

# Synthesis, Characterization and X-ray Scintillation of CaWO<sub>4</sub> Embedded Polystyrene Composite Films

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The rapid advancement of X-ray imaging technologies has increased the demand for cost-effective, scalable and high-performance scintillation materials. As a result, composite scintillators have emerged as promising alternatives to conventional single-crystal scintillators, which possess limitations such as high synthesis costs, long growth times and poor scalability. Polymer–inorganic composite scintillators combine the low cost, mechanical flexibility and scalability of organic matrices with the high density and light yield of inorganic scintillators [1,2]. Calcium tungstate was one of the earliest scintillators employed in practical radiation detection and continues to attract significant interest due to its stable physical and chemical properties, efficient blue scintillation, low toxicity and cost-effectiveness. Polystyrene has also proven to be an effective scintillator matrix due to its good optical transparency, ease of processing, and compatibility with inorganic scintillating fillers, making it well-suited for composite-based imaging applications.

In this work, CaWO<sub>4</sub> ceramic powders were synthesized via a hydrothermal method and characterized using X-ray diffraction, optical, and radioluminescence studies. XRD confirmed the formation of the tetragonal CaWO<sub>4</sub> phase having space group I4<sub>1</sub>/a, while optical studies revealed a bandgap of 4.2 eV, with broad photoluminescence and radioluminescence emission bands centered at approximately 420 nm. CaWO<sub>4</sub> particles were incorporated into a polystyrene matrix to fabricate composite scintillation films using a solution-casting technique. The polymer films were optimized to achieve uniform particle distribution and consistent film thickness. XRD analysis of the composite films revealed the presence of both the amorphous halo of polystyrene at 19.7° and the corresponding diffraction peaks for CaWO<sub>4</sub>. Radioluminescence analysis, in response to X-ray excitation, demonstrated efficient X-ray to visible light conversion, with a prominent blue emission originating from CaWO<sub>4</sub>, confirming the potential of these low-cost, scalable, and flexible composite films for X-ray imaging applications.

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2. S. Sen, M. Tyagi, K. Sharma, P.S. Sarker, S. Sarker, C.B. Basak, S. Pitale, M. Ghosh, S.C. Gadkari, “Organic-Inorganic Composite Films Based on Gd<sub>3</sub>Ga<sub>3</sub>Al<sub>2</sub>O<sub>12</sub>:Ce Scintillator Nanoparticles for X-ray Imaging Applications”, *ACS Appl Mater Interfaces*, **9**, 37310 (2017).