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5.111 Principles of Chemical Science
Fall 2008

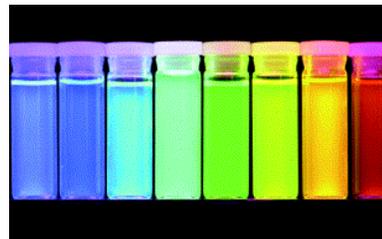
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Wave-Particle Duality of Light: Quantum Dot Research at MIT

See Lecture 3 for a description of the wave-particle duality of light.

Example from page 5 of Lecture 3 notes following a description of the relationship between the wavelength (λ) and frequency (ν) of light: $\lambda\nu = c = 2.9979 \times 10^8 \text{ ms}^{-1}$

Quantum dots are fluorescent nanoparticles of semiconductor material. Their small size and favorable fluorescent properties (such as intense brightness) make them ideal candidates for biological and medicinal imaging applications. For example, chemical attachment of quantum dots to specific cell types, such as cancer cells, may lead to important advances in imaging cancer. By shining UV light onto the area near a tumor and detecting the light emitted from the quantum dots, a surgeon could unambiguously visualize tumor cells.



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MIT Chemistry Research Example:

Research in the **Bawendi laboratory** includes the synthesis and application of **quantum dots**, semiconductor crystals of <10 nm in diameter. Quantum dots excited by UV radiation emit light of characteristic color that corresponds to the size and material of the quantum dot. Smaller dots emit bluer (higher frequency) light and larger dots emit redder (lower frequency) light. Quantum dots are being used and designed for an ever-increasing number of biological and sensor applications.

Quantum Dots

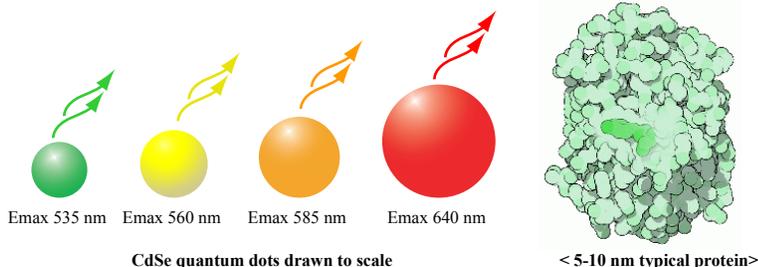


Figure by MIT OpenCourseWare.

CdSe quantum dots drawn to scale

<5-10 nm typical protein>

- Methods developed by the Bawendi lab for synthesizing quantum dots are now used by research groups around the world.
- In collaboration with other laboratories, including the lab of MIT professor **Alice Ting**, new cell imaging applications are being developed for quantum dots.

Bawendi lab research webpage:

<http://nanocluster.mit.edu/research.php>

Ting lab quantum dot research link:

http://web.mit.edu/chemistry/Ting_Lab/research-enzymereporters.html

The Tech (MIT newspaper) interview with Prof. Bawendi:

<http://www-tech.mit.edu/V128/N35/bawendi.html>