Development of CsI:Tl Nanoparticles by Pulsed Laser Ablation Technique for Radiation Detection

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Scintillation nanomaterials have potential applications such as X-ray detectors, high-energy physics, medical imaging, astrophysics, oil exploration, security inspection, and optoelectronics, display, and image convertors. As reported, Thallium-doped CsI (CsI:Tl) is a well-known inorganic scintillator due to its high light yield and efficient luminescence response. Although bulk and single-crystal CsI:Tl scintillators are widely used, the development of CsI:Tl in nano dimensional form is expected to further enhance its optical and scintillation properties owing to quantum confinement effects and increased surface-to-volume ratio [1]. Conventional synthesis techniques for CsI:Tl nanomaterials are mostly vacuum-based and involve complex processing routes. In the present work, a simple and contamination-free pulsed laser ablation in liquid (PLAL) method has been employed for the preparation of CsI:Tl nanoparticles. A CsI:Tl single crystal target was immersed in isopropyl alcohol (IPA) and ablated using a pulsed laser pulsed laser source with a fixed laser energy of 60 mJ throughout the experiment to generate a stable colloidal suspension of nanoparticles followed by the drop casting method to make a thin-film. The structural and morphological characteristics of the synthesized CsI:Tl nanoparticles were investigated using X-ray diffraction (XRD) and scanning electron microscopy (SEM). XRD analysis confirmed the formation of crystalline CsI:Tl phase, while SEM revealed the formation of fine-sized nanoparticles in the nanometer range.

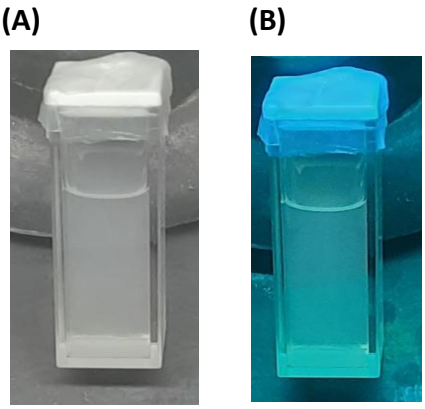

Figure 1: CsI:Tl colloidal nanoparticle solution in IPA (A) Under natural light, (B) Under UV light.

This work demonstrates that PLAL is an effective and straightforward technique for producing CsI:Tl nanoparticles. The obtained results indicate that nano-sized CsI:Tl can serve as a promising material for future scintillation-based applications. Further exploration of CsI:Tl in nano-dimensions may lead to improved performance in radiation detection and optoelectronic devices.

[1] Abd-Alrahman, A. S., Ismail, R. A., & Mohammed, M. A. (2022). Colloidal synthesis of cesium iodide nanocrystals for visible-enhanced photodetection applications. *Physica E: Low-dimensional Systems and Nanostructures*, *143*, 115375.

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