Effect of Soaking Time on the Optical and Scintillation Performances of Tb^{3+} Doped Oxyhalide Phosphate Glass

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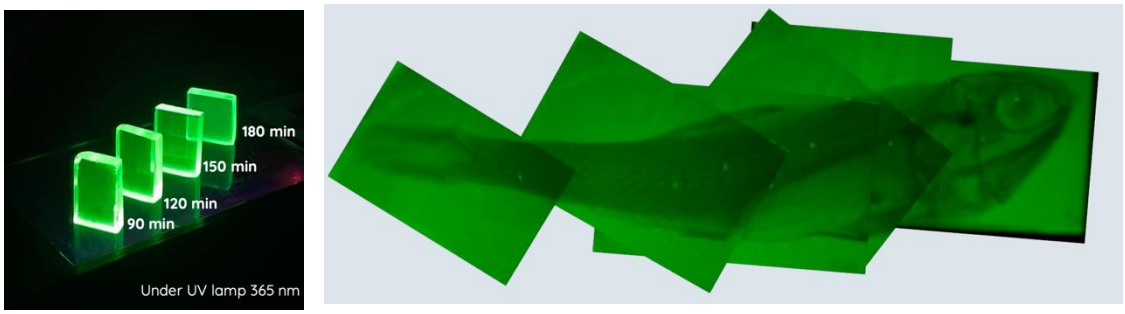
This study investigates the impact of soaking time on the optical and scintillation performance of Tb^{3+}-doped oxyhalide phosphate glass. Glasses were fabricated in composition $20NaCl–10GdF_3–10AlF_3–59P_2O_5–1Tb_2O_3$ (mol%), and all samples were melted at the same temperature with different soaking times at 90, 120, 150, and 180 minutes. The absorption spectra of all samples confirmed the presence of Tb^{3+} ions in the glass matrix. According to the photoluminescence emission spectra, the glass sample soaked for 120 minutes exhibited the highest emission intensity, with its primary peak occurring at 543 nm. The quantum efficiency was measured, yielding a value of 128%. Similarly, radioluminescence spectra identified a prominent emission peak at 540 nm, attributable to the Tb^{3+} ($^5D_4 \rightarrow {}^7F_5$) transition. In comparison with commercial scintillators, BGO and SG101 glass, the radioluminescence light of the 120 minutes soaking time sample reached 7.67% and 7.89%, respectively. The decay time was measured to be a few milliseconds. The modulation transfer function (MTF) at 0.2 spatial frequency for 120-minute soaking time sample was 11.2 lp/mm. Finally, the developed glass was successfully used as a scintillator for X-ray imaging, demonstrated by imaging a small fish using a CMOS-based X-ray imaging system. These results confirm that Tb^{3+} doped oxyhalide phosphate glass is a promising scintillator material for X-ray imaging applications.



Green emission from Tb^{3+} doped oxyhalide phosphate glass and application in fish radiography using the developed glass