Effects of Irradiation on Luminescent Properties of $Ce_xLa_{1-x}F_3:Tb^{3+}$ Scintillating Nanoparticles

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It was demonstrated, that Tb-doped cerium lanthanum fluoride ($Ce_xLa_{1-x}F_3:Tb^{3+}$) nanoparticles feature interesting optical and scintillating properties, as well as good chemical stability [1,2]. These features make them prospective candidates for various biomedical applications involving diagnostic or therapeutic irradiation [3,4]. Therefore, a systematic study of radiation-induced effects on their structural stability, luminescent properties and cathodoluminescence under excitation by ionizing radiation is required.

In this work, $Ce_xLa_{1-x}F_3:Tb^{3+}$ nanopowders were synthesized using a sol-gel method, allowing for low-temperature synthesis with reproducible incorporation of rare-earth dopants and good control of the final material composition [4]. The morphology, structural, luminescent, and defect-related properties of the as-prepared powders were characterized using X-ray diffraction (XRD), room-temperature (RT) photoluminescence (PL) and radioluminescence (RL). Electron paramagnetic resonance (EPR) spectroscopy was used to investigate defect states and radiation-induced changes in the local electronic environment. Cathodoluminescence (CL) was employed to probe the scintillation response of the nanoparticles under electron irradiation. Subsequently, the powder samples were exposed to different types of ionizing radiation, including accelerated electrons, protons, and gamma rays. Post irradiation, the XRD, RT PL, RL, EPR and CL were used again to evaluate the changes.

The obtained results contribute to better understanding of radiation induced changes in luminescent fluoride nanomaterials under different types of ionizing radiation. The data presented may serve as a basis for further investigation of these materials in biomedical context.

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