Dosimetric Properties of MgB_4O_7:Ce and MgB_4O_7:Ce, Li for Thermoluminescence Dosimetry Applications

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Thermoluminescent dosimetry is known as a well-established technique for monitoring radiation dose in medical practices. Some most used thermoluminescent dosimeters (TLDs) are: LiF:Mg,Ti (TLD-100), CaF:Mn, $CaSO_4$:Dy, $Li_2B_4O_7$, and aluminophosphate glasses. Recent studies have demonstrated that borates can be very useful for TL dosimetry because their compounds may be more sensitive to radiation than the commercial dosimeters as TLD-100. Furthermore, compounds with ^{10}B allow the detection of thermal neutrons ($E < 0.25$ eV). They also have other good dosimetric properties, such as linear dose response over a large absorbed dose range, effective atomic number close to that of human tissue, and a simple TL emission curve with a single peak. However, there is not much discussion about preparation routes for dosimeters based on borates and on the structure of their compounds. Among these, we examined thermoluminescence properties of magnesium tetraborate doped with cerium (MgB_4O_7:Ce) and co-doped with lithium (MgB_4O_7:Ce,Li). Some important TL properties were investigated such as: dose response for γ and β, fading and kinetic parameters of TL curves. To study TL response, the material was investigated in pellet format (3 mm diameter) that were irradiated with sources of β particles ($^{90}Sr/^{90}Y$) and γ-rays (^{60}Co) with different absorbed doses. The TL responses were measured using an TL/OSL reader (TL/OSL reader Riso). The results showed that the materials have great potential for TLD dosimetry, presenting low fading of TL signal ($< 3\%$ in one month) and prevalence of first-order TL peak. The dose response curves also show that saturation occurs at higher doses (up to 1000 Gy) and the kinetic parameter shows TL curve follow kinetic of first order.