NANOMETER-SIZED Eu^{3+} DOPED In_2O_3 SEMICONDUCTOR PARTICLES. SYNTHESIS, STRUCTURAL CHARACTERIZATION AND LUMINESCENT PROPERTIES

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At the present time, there is an increasing attention for the applications of nanoparticles to photonic systems owing that their small dimensions imply enhanced luminescent properties[1]. On the other hand, rare earth (RE)–doped materials are also attractive in the area of photonic applications[2]. These considerations motivate to study the optical properties of RE doped nanoparticles. With the appropriate choice of host matrix and RE doping, the optical properties of a material could be improved considerably. In this respect, Indium Oxide (In_2O_3) is an interesting n-type semiconductor material with a wide band gap (E_g=3.6 eV at 300 K) with different applications in optical and electric devices[3], solar cells, liquid crystal devices[4], gas sensors[5], etc.

Nanosized In_2O_3 particles doped with Eu^{3+} embedded in a silica matrix have been synthesized by thermal treatment of sol-gel glasses prepared with different compositions. The segregated In_2O_3 nanocrystals present a size distribution depending on the preparation conditions. They have been characterized by High Resolution Transmission Electron Microscopy (HRTEM) and X-ray Diffraction (XRD). For a glass composition of $90SiO_2$-$10In_2O_3$, with 0.4 mol % of Eu^{3+} and heat treatment at 900°C, the obtained average radii were around 3 nm. This value is comparable to the bulk exciton Bohr radius of 2.38 nm in In_2O_3, resulting a wide band-gap semiconductor quantum-dot system of In_2O_3 immersed in a glassy insulator of SiO_2. In these strong confinement conditions the energy gap increases appreciably when the nanocrystal size decreases[6]. The Eu^{3+} ions located in the In_2O_3 nanocrystals could be excited selectively by energy transfer from the semiconductor host[7,8]. Moreover, the spectroscopic properties of these Eu^{3+} ions in the In_2O_3 nanocrystals were compared with those of the ions remaining in the silica glassy matrix.

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