Solution-Processed Perovskite Radiation Detectors for X-ray Diagnostics

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Metal-halide perovskites are emerging as promising active materials for direct X-ray detection because they combine high-Z constituent elements, strong X-ray attenuation, high bulk resistivity and favorable charge transport. Reported mobility-lifetime ($\mu\tau$) products can be competitive with conventional detector semiconductors, while low-temperature solution processing offers a route to scalable and cost-effective detector fabrication. These features make perovskites attractive for compact sensors for diagnostic imaging, scientific instrumentation and detector R&D.

This contribution presents ongoing work on hybrid organic-inorganic perovskite radiation detectors fabricated by microfluidic soft lithography and micropad-dewetting. These methods enable controlled crystallization of $MAPbBr_3$ perovskite absorbers directly on patterned conductive glass substrates, providing a platform to study material quality, dark-current behavior, charge transport and radiation-induced photocurrent. In parallel, perovskite layers are grown on silicon substrates to investigate hybrid detector configurations and the influence of the perovskite-silicon interface on device response.

The integration of high-Z perovskite absorbers with silicon technology is relevant for future pixelated detectors, where efficient X-ray absorption may be combined with the low-noise and high-spatial-resolution capabilities of mature CMOS platforms. X-ray irradiation measurements on fabricated devices show a measurable photocurrent response, while preliminary perovskite-on-silicon results support the feasibility of a functional hybrid detector structure. Current efforts focus on interface optimization, dark-current suppression, charge-collection improvement and long-term stability, which remain key steps toward practical implementation of solution-processed perovskite radiation detectors for next-generation X-ray diagnostic and imaging systems.