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Spectral-Structural Regularities of Rare-Earth Phosphates

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SPECTRAL-STRUCTURAL REGULARITIES OF RARE-EARTH PHOSPHATES

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The results of spectral and structural studies of thulium and lutecium orthophosphates doped with rare-earth Ln^{3+} ions ($\text{Ln}=\text{Ce}, \text{Nd}, \text{Eu}, \text{Tb}, \text{Er}$) are presented. The compounds have been synthesized by chemical transport method. Luminescence and absorption spectra in visible and IR-spectrum ranges are obtained at 77 and 300K. Studies of characteristic optical transitions of Ln^{3+} ions enabled to identify their Stark sublevels and calculate crystalline field parameters. Vibrational spectroscopy data are used for the analysis of luminescence features of rare-earth ions in the orthophosphate matrix. Raman and middle IR-absorption spectra are investigated at room temperature. IR Fourier transform spectrograms are obtained at 5K. By X-ray diffraction isomorphic substitution of the lattice cations with other Ln^{3+} ions (up to 5-10 mol%) has been found to result in the formation of solid solutions based on tetragonal modification of TmPO_4 type. With further increase of the active ion concentration, the material transforms into the two-phase mixture. The combination of the spectroscopic methods enables to analyse in detail the variations of crystal lattice and phosphorus-oxygen-ligand crystalline field parameters as transition from single-phase solid solutions to two-phase mixtures of rare-earth orthophosphates.