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# High-Performance Spectral-Conversion Luminescence Nanoprobes: What's Ahead?

**Abstract:**

Lanthanide-doped nanoparticles exhibit unique luminescent properties, including a massive Stokes shift, a sharp bandwidth of emission, high resistance to optical blinking, and photobleaching. Uniquely, they can also convert long-wavelength stimulation into short-wavelength emission. These attributes offer the opportunity to develop alternative luminescent labels to organic fluorophores and quantum dots. In recent years, researchers have demonstrated the use of spectral-conversion nanocrystals for many biological applications, such as highly sensitive molecular detection and autofluorescence-free cell imaging. With significant progress made over the past decade, we can now design and fabricate nanoparticles that display tailorable optical properties. In particular, we can generate a wealth of color output under single-wavelength excitation by rational control of different combinations of dopants and dopant concentration. By incorporating a set of lanthanide ions at defined concentrations into different layers of a core-shell structure, we have expanded the emission spectra of the particles to cover almost the entire visible region, which is unavailable to conventional bulk phosphors. In this talk, I will highlight recent advances in the broad utility of lanthanide-based nanocrystals for multimodal imaging, bio-detection, therapy, display, and nanophotonics.