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Synthesis And Luminescence Studies Of MgO:Tb For Use In Radiation Dosimetry

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Although the application of optically stimulated luminescence (OSL) in dosimetry was introduced long time ago, at the moment there are only two standard materials for this purpose: Al₂O₃:C and BeO. On this way, with the objective to increase the number of OSL materials, this work present a study of MgO:Tb, which has promising dosimetric properties such as low Z_{eff}, potential use as UV dosimeter [1], high TL intensity, etc. All the the luminescence studies were carried out on samples prepared in Laboratory.

The samples were synthesized using MgO, Mg(NO₃)₂. 6H₂O and Tb(NO₃)₃.6H₂O precursors, with Tb concentrations between 0.1 and 1 mol% and thermal treated at high temperature ~1500°C. X-ray diffraction measurements were done in a MiniFlex diffractometer and showed MgO and Mg₂SiO₄ phase, the last in minor proportion. TL and OSL measurements were performed in Daybreak equipment using Schott BG-39 and Corning 7-59 optical filters in front of the photomultiplier. For OSL, it was used a green laser (532 nm) acopled to the equipmente. The heating rate used in TL was 5°C/s. TL spectra measurements were carried out in CARY 500 fluorimeter connected to the TL reader by an optical fiber. All the irradiations were done in a ⁶⁰Co source at RT and the irradiation doses were between 1-10 Gy.

The sample doped with 0.1 mol% presented highest luminescence when compared to the other doped samples. TL emission spectra, after gamma irradiation with high dose, presented strong Tb³⁺ emission lines . TL glow curve of the samples showed an intense and well defined peak having the maximum at 200°C and other less intense at 350°C. The relationship between 200°C TL peak and dose was linear and the minimum detectable dose, obtained by interpolation taking into account three times the standard deviation of the zero dose reading, was ~20 mGy. The OSL properties from MgO:Tb were also investigated. The OSL signal presented a linear behavior with the dose.

The sample of MgO:Tb (0.1 mol%) showed an intense TL peak at 200°C. The minimum detectable dose was ~20 mGy for TL. The material has a promising potential to be use in TL/OSL dosimetry.

[1]Kortov et al. (1993) Radiat. Prot. Dosim. 47 (1/4), 253-276.