Solution, Solid-State Two Step Synthesis and Optical Properties of ZnO and SnO2 Nanoparticles and Their Nanocomposites with SiO2

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Nanostructure luminescent ZnO and SnO2 materials are prepared by a two-step solid-state method based on the solution preparation of the macromolecular precursors ZnCl2·Chitosan and SnCl2·Chitosan having different ratios (1:1, 1:5 and 1:10), their pyrolysis under air at 800 °C. The pyrolytic ZnO and SnO2 nanomaterials show a dependence of the particle size, morphology and luminescent properties with the ratio [metal/polymer] in the MCl2·Chitosan precursors. Thus, ZnO semiconductor materials exhibit luminescence spectra with several emission at 440 nm corresponds to a radiative transition of an electron from the shallow donor level of oxygen vacancies, and the zinc interstitial, to the valence band. On the other hand, the photoluminescence spectrum of the nanostructured SnO2 shows an intense blue luminescence at a wavelength of 420 nm which may be attributed to oxygen-related defects that have been introduced during the growth process of the nanoparticles. Additionally, whereas SnO2 was successfully incorporated into SiO2 structure (SnO2//SiO2) by pyrolysis of solid-state mixtures of the precursors SnCl2·Chitosan in the presence of SiO2, the same reaction carried out with ZnCl2·Chitosan precursors led to a mixture of Zn2SiO4 and SiO2. Thus, this new methodology yields nanostructured semiconductor materials, ZnO and SnO2, suitable for optoelectronic and sensor solid-state devices.

Chitosan

SnO2·SiO2

Solid-state synthesis

ZnO·SiO2