

Luminescence Investigations of ZnGa₂O₄ Polycrystals Co-doped with Mn²⁺ and Eu³⁺ Ions

A. Luchechko¹, O. Kravets¹, O. Tsvetkova¹, A. Vaskiv²

¹*Department of Sensor and Semiconductor Electronics, Ivan Franko National University of Lviv,
107 Tarnavskogo Str., 79017 Lviv, Ukraine*

²*Scientific-Technical and Educational Center of Low Temperature Studies,
Ivan Franko National University of Lviv, 50 Drahomanova Str., 79005 Lviv, Ukraine*

More and more attention has been paid to metal gallate spinel compounds focusing on the developing of different types of display technologies due to advantage over sulfide phosphors. Zinc gallate spinel compounds are one of the promising materials with possible applications in vacuum fluorescent displays and field emission displays [1]. Metal gallate spinel modified by doping with rare-earth ions and transition metals exhibits promising results. Spinel doped with Mn²⁺ and Eu³⁺ ions show excellent luminescent properties in “green” and “orange-red” spectral regions, respectively [2].

In this work, ZnGa₂O₄: 0,05 mol.% Mn²⁺ and ZnGa₂O₄: 0,05 mol.% Mn²⁺, 4 mol.% Eu³⁺ ceramic samples have been synthesized via high-temperature solid-state reaction method at ~1200 °C in air. X-ray diffraction measurements confirmed single-phase nature of all samples. The luminescence properties were investigated under different excitation wavelengths at room and liquid nitrogen temperature.

Intense Mn²⁺ ions excitation was found in 230-280 nm region of spectra. Doping with Eu³⁺ ions leads to suppression of Mn²⁺ excitation in the ZnGa₂O₄: Mn²⁺, Eu³⁺. The *f-f* excitation lines (350-550 nm) and a broad band in 250-350 nm spectral region were found on excitation spectra of ZnGa₂O₄: Mn²⁺, Eu³⁺ with registration at 617 nm. The UV excitation band is asymmetrical and related with charge transfer from O²⁻ to Eu³⁺ ions.

Complex broad band in 325-475 nm spectral region corresponds to matrix luminescence and intense band peaking around 505 nm related to Mn²⁺ emission were found at 240 nm excitation. Together with above mentioned bands Eu³⁺ emission was found in 575-650 nm spectral region at 290 nm excitation. These lines correspond to ⁵D₀→⁷F_{*j*} (*j*= 0, 1, 2) transitions in 4f⁶ configuration of Eu³⁺ ions. Incorporation of Eu³⁺ ions leads to suppression of both kinds of luminescence.

Changing of excitation wavelength and temperature leads to the redistribution of luminescence intensities in three spectral regions corresponding to the matrix luminescence, emissions of Mn²⁺ and Eu³⁺ ions.

[1] Musa Mutlu Can et al., *J. of Alloys and Compounds* **549** (2013) 303-307.

[2] A. Luchechko et al., *Radiation measurements* **90** (2016) 47-50.