Nanooptics and photonics

Synthesis and luminescent properties of $Gd_3Ga_5O_{12}$ nanopowders doped with Tb^{3+} ions

A. Luchechko[1]*, L. Kostyk[1], S. Varvarenko[2], O. Tsvetkova[1], R. Lys[1]

[1] Department of Sensor and Semiconductor Electronics, Ivan Franko National University of Lviv, Tarnavskogo St.107, 79017 Lviv, Ukraine.
E-mail: luchechko@electronics.lnu.edu.ua

[2] Department of Organic Chemistry, National University "Lvivska Politechnika", Bandera St. 12, 79013 Lviv, Ukraine.

Rare earth doped gadolinium gallium garnet has attracted much attention as an important material for many applications in optoelectronics, quantum electronics, laser physics, biomedicine, and other areas [1, 2]. The nanocrystalline oxide materials, especially with garnet structure, doped with trivalent rare earth ions, for example, effective emitting Tb^{3+} ions, can exceed the crystal analogs in some physical properties.

Gadolinium gallium garnet nanopowders doped with Tb^{3+} ions with concentration 1.0 mol% were synthesized via the co-precipitation method in a polyethylene glycol (PEG)-assisted process. The preparation and luminescence properties of these nanopowder materials are reported. Prepared samples were characterized using X-ray powder diffraction (XRD), scanning electron microscope (SEM), atomic force microscopy (AFM), photoluminescence excitation (PLE) and PL emission spectra.

Powder XRD data reveal that the crystal structure belongs to a garnet with a cubic space group. The average crystallite size was calculated depending on calcination temperature. Calcination at higher temperature leads to increase in the size of the crystalline particle. Spectroscopic properties, i.e. excitation and emission were investigated at room temperature. Photoluminescence spectra contain the emission bands in blue and green spectral regions. The relative intensity of these emissions depends on synthesis conditions, including PEG concentration and calcination temperature.

1. *Martín-Rodríguez R., Valiente R. et al.* Upconversion luminescence in nanocrystals of $Gd_3Ga_5O_{12}$ and $Y_3Al_5O_{12}$ doped with Tb^{3+} - Yb^{3+} and Eu^{3+} - Yb^{3+} // J Phys Chem C.-2009.-**113**. P.12195-12200.

2. *Luchechko A, Kostyk L. et al.* Green-emitting $Gd_3Ga_5O_{12}$: Tb^{3+} nanoparticles phosphor: synthesis, structure, and luminescence // Nanoscale Research Letters. -2017. -**12:263**. -P. 1-6.