

Nanostructured Al₂O₃ - AlNd Phosphors: OSL and TL Analyses and Morphological Investigations

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The present paper describes the morphological and luminescent characterization of nanocrystals of Nd₂O₃ embedded on alumina - Al₂O₃ matrix. The samples were prepared using the sol-gel technique and thermally treated to high temperatures.

The phase of alumina as well as the morphology of the nanocrystal were characterized using X-ray diffraction (XRD), scanning transmission electron microscope (STEM) coupled to energy-dispersive X-ray spectroscopy (EDS). The luminescence properties were investigated using the Thermoluminescence (TL) and Optically Stimulated Luminescence (OSL) techniques. XRD results show intense peaks corresponding to the pattern of Al₂O₃ α -phase and to Al-Nd (Aluminum - Neodymium), resulting into the Al₂O₃ - AlNd phosphors; on the other hand, TEM images show that the AlNd nanocrystals (100-120 nm) locate on the surface of Al₂O₃ grains (70-90 μ m), and the EDS measurements confirmed the nanocrystals presence, showing the predominance of Al, Nd and O atoms.

TL measurements were taken in two regions of the spectra, one between 259 and 390 nm using a UV filter (U-340) and the other between 329 and 490 nm using a combination filter (BG-39+Kopp). In both regions of the spectra all doped samples presented a dosimetric peak at 200°C and peaks with low intensity at high temperatures. The sample doped with 2.5% of Nd₂O₃ shows the highest intensity in both regions of the spectra, when it is compared to undoped sample, the intensity is 9 times in the VIS region and 1.5 times in the UV higher. Concentration quenching phenomena were observed in samples doped with concentrations higher than 2.5%.

OSL was measured using blue stimulation (LEDs 470 nm) and detected in UV using the U-340 optical filter. OSL measurements show a similar behaviour to those found in TL, the sample doped with 2.5% of Nd₂O₃ supplied the OSL response 1.5 times higher than the undoped sample.

TL and OSL growth curves were performed for undoped and 2.5% of Nd₂O₃ doped sample and both samples presented a linear response to the dose in interval of 1 to 20 Gy. The minimum detectable dose using TL for an undoped sample was 760 mGy, and using OSL it was 260 mGy, while for Al₂O₃ - AlNd, the MDD was 54 mGy with TL and 76 mGy using OSL.