

Lanthanide ions (Eu^{3+} , Er^{3+} , Pr^{3+}) as luminescence and charge carrier centers in Sr_2TiO_4

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A series of strontium orthotitanate (Sr_2TiO_4) samples doped with 2% of a mole of europium, praseodymium, and erbium were obtained using the solid-state synthesis method. The X-ray diffraction (XRD) technique confirms the phase purity of all samples and the lack of the influence of dopants at a given concentration on the structure of materials. The optical properties indicate, in the case of $\text{Sr}_2\text{TiO}_4:\text{Eu}^{3+}$, two independent emission (PL) and excitation (PLE) spectra attributed to the Eu^{3+} ions at sites with different symmetries: low – excited at 360 nm and high – excited at 325 nm, while, for $\text{Sr}_2\text{TiO}_4:\text{Er}^{3+}$ and $\text{Sr}_2\text{TiO}_4:\text{Pr}^{3+}$, the emission spectra do not depend on the excitation wavelength. The measurements of X-ray photoemission spectroscopy (XPS) indicate the presence of only one type of charge compensation mechanism, which is based on the creation of strontium vacancies (V_{Sr}'') in all cases. This suggests that the different charge compensation mechanisms cannot easily explain the presence of Eu^{3+} at two nonequivalent crystal sites. The photocurrent excitation (PCE) spectroscopy investigations, that have not been reported in the literature so far, show that among all the studied dopants, only Pr^{3+} can promote the electrons to the conduction band and give rise to electron conductivity. The results collected from the PLE and PCE spectra allowed us to find the location of the ground states of lanthanides(II)/(III) in the studied matrix.

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