

Influence of ionic liquid and oleic acid assisted methods on the spectroscopic properties of Nd³⁺-doped GdPO₄ nano-particles

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Streszczenie

We report a detailed analysis of both the structural and spectroscopic properties of Nd³⁺-doped GdPO₄ nano-powders obtained *via* various wet synthesis methods. This type of material may be useful in optoelectronics, bioimaging and biomedicine. Three series of Nd³⁺-doped nano-materials with different concentrations of the optical activator (1–10 mol%) were obtained *via* ionic liquid assisted classical hydrothermal (IL HT) and microwave (IL MW) methods as well as *via* an oleic acid assisted hydrothermal (OA HT) method. A powder X-ray diffraction (PXRD) technique confirmed that the obtained GdPO₄ nano-powders crystallize in a monoclinic system (*P*2₁/*n*) with the average grain size ranging from 40 to 100 nm; the smallest grains are obtained *via* the ionic liquid assisted microwave method, and no other phase has been detected for any of the materials obtained. Electron microscopy techniques *i.e.* SEM and TEM were used to demonstrate the differences in the morphology and grain size, which resulted in the spectroscopic properties of nano-materials. The nine-fold coordinated Gd³⁺ ion in GdPO₄ is easily substituted by the Nd³⁺ one with the C₁ symmetry due to their similar ionic radii, so that high-resolution low-temperature absorption and emission spectra do not show any structural distortion. The ⁴F_{3/2} excited state dynamics studied at 77 K showed abnormal behavior, similar to that already observed for Nd³⁺ ions embedded in the YPO₄ and LuPO₄ tetragonal orthophosphates crystallizing in a xenotime-type crystal system.

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