A new generation of QDs

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Technology Overview

High particle uniformity, high photoluminescence quantum yields, narrow and symmetric emission spectral lineshapes and minimal single-dot emission intermittency (known as blinking) have been recognized as universal requirements for the successful use of colloidal quantum dots in nearly all optical applications. However, synthesizing samples that simultaneously meet all these four criteria has proven challenging. Recently we reported the synthesis of such high-quality CdSe–CdS core–shell quantum dots in an optimized process that maintains a slow growth rate of the shell through the use of octanethiol and cadmium oleate as precursors. In contrast with previous observations, single-dot blinking is significantly suppressed with only a relatively thin shell. Furthermore, we demonstrate the elimination of the ensemble luminescence photodarkening that is an intrinsic consequence of quantum dot blinking statistical ageing.

Biomedical Application Potential

We demonstrated that these core/shell QDs can be easily soluble in water with high PL QYs, rendering them promising for in vivo imaging. The small size and high photoluminescence quantum yields of these novel quantum dots render them superior in vivo imaging agents compared with conventional quantum dots. We anticipate that this new generation of QDs will result in significant improvements in a variety of applications, ranging from solid-state lighting and illumination to biological labelling and tracking.
a) Photoluminescence (PL), b) absorption spectra of CdSe/CdS core/shell QDs. c)-f) TEM images of CdSe/CdS QDs with different CdS shell thickness. The scales bars are 50nm.

High-resolution TEM images of new generation CdSe/CdS core/shell QDs, indicating high crystallinity of individual QDs. Scale bars in b)-e) are 5 nm.
This new generation QDs show significantly suppressed blinking with an average “on” time fraction of 94%.

Photoluminescence quantum yield (PL QY) of QDs in hexane (QDs), and in water after ligand exchange with polyethylene glycol thiol (QDs-PEG-SH) and poly imidazole ligands (QDs-PIL). The corresponding multiphoton in vivo images are shown on the right.

Center Publications


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