

INTRINSIC AND DOPANT-DRIVEN LUMINESCENCE IN LiMgPO₄*

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Nowadays, lithium–magnesium phosphate with an olivine structure is of special importance for radiation dosimetry applications, which is mainly due to chemical and thermal stability as well as ease of synthesis and low cost of the material. LiMgPO₄ turned out to be suitable for both optically (OSL) and thermally (TSL) stimulated luminescence [1].

In this work, we consider in detail peculiarities of photo-, radio-, and thermoluminescence in pure and doped Li-Mg phosphate with different morphology and synthesized using various methods. It is shown that, other things being equal, the smaller the specific surface of the powder sample, the higher the optical yield. Thus, undoped LiMgPO₄ with the best characteristics was obtained by melting and following quenching. To understand the nature of surface and bulk point defects that can act as traps and luminescence centers, the ESR method was applied. We determined the energy of defects using *ab initio* calculations and UV-viz spectroscopy.

Although pure LiMgPO₄ accumulates energy under ionizing irradiation and keeps it for a long time, to significantly enhance the dosimetric response, the presence of rare earth ions is required. A series of LiMgPO₄:RE³⁺ phosphors was synthesized by the conventional solid-state method. It has been shown that all rare earths can be divided into two groups: Sm, Gd, Tb, Dy, Eu and Tm manifest themselves in RL and TSL spectra by the appearance of a characteristic set of lines reflecting the luminescence of rare earth elements as a result of f–f transitions from an excited state to a lower one, while Er, Pr, Yb, Ce, Ho, and Nd only greatly enhance the two-humped RL and TSL spectra of the phosphate matrix (Fig.1). The discovered effect was attributed to non-radiative energy transfer [2] from some RE³⁺ ions to matrix defects with energies close to the energies of upper radiation levels of these RE³⁺. Regardless of the dopant, all irradiated samples exhibit thermoluminescence at temperatures of 100–300 °C, which significantly exceeds that of pure LiMgPO₄ in intensity. The best and almost similar characteristics are demonstrated by LiMgPO₄:Er and LiMgPO₄:Tb despite the fact that terbium in LiMgPO₄:Tb acts as a TSL activator and erbium is a sensitizer, enhancing the stimulated luminescence of the matrix.

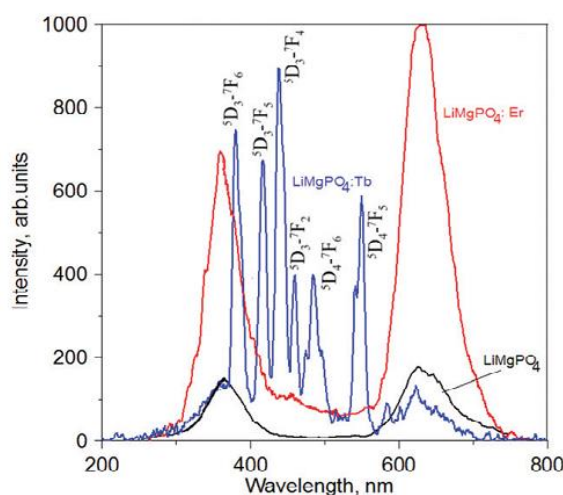


Fig.1. RL spectra of LiMgPO₄, LiMgPO₄:Er and LiMgPO₄:Tb.

REFERENCES

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