A new synthesis of core/shell cuins$_2$/zns quantum dots for biolabeling

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Quantum dots (QDs) are semiconductor nanocrystals that possess unique optical properties attributed to the quantum confinement effect. Thanks to their broad absorption profiles the simultaneous excitation of multiple colors of QDs is possible unlike the conventional organic dyes. Moreover, the QDs surface can be functionalized by conjugation with various molecules enabling the nanoparticles to be dispersed in water and to be specifically addressed for biological applications (1-2).

During the last decade, low band gap II-VI and IV-VI semiconductors have been a major focus in the form of size and shape-controlled nanocrystals (NCs). Many synthetic pathways have been developed to obtain highly emissive CdSe or CdTe core QDs, especially for biological labeling. However, despite their appealing optical properties, the intrinsic toxicity of Cd, Te or Se elements and the production of reactive oxygen species (ROS) from these nanocrystals shed a doubt on the future applicability of these QDs, particularly in view of recent environmental regulations (3-4). Thus, there is a big interest in developing new synthetic pathways for production of highly fluorescent Cd–free QDs. One of a possible alternative materials are ternary I–III–VI NCs, including CuInS$_2$ (CIS), which possess much lower toxicity, high absorption coefficient, high stability, and tunable emissions from visible to NIR region (2).

Here, we report a new synthesis of core/shell CuInS$_2$/ZnS QDs with PL emission at ca. 610 nm, and photoluminescence quantum yield (QY) up to 65%. The successful transfer of these dots into water was achieved via overcoating with the amphiphilic polymer, poly(maleic anhydride-alt-1-octadecene) (PMAO). The products were characterized by means of UV–vis and fluorescence spectroscopies, X-ray diffraction (XRD), dynamic light scattering (DLS) and high resolution transmission electron microscopy (HRTEM) (Fig. 1). The PMAO-coated QDs emit at ca. 640 nm with QY of 35%.

![Absorption and PL emission spectra](image1)

![High resolution micrograph](image2)

Fig. 1 Absorption and PL emission spectra (A) and (B) high resolution micrograph of PMAO-coated CuInS$_2$/ZnS QDs.

References
[5]