SUBSTRATE-GUIDED GROWTH OF MILLIMETER-THICK, LARGE-AREA PEROVSKITE SINGLE CRYSTALS FOR HIGH-PERFORMANCE X-RAY DETECTION

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Metal halide perovskites (MHPs) have recently emerged as promising materials for optoelectronic devices, such as solar cells, LEDs, and X-ray detectors, due to their remarkable optical and electrical characteristics. They are especially attractive for direct-type X-ray detection due to their long carrier diffusion lengths, high resistivity, strong X-ray attenuation coefficients, and tunable bandgaps. Among MHPs, single crystals are particularly appealing since they usually show higher mobility-lifetime products and lower defect densities.

Despite these advantages, the practical application of MHP single crystals in commercial X-ray detectors is still challenging, mainly because it is difficult to produce large-area crystals with precisely controlled thickness on the millimeter scale. Excessive vertical thickening during lateral expansion is a common problem with conventional solution-growth techniques, necessitating mechanical post-processing like cutting or polishing. These procedures may lead to the waste of valuable materials and the formation of cracks or other defects.

To address these limitations, we present a new crystal-growth platform that allows the production of large-area MHP single crystals (up to 50 mm × 50 mm) with a precisely controlled thickness of 1 mm. By removing the requirement for post-growth thinning, this technique increases yield while maintaining structural integrity. X-ray detectors constructed from these large-area, thin MHP single crystals exhibit excellent performance, achieving a sensitivity of $1.46 \times 10^4 C/Gy\_air \cdot cm^2$.