

Impact of Cs⁺ doping on the Scintillation Performance of Tl(Gd_{0.99}Ce_{0.01})₂Cl₇ Single Crystals

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The scintillation performance of TlGd₂Cl₇:Ce³⁺ single crystals has previously been reported by Khan et al. and Loef et al. [1,2]. This material exhibits a high effective atomic number and moderate density, with scintillation properties including an energy resolution of ~6-7% (FWHM), a light yield of approximately 50,000 ph/MeV, and three distinct decay time components. However, the layered crystal structure of this scintillator represents a major limitation, as it restricts practical applications and adversely affects both scintillation performance and the growth of high-quality single crystals. In the present study, we investigate the effect of Cs⁺ ion doping on the scintillation properties of TlGd₂Cl₇:Ce³⁺ single crystals. Various molar concentrations of Cs⁺ ions were introduced to suppress the layered structure. Under 662 keV γ -ray excitation, the Tl(Gd_{0.99}Ce_{0.01})₂Cl₇ single crystal doped with 0.5 mol% Cs exhibited an improved energy resolution of 4.1% (FWHM) and an enhanced light yield of approximately 65,000 ph/MeV. Three decay components were observed with time constants of 83 ns (6%), 285 ns (24%), and 952 ns (70%). Compared to previously reported values [1], the long decay components were significantly reduced due to Cs⁺ doping. Figure 1 shows the X-ray-induced luminescence spectra recorded at room temperature, where a noticeable shift in the emission peak position was observed for Tl(Gd_{0.99}Ce_{0.01})₂Cl₇:0.5%Cs relative to the undoped crystal.

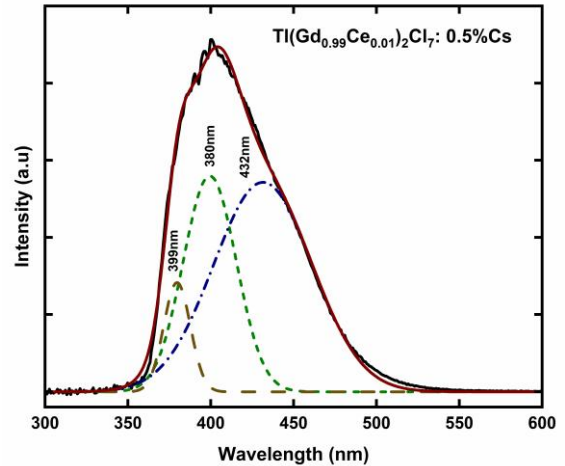


Fig.1 X-ray induced luminescence spectrum of Tl(Gd_{0.99}Ce_{0.01})₂Cl₇:Cs Single Crystal

References

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