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Bioengineered II–VI Semiconductor Quantum Dot–Carboxymethylcellulose Nanoconjugates as Multifunctional Fluorescent Nanoprobes for Bioimaging Live Cells

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Colloidal semiconductor quantum dots (QDs) are light-emitting ultra-small nanoparticles, which have emerged as a new class of nanoprobes with unique optical properties for bioimaging and biomedical diagnostic. However, to be used for most biomedical applications the biocompatibility and water-solubility are mandatory that can achieved through surface modification forming QD-nanoconjugates. In this study, semiconductor II-VI quantum dots of type MX (M=Cd, Pb, Zn, X= S) were directly synthesized in aqueous media and at room temperature using carboxymethylcellulose sodium salt (CMC) behaving simultaneously as stabilizing and surface biofunctional ligand. These nanoconjugates were extensively characterized using UV-visible spectroscopy, photoluminescence spectroscopy, X-ray photoelectron spectroscopy, Fourier transform infrared spectroscopy, X-ray diffraction, transmission electron microscopy, dynamic light scattering and zeta potential. The results demonstrated that the biopolymer was effective on nucleating and stabilizing the colloidal nanocrystals of CdS, ZnS, and PbS with the average diameter ranging from 2.0 to 5.0 nm depending on the composition of the semiconductor core, which showed quantum-size confinement effect. These QD/polysaccharide conjugates showed luminescent activity from UV-visible to near-infrared range of the spectra under violet laser excitation. Moreover, the bioassays performed proved that these novel nanoconjugates were biocompatible and behaved as composition-dependent fluorescent nanoprobes for *in vitro* live cell bioimaging with very promising perspectives to be used in numerous biomedical applications and nanomedicine.

Keywords: Quantum dots; Fluorescence; Biopolymer; Cell imaging; Cytotoxicity; Nanoconjugates.

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