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HALLOYSITE – QUANTUM DOTS NANOCOMPOSITES FOR THE INTRACELLULAR LABELING

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Halloysite – quantum dots nanocomposites for the intracellular labeling

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Introduction

Quantum dots (QD) are widely used for cellular labeling due to enhanced brightness, resistance to photobleaching and multicolor light emissions, thus being superior to traditional organic fluorescent dyes. The inherent problem of quantum dots applications is the toxicity of the ligands used in the synthesis or of the quantum dots themselves.

Methods

We have synthesized CdS, $Cd_xZn_{1-x}S$, CdSe, and FeSe quantum dots in the presence of halloysite – tubular clay serving as the stabilizing agent instead of the potentially toxic ligands. The obtained nanotubule-QD composites were characterized by transmission electron microscopy, and by reflectance and fluorescence spectroscopy. The halloysite–QD composites were tested for labeling of human skin fibroblasts and prostate cancer cells.

Results

We synthesized halloysite nanotubes with 2-3 nm diameter nanoparticles adsorbed into the lumen or onto the outer surface of halloysite (see Figure 1). In the absence of halloysite, analogous synthetic procedures led to the agglomeration of particles into a bulk precipitate. The obtained composites exhibited spectral properties typical for the quantum dots. The uptake of the halloysite–quantum dots composites by human cells was confirmed by dark-field and fluorescence microscopy. The human cells both QD-halloysite treated and untreated completely covered the substrates grown in Petri-dish within 4–5 days. Cell morphology and cellular proliferation were not affected by the QD-halloysite treatment, contrary to the poisonous effect of pure uncoated QDs.

Discussion

Adsorption of quantum dots on halloysite nanotubes prevents them from aggregation. The pronounced scattering and fluorescence demonstrated by halloysite–quantum dots composites allow using them as intracellular markers. Depending on the chemical composition, halloysite-based QD-markers are either diffusely distributed within the cytoplasm or predominantly agglomerated in perinuclear regions. Thus, the obtained tubular clay encapsulations of quantum dots are the perspective markers for the applications in biomedical studies.

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