

Development and Performance Assessment of Single- and Double-Layer TbAG:Ce and YAG:Ce Composite Scintillators on GAGG:Ce Substrates for Optimized α - γ Discrimination and Pulse-Shape Analysis

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In this work, we report the fabrication and characterization of composite scintillators based on the single-layered and double-layered epitaxial structures containing single-crystalline films (SCFs) and bulk single crystal (SC) scintillators of garnet compounds for enhanced α - γ discrimination in mixed radiation fields. The composite scintillators under study consist of TbAG:Ce SCF (first layer) and YAG:Ce (second layer) SCFs grown step-by-step using liquid-phase epitaxy (LPE) method onto Czochralski-grown $\text{Gd}_3\text{Ga}_{2.5}\text{Al}_{2.5}\text{O}_{12}$ (GAGG:Ce) bulk SC substrates. Such single- and double-film architectures were designed to optimize energy absorption and pulse-shape discrimination (PSD) performance for low-penetrating α -particles and high-energy γ -rays.

Energy calibration of composite scintillators was performed using different γ -ray sources (^{57}Co , ^{51}Cr , and ^{137}Cs), enabling conversion of detector signals to a calibrated electron-equivalent energy scale (keVee). Integration gates were systematically optimized, yielding maximum figures-of-merit (FOM) of 1.4 for the GAGG:Ce SC substrate, 1.9 for the TbAG:Ce SCF/GAGG:Ce SC single-film composite, and 5.0 for the YAG:Ce SCF/TbAG:Ce SCF /GAGG:Ce SC double-film composite, demonstrating progressive improvement in α - γ discrimination with increasing structural complexity. Two-dimensional PSD density maps reveal well-separated α and γ populations, with the highest separation observed for the double-film composite. These results indicate that engineering of LPE-grown composites provides tunable scintillation decay profiles, enhanced temporal separation, and increased light yield, making them promising candidates for applications such as mixed-radiation-field detection, dosimetry, and radiation monitoring [1].

[1] Yu. V. Zorenko, S. S. Novosad, M. V. Pashkovskii, A. B. Lyskovich, V. G. Savitskii, M. M. Batenchuk, P. S. Maluyutenkov, 544 N. I. Patsagan, I. V. Nazar, and V. I. Gorbenko, *J. Appl. Spectrosc.* 52, 645–649 (1990). 545

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