Contribution ID: **116** Type: **Poster Presentation**

Characterisation and performance of vapour-deposited lead halide perovskite films for radiation detection applications

Wednesday 5 March 2025 13:35 (1 minute)

Thin film (TF) metal halide perovskites are an emerging technology that are a promising material for use as radiation detectors, with potential for use as large-area imaging detectors. However, current solution-processing methods face challenges in achieving thick and uniform perovskite films. Vacuum-based deposition techniques can produce high quality uniform films but this approach has not been extensively developed for metal halide perovskite radiation detectors. In this study, single-source vacuum deposition (SSVD) using an in-house deposition system was employed to deposit lead halide perovskite films. Perovskite films were deposited onto glass substrates at different deposition rates and the film thickness and roughness were measured using a profilometer. SEM and EDS analysis was used to evaluate morphology and composition of the deposited films. Optical properties were characterised using photoluminescence (PL) measurements and the X-ray responses of the films assessed. Preliminary results showed that TFs achieved a maximum thickness of 7 µm with a roughness of ˜0.95 µm. SEM analysis indicated grain sizes ranging from 0.4 µm to 1 µm and some evidence of pinholes was observed. EDS and PL measurements confirmed the perovskite film composition. Work is ongoing to increase the film thickness and to improve the morphology, and a full study of X-ray sensitivity will be reported.

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Session Classification: Lunch and Posters