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Fabrication and Optical Characterisation 2D Perovskite Scintillators

Two-dimensional (2D) hybrid perovskite materials have emerged as promising candidates for next-generation scintillators due to their high light yields, fast radiative recombination and low-temperature solution-processability [1]. The aim of this study is to develop a bright, efficient radiation detector using different fabrication processes such as doping and pellet pressing for nuclear forensic applications. In this work, we report the fabrication and characterisation of the 2D perovskite n-butylammonium lead bromide (BA2PbBr4) using several techniques.

BA2PbBr4 belongs to the Ruddlesden-Popper group of 2D perovskites, where inorganic layers are separated by butylammonium cations. This structure results in strong excitonic emission and enhanced resistance to environmental degradation. High-quality BA2PbBr4 crystals are grown using a slow-cooling method, yielding large 1cmx1cm sized crystals up to 1mm thick. Dopants such as Manganese can be incorporated into the initial solution. Dopants allow desirable properties to be selected such as emission wavelengths, lifetimes and crystal structure. For practical handling and scintillation measurements, the as-grown crystals can be ground into a fine powder and compressed into pellets using a hydraulic press. This process enables uniform sizes and thicknesses of material.

BA2PbBr4 single crystals and pellets show a higher light yield compared to LYSO. BA2PbBr4 also shows a strong response to gamma radiation. A further advantage of BA2PbBr4 is its uniquely short lifetime under 5ns compared to LYSO at 40ns and other commercial scintillators in the millisecond range [2]. Traditional scintillator materials also often suffer from high fabrication costs and limited tunability. These 2D perovskites therefore serve as a promising candidate for the next generation of scintillators for radiation detection.

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