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"Controlled growth of Gd2O2S:Ln3+ based nanostructures: A study of their optical properties and biological response."

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Lanthanide (Ln3+= Tb3+, Eu3+,Yb3+)-doped gadolinium oxysulfide (Gd2O2S:Ln3+) nanostructures have been synthesized by a hydrothermal method followed by a reaction with sulfur. We studied parameters such as: type of nucleating agent, concentration of precursors, temperature of the stock solutions, reaction time and reaction temperature to obtain well defined homogeneous nanostructures with specific shape and size. The chemical evolution of the formed particles was followed by the Infrared Spectroscopy (FTIR), thus showing the removal of the hydroxicarbonate precursors at different stages of synthesis. X ray analysis (WAXD) confirmed that the calcination and sulfidation processes produced cubic and hexagonal crystalline structures. The photoluminescent (PL) properties of the materials have been evaluated as response to UV (for Tb3+) and IR (for Eu3+:Yb3+) light excitation in solid phase and in colloidal suspension. After excitation of nanostructures, a strong green and/or red fluorescent emission which depends of the doping agent was observed, in this regard the up-conversion properties of the nanostructures were also studied. In colloidal suspensions, the emission spectra of the oxide and oxysulfide phases were compared, and it was observed that the sulfidation process increased the integrated emission intensity seventy-fold with respect to the former. In addition it was found that the precipitation agent strongly influences the shape of the structures. To evaluate the particles behavior in aqueous media an electrophoretic mobility study was carried out, thus observing that the fluorescence emission depends on the pH of the solution, which in turn correlates well with the electrophoretic mobility of the nanoparticles. Finally toxic effects of oxysulfide nanostructures were evaluated using cell viability, apoptosis, cell-cycle progression and immunological response techniques. Results indicate that apoptosis was enhanced in both types of cells. However, PBMC cells are less sensitive than HeLa cells. Furthermore, GOSNPs significantly reduced the activation and cell cycle progression of PBMC and HeLa cells respectively. Interestingly, an increase in pro-inflammatory cytokines was not observed. Our data suggest that fluorescence applications of GOSNPs for biolabeling are not cytotoxic in primary immune cells and they may have an immunomodulatory effect.

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