Y_2O_3:Eu@SiO_2: a luminescente core-shell structured material

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The luminescent properties of rare earth ions in inorganic oxide have received great attention in order to develop optical devices with high performance. Silica is a quite inert inorganic polymer, and it has many technological and industrial applications, including taking part of core-shell type systems produced by the sol-gel routes. The aim of this work is to prepare a luminescent core@shell system based on the red phosphor Y_2O_3:Eu^{3+} covered with silica, i.e., Y_2O_3:Eu^{3+}@SiO_2. Red phosphor spherical particles were previously prepared from hydroxicarbonate precursor[1] and them coated by silica using TEOS in an adapted sol-gel methodology.[2-3] SEM and TEM images of the produced sample before and after coating, Fig. 1, show agglomerates of spherical particles with average size of about 185 and 188 nm, respectively with homogeneous distribution indicating that the coating layer do not put on to much size on the particles. Through TEM images it is possible to observe a thin silica layer on the luminescent particles, which was supported by EDS measurements. Raman and FTIR spectra showed bands assigned to active modes related to RE-O vibrations; in Raman spectra the fluorescence of europium generated by the 633 nm incident laser was also detected. Particles before and after silica coating exhibit the same expected red emission in the visible range ascribed to all $^5D_0 \rightarrow {}^7F_{0\text{-}4}$ Eu^{3+} set of transitions, ensuring that this core-shell methodology did not modify Eu^{3+} spectral profile. However, a slight decrease in the relative emission intensity was verified after the coating process. Based on all results it is possible to conclude that the core@shell type luminescent system with the core formed by the crystalline red phosphor Y_2O_3:Eu^{3+} and the shell consisting of silica was successfully obtained, being a promising material to be applied in optical devices.

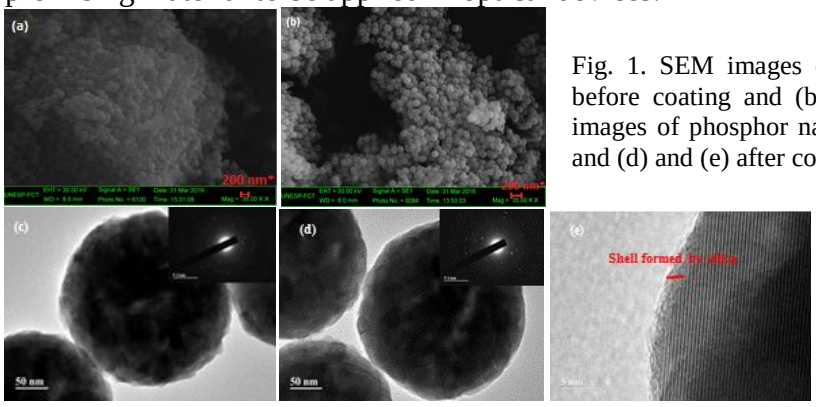

Fig. 1. SEM images of phosphor nanoparticles (a) before coating and (b) after coating process. TEM images of phosphor nanoparticles (c) before coating and (d) and (e) after coating process.

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