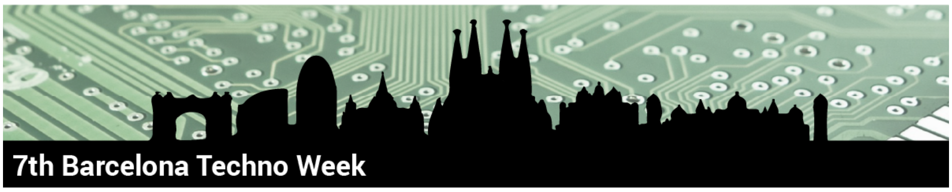

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Stable perovskite single-crystal X-ray imaging detectors with single-photon sensitivity

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A major thrust of medical X-ray imaging is to minimize the X-ray dose acquired by the patient, down to single-photon sensitivity. Such characteristics have been demonstrated with only a few direct-detection semiconductor materials such as CdTe and Si; nonetheless, their industrial deployment in medical diagnostics is still impeded by elaborate and costly fabrication processes. Hybrid lead halide perovskites can be a viable alternative owing to their facile solution growth. However, hybrid perovskites are unstable under high-field biasing in X-ray detectors, owing to structural lability and mixed electronic–ionic conductivity. Here we show that both single-photon-counting and long-term stable performance of perovskite X-ray detectors are attained in the photovoltaic mode of operation at zero-voltage bias, employing thick and uniform methylammonium lead iodide single-crystal films (up to 300 μm) and solution directly grown on hole-transporting electrodes. The operational device stability exceeded one year. Detection efficiency of 88% and noise-equivalent dose of 90 pGyair are obtained with 18 keV X-rays, allowing single-photon-sensitive, low-dose and energy-resolved X-ray imaging.

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