of ice crystals that had previously been beyond the ability of current ice crystal scattering instruments to characterize. The researchers said that this instrument is designed to be used for laboratory studies, as cited here, and also can be mounted on aircraft with specially designed fuselage ports for studies of ambient air.

TARA D. WASHINGTON

Colloidal Single-Sized Nanocrystal Ensemble Exhibits Bright, Narrow-Band PL

Nanocrystals and nanoparticles are currently of great interest for a variety of applications, ranging from precision polishing of surfaces to bio-oriented, energy-associated, environmental-related, and security-allied applications. In particular, colloidal semiconductor quantum dots, which are ultra-small nanocrystals and spherical in shape, have demonstrated excellent optical properties such as narrow photoemission and broad absorption, and thus create potential for new applications as well as to replace traditional fluorescence dye molecules in existing areas. Most processes for synthesis of colloidal quantum dots yield a dispersion of particle sizes, which results in photoemission linewidths (e. g., ~30 nm) that are substantially broader (due to inhomogeneous broadening) than the linewidth of a single quantum dot. K. Yu and colleagues at the National Research Council of Canada have now synthesized single-sized nanocrystal ensembles exhibiting bright bandgap photoluminescence (PL) but with bandwidth as narrow as that from a single quantum dot (e.g., ~10 nm).

Yu's group has developed a methodology of molecular synthesis for the precise formation of colloidal semiconductor nanocrystals using a synthetic approach

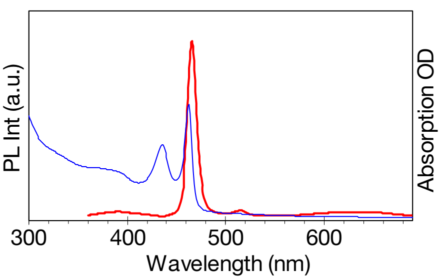

Figure 1. CdSe magic-sized nanocrystal Family 463 dispersed in toluene demonstrates pure-color light absorption (blue line, right y axis) and emission (red line, left y axis). Reprinted with permission from the *Journal of Physical Chemistry C* **112**(36) (2008) p. 13805. ©2008 American Chemical Society.

analogous to bottom-up self-assembly. This research group specializes in the development of colloidal single-sized nanocrystal ensembles, also called magic-sized nanocrystal (MSN) ensembles, using semiconductor quantum dots such as cadmium selenide (CdSe). The MSN ensembles have the special optical property of sharp light absorption near the absorption band edge and pure-color emission due to the absence of inhomogeneous broadening rising from their single-size property, with an optical response equivalent to one single quantum dot. The group's latest nanotechnology results on molecular synthesis were reported in the September 11 issue of the *Journal of Physical Chemistry C* (DOI: 10.1021/ jp803845n; p. 13805).

The molecular synthesis of single-sized ensembles simplifies handling and promises to be practical in large-scale production with high reproducibility. This ready approach uses a fatty acid as surface ligands, with 1-octadecene as the reaction medium. For CdSe, cadmium acetate dihydrate and elemental selenium are the sources of Cd and Se, respectively. With low acid-to-Cd and high Cd-to-Se feed molar ratios, all of these chemicals are loaded at room temperature in a reaction flask, and the growth of the CdSe MSNs is carried out at 120°C–240°C. This synthetic approach allows long periods of growth and annealing at elevated temperatures, resulting in high-quality CdSe MSNs showing strong bandgap PL.

Three different ensembles were reported, classified as Family 513, Family 463, and Family 395, based on their lowest energy absorption peaks in nanometers. Each of the three MSN ensembles reported has a narrow bandwidth. For example, Family 463 emits near 465 nm (2.67 eV) (shown in Figure 1), and its bandgap nonresonance photoluminescence bandwidth at room temperature is only 7.6 nm. Such a narrow nonresonant bandwidth has been observed in the past only in the emission spectrum of a single dot rather than an ensemble.

Yu's team has carefully evaluated the growth kinetics of these magic-sized nanocrystals, trying to identify a previously unknown reaction growth mechanism. Their experimental data demonstrate the possibility of optimizing reactions to produce desired nanocrystals and to translate laboratory experiments into product applications. Presently, the researchers are extending their efforts beyond CdSe to the molecular synthesis of various other compositions with bandgap photoluminescence and to the exploration of the formation mechanism.

GOPAL RAO