

Nanooptics and photonics

Morphology and optical-luminescence investigations of ZnGa₂O₄ spinel compound co-doped with Mn²⁺ and Eu³⁺ ions

O. Kravets¹, O. Zaremba², I. Oshchapovsky², Ya. Shpotyuk^{1, 3},
A. Luchechko¹, K. Szmuc³, J. Cebulski³

¹ Department of Sensor and Semiconductor Electronics, Ivan Franko National University of Lviv, Tarnavskogo Str., 107, Lviv 79017, Ukraine.
E-mail: oleg.kravets92@gmail.com

² Department of Inorganic Chemistry, Ivan Franko National University of Lviv, Kyryla and Mefodiya Str., 6, Lviv 79005, Ukraine.

³ Centre for Innovation and Transfer of Natural Sciences and Engineering Knowledge, University of Rzeszow, Rzeszow, 35-959, Poland.

The constantly increasing need of energy saving devices motivates researchers to explore new materials. The zinc gallate compound is a promising material for application as efficient phosphors in modern deep UV-LEDs [1]. Modification of a spinel matrix by doping with transition metal ions or rare-earth elements in spinel matrix gives a phosphor material with emission in the broad spectral range [1, 2].

In this work, ZnGa₂O₄: 0,05 mol.% Mn²⁺ and ZnGa₂O₄: 0,05 mol.% Mn²⁺, 4 mol.% Eu³⁺ ceramic samples have been synthesized via solid-state reaction method at 1200 °C. The samples were characterized by XRD, optical and luminescence spectroscopy analysis. The morphology of the samples at the nanoscale level was investigated by transmission electron microscopy.

The XRD analysis confirmed a single phase nature of ZnGa₂O₄: Mn²⁺ sample. Although, ZnGa₂O₄: Mn²⁺, Eu³⁺ shows a sign of undefined additional phase. EDX analysis shows homogeneous distributions of the elements in the grain volume. A spot with a different stoichiometry was found probably due to the presence of the additional phase. The optical absorption spectra well correlate with photoluminescence excitation spectra. The emission spectra exhibit a weak matrix luminescence with a maximum around 430 nm and strong emission of Mn²⁺ ions with band maximum at about 505 nm. Emission of Eu³⁺ ions is presented by both electric dipole and magnetic dipole transitions in the red spectral region.

1. Luchechko A., Kravets O. Novel visible phosphors based on MgGa₂O₄-ZnGa₂O₄ solid solutions with spinel structure co-doped with Mn²⁺ and Eu³⁺ ions // J. Lumin.-2017.-**Article in press**.
2. Costa G.K.B., et al. Preparation, structure analysis and photoluminescence properties of MgGa₂O₄:Mn²⁺ // Opt. Mater.-2009.-**31**.-P. 1620–1627.