

Effect of calcium impurities on optical band gap values of lanthanum and samarium vanadate nanoparticles

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The rare-earth (RE) orthovanadate nanoparticles with compositions characterized by increased ability to absorb and transform light from the near-ultraviolet range of the spectrum are promising for wide range of practical applications as luminescent light converting materials. Heterovalent substitutions of the RE ions with double charged cations are used to increase absorption of such compounds in the 350 – 450 nm spectral range. In this paper, we report the results of the effects of calcium impurities on the optical band gap width of vanadate nanoparticles. This work uses calculations based on the measured experimentally diffuse reflection spectra of the $\text{La}_{1-y}\text{Ca}_y\text{VO}_4$, $\text{La}_{1-y}\text{Sm}_y\text{VO}_4$, $\text{La}_{1-x-y}\text{Sm}_x\text{Ca}_y\text{VO}_4$ nanoparticles synthesized by sol-gel method. The measured spectra consist of broad band in around 300 - 350 nm, which corresponds to the internal transitions in the vanadate anion. It was found that the edge of the reflection spectra is shifted to the long-wavelength region with increasing calcium impurity concentration. Using the Kubelka-Munch transformation of the measured reflection spectra by the formula $F = (1-R)^2/2R$, where R is the diffuse reflection spectrum, the band gaps of the investigated samples were determined. We suppose that the red shift is occurred due to the formation of additional Ca-induced defect states near the absorption edge. The structure of these defects in the doped vanadate nanoparticles is discussed.

Topics

Session A. Physics of condensed matter and spectroscopy

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