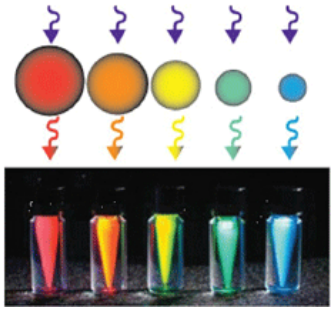
Technical Information:

Fluorescence Imaging with Quantum Dot Nanocrystals

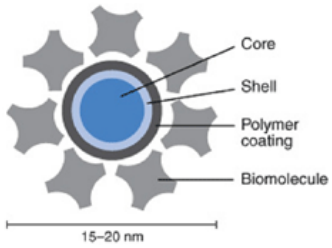
Quantum dot nanocrystals are fluorophores in that they absorb photons of light and then re-emit longer-wavelength photons nearly instantaneously. However, there are some important differences between quantum dots (e.g., Qdot® nanocrystals made by Invitrogen Molecular Probes®) and traditional fluorophores including organic dyes and naturally fluorescing proteins. Quantum dots are nanometer-scale clusters of semiconductor atoms, typically coated with an additional semiconductor shell and then a polymer coating to enable coupling to proteins, oligonucleotides, small molecules, etc., which are then used for direct binding of the quantum dots to targets of interest.

Nanocrystals are extremely bright and highly photostable, making them ideal for applications that require high sensitivity with minimal label interference, as well as long-term photostability, such as live-cell imaging and dynamic studies. Their excellent photostability also means they are fixable and archivable for permanent sample storage in pathology applications, for example. Because there is a direct relationship between the size of a nanocrystal and the wavelength of the emitted fluorescence, a full range of nanocrystals can be made – each with a narrow distinct emission spectrum and all excited by a single blue or ultraviolet wavelength. Thus nanocrystals are ideal for dense multiplexing. Some important nanocrystal features that may limit certain applications include their fairly large physical size and long lifetime.

To take advantage of nanocrystal features, it is important to use properly optimized filters. Semrock offers BrightLine® filter sets perfectly optimized for the most popular quantum dot imaging applications. A universal deep-blue exciter provides superior excitation efficiency while avoiding the excitation of DAPI and undesirable autofluorescence and preventing unnecessary phototoxic irradiation of the sample. This filter is combined with a dichroic beamsplitter with extremely wide reflection and transmission bands for maximum flexibility, and narrow, highly transmitting emission filters matched to each of the most important Qdot wavelengths. A universal set with a long-wave-pass emitter enables simultaneous imaging of multiple quantum dots by eye or with a color camera. Best of all, these filters share the incredible “no burn-out” reliability of all BrightLine filters, a perfect match for highly photostable quantum dot nanocrystals!



Different-sized nanocrystals emit different colors. Images courtesy of Molecular Probes®.



Structure of a nanocrystal.