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Ultrasensitive spectroscopy of ultrasmall quantum dots for energy conversion and lighting applications LLOYD DAVIS, Center for Laser Applications, University of Tennessee Space Institute, NOAH ORFIELD, SANDRA ROSENTHAL, Department of Chemistry, Vanderbilt University — Quantum dots typically have narrow spectra with a peak that tunes with their size but ultrasmall semiconductor nanocrystals of diameters less than a few nanometers have size-independent spectra and many other strikingly different properties. One especially interesting feature is that ultrasmall CdSe nanocrystals emit an almost pure white-light spectrum, which has great potential for solid-state lighting that yields excellent color rendering. To gain understanding of the photophysical properties and mechanisms for broadband emission, we have constructed a modular fluorescence microscope for ultrasensitive spectroscopy of individual nanoparticles. Using 400-nm wide-field excitation from a frequency-doubled Ti-Sapphire laser and a high-efficiency electron-multiplying CCD, we observe that single CdSe nanocrystals exhibit blinking and abrupt photobleaching, often after detection of only a few hundred photons. Moreover, spectrally dispersed imaging shows that each particle emits the entire broadband spectrum. We discuss mechanisms for homogeneous broadband emission and ongoing experiments in which the instrument is configured for scanning, confocal, two-channel, time-resolved single photon counting for studies of photon antibunching, emission lifetimes, and correlations between spectral regions.

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