Chemistry of Materials* (p. 1261; DOI: 10.1021/cm0478632), thiophene rings (1) and 4-trifluoromethylphenyl rings (2) are used as terminal groups for electron-donating and electron-accepting parts, respectively, in an anthracene unit to produce derivatives for *p*- and *n*-type transistor materials. The researchers constructed OFETs using these derivatives and demonstrated their performances as *p*- and *n*-type semiconductors. OFETs were fabricated on SiO₂/Si substrates using a top-contact geometry with gold source and drain contacts deposited on the organics. According to the research team, the absorption data reveal that the HOMO–LUMO gap for 1 is 2.85 eV and 2.68 eV for 2. Through analysis, the researchers demonstrated that FETs with the derivatives 1 and 2 have been constructed with electron and hole mobilities on the order of 10⁻³ cm²/V s. X-ray diffraction, they said, reveals high lamellar ordering and crystallinity for 1 and disorder for 2. Atomic force microscopy shows a small grain size for 1 and a large grain size for 2, which have important implications for transport. The researchers conclude that the terminal substituents near the gate electrode have a great effect in determining the polarity of FET characteristics.

VIVEK RANJAN

Nanopipettes and Nanoparticles Enable Detection of Single DNA Molecules

Progress in DNA detection methods may lead to new ultrafast DNA sequencing methods, which are essential for the development of new lab-on-a-chip technologies. In the February issue of *Nano-Letters* (p. 403; DOI: 10.1021/nl0480464), M. Karhanek and colleagues from the