MATRL 265 Class 6: Quantum Dots

The notion of direct and indirect band gaps.

Direct band gap semiconductors display *quantum confinement* when their sizes are made small. Their photophysics is significantly affected as a consequence. For a recent review of the photophysics of semiconducting quantum dots in solution (as well as "single-molecule" studies, please see:

M. Nirmal, and L. E. Brus, Luminescence photophysics in semiconductor nanocrystals, *Acc. Chem. Res.* **32** (1999) 407-414. DOI.

The following paper was very important for the size-controlled synthesis of semiconductor quantum dots:

C. B. Murray, D. J. Norris, and M. G. Bawendi, Synthesis and characterization of nearly monodisperse CdE (E = sulfur, selenium, tellurium) semiconductor nanocrystallites, *J. Am. Chem. Soc.* **115** (1993) 8706-8715. Pick this up from http://pubs.acs.org

Quantum dots can be self-organized into superlattices:

C. B. Murray, C. R. Kagan, and M. G. Bawendi, Self-organization of CdSe nanocrystallites into three-dimensional quantum dot superlattices, *Science* **270** (1995) 1335-1338. Science.

The best optical properties are obtained from quantum dots that are capped with a material of a larger band gap:

M. A. Hines and P. Guyot-Sionnest, Synthesis and characterization of strongly luminescing ZnS-capped CdSe nanocrystals, *J. Phys. Chem.* **100** (1996) 468-471. DOI.