Thermoluminescence and Optically Stimulated Luminescence of $CaSO_4$:Mn,Tb with different dopant concentrations

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This study systematically evaluates the thermoluminescence (TL) and optically stimulated luminescence (OSL) properties of $CaSO_4$ crystals doped with manganese (Mn) and terbium (Tb), focusing on dopant concentrations within the ranges of Mn (0.1 mol% – 2 mol%) and Tb (0.05 mol% – 1 mol%). Synthesized via the slow evaporation route, this investigation is part of an ongoing experimental series initiated by Silva et al. (2022) [1], exploring $CaSO_4$:Mn,Tb crystals at a concentration of 0.1 mol%, the validating their properties for dosimetric purposes. A structural phase identification was conducted using X-ray diffraction, and emission and excitation photoluminescence (PL) spectra confirmed the presence of Tb^{3+} and Mn^{2+} ions in the crystalline matrices. Dosimetric characterization utilized pellets prepared by incorporating Teflon into the phosphors. In-depth investigations involved analyzing TL glow curves and Continuous Wave Optically Stimulated Luminescence (CW-OSL) curves. Observations revealed that TL intensity increased as the co-doped concentration of Tb decreased while maintaining the concentration of Mn constant. Conversely, at a constant terbium concentration, TL intensity was higher with 0.5 mol% of manganese compared to 0.1 mol%, but higher concentrations of manganese (1 mol% and 2 mol%) resulted in decreased TL intensity. The study also explored dose-response, reproducibility, fading, sensitivity, step-annealing curve analyses, experimental determination of temperature dependence, and the minimum detectable dose (MDD) exposed to beta radiation of the pellets. This research underscores the importance of optimizing dopant concentrations to enhance the potential of these phosphors for precise and reliable dosimetry, thereby advancing both the understanding of these materials and their potential for further development in the field of radiation dosimetry.

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Reference

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