gies and two monomers with zero energy (see Figure 1d), so that application of a perpendicular electric field results in different potentials at the bottom and top layers. This lifts the degeneracy of the two monomers and induces a bandgap.

The researchers said, "Our work suggests that a tunable bandgap can be induced in thicker graphene samples with ABC (rhombohedral) stacking order, thus providing a still broader class of materials with a tunable bandgap."

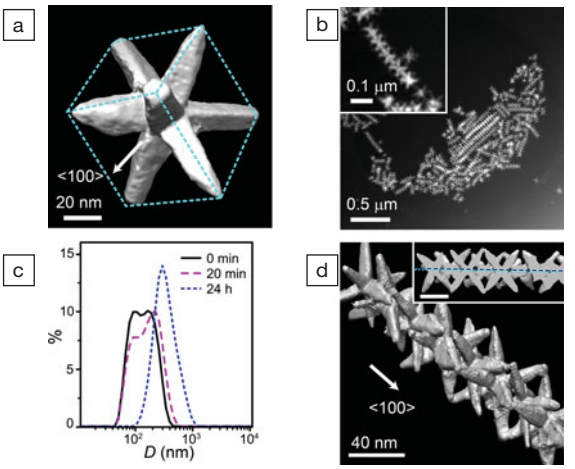
Steven Trohalaki

Octapodal nanocrystals self-assemble into micrometer superstructures

Researchers have created octapodal nanoparticles that self-assemble on a number of levels to ultimately generate micrometer-sized superstructures. Their work opens the door to fast and reversible cation exchange systems, the possibility of building three-dimensional (3D) ion sensors and porous electrodes, and other applications arising from the ability to establish complex geometries of dielectric and conductive materials.

K. Miszta from the Instituto Italiano di Tecnologia in Genova, Italy, J. de Graaf and R. van Roij from Utrecht University, the Netherlands, and their colleagues reported their discovery of this phenomenon in the November issue of *Nature Materials* (DOI: 10.1038/nmat3121; p. 872). By growing eight CdS pods out of a CdSe core, the researchers were able to fabricate monodisperse, colloidally predictable octapods that approached 100 nm in diameter. These octapods self-assembled into linear chains of interlocked octapods up to 400 nm in length in a toluene solvent. After aging the toluene solution for 24 hours, the addition of acetonitrile to the toluene caused the chains to precipitate out into 3D ordered superstructures 2 µm in length, composed entirely of self-assembled chains.

To create these structures, the researchers modified a previous procedure which allowed for unprecedented homogeneity and monodispersity of particles. The team coated the particles with hydrophobic surfactant molecules to improve interactions before immersing them in toluene. The toluene octapod solution (250 µL) was aged for 12–24 hours, and then mixed with 1 mL of acetonitrile. Two to five hours later the researchers transferred the resulting precipitate to a conductive substrate for scanning and transmission electron microscopy analysis. Aggregation in solution was monitored by dynamic light-scattering microscopy. The concentration of octapods in the final solution was on the order of 10^{-8} molar.



Formation of octapod chains in toluene: (a) three-dimensional (3D) reconstruction from scanning transmission electron microscopy (STEM) projections; (b) STEM image after 24 h of ageing; (c) cluster size distribution curves at different ageing times, *D* is the size of the aggregates, % is the percentage of frequency; and (d) 3D reconstruction of a single chain, demonstrating the interlocking sequence along <100> of the cube in (a), with the octapod centers well aligned on the chain axis, as shown by the cut-through of the inset. Reprinted with permission from *Nature Mater*. (DOI: 10.1038/nmat3121).

Benjamin Scheiner

Graphene allows ultrashort pulse generation in solid-state laser

Graphene is a point-bandgap semiconductor with a linear dispersion of electrons with low energy that can be described by the Dirac equation involving relativistic effects. It also possesses large polarizability when illuminated by light, that is, large optical nonlinearity. These unique characteristics, in combination with the ultrafast relaxations of charge carriers (electrons and holes) in this material, in the femtosecond and picosecond time scale, suggest that graphene can be useful as an ultrafast saturable absorber (SA), that is, a material in which absorption of light decreases when the light intensity increases, and in a very short period of time. This property is fundamental for the generation of ultrashort light pulses in laser technology. Furthermore, graphene can be used for this application in a very broad spectral range without requiring modification of the electronic bandgap. F. Rotermund from Ajou University, South Korea, B.H. Hong from Sungkyunkwan University, South Korea, and their colleagues have reported in the October 15 issue of *Optics Letters* (DOI: 10.1364/OL.36.004089; p. 4089) the fabrication of high-quality, large-area graphene SAs and their application for efficient mode-locking of a solid-state laser operating

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