A simple and novel method to synthesize doped and undoped SnO2 nanocrystals at room temperature

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Abstract

The development of chemical routes that enable the processing of SnO2 nanoparticles with high crystallinity at low temperature may be useful for the development of materials and devices with improved performance, as gas sensors, catalyst supports, and others. Therefore the purpose of this work is to describe a new approach to obtain SnO2 nanoparticles with high crystallinity at room temperature, based on the controlled hydrolysis of tin ions in an alcoholic solution. The purpose is to control the size of SnO2 particles and prevent particle coagulation, using a steric stabilizer. For this, we used a cationic surfactant (tetrabutylammonium hydroxide ((TBA)OH)) with a [(TBA)OH]/[SnO2] ratio of 5, 10, and 20. The colloidal suspension of untreated SnO2 and SnO2 with different (TBA)OH concentrations was characterized by photoluminescence emission spectroscopy (PL), which is related to direct interband electronic transitions (band gap energy). Besides, in order to evaluate the possibility of synthesizing doped SnO2 nanocrystals by this process, we added 14% in mol of Sb to be incorporated within the SnO2 lattice. The presence of crystalline SnO2 with a rutile-type structure was confirmed by X-ray diffraction (XRD) analysis. The high-resolution transmission electron microscopy (HRTEM) image confirms the presence of well-crystallized nanocrystals, with particle size raging from 1 to 3nm. These results confirm that the chemical method herein described allowed to obtain SnO2 crystalline nanoparticles, with the possibility of controlling the particle size by the use of a surfactant. Sb-doped SnO2 nanocrystals were also synthesized by the same method with a high degree of chemical homogeneity.