Solution-grown single-crystalline perovskite nuclear batteries with 10% power conversion efficiency.

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Abstract:

Nuclear batteries offer exceptional longevity and energy density, ideal for autonomous applications in spacecraft, pacemakers and remote scientific stations. However, no radiation-converting material currently combines high efficiency, low cost, and scalability. For instance, diamond-based betavoltaic cells with a champion efficiency of 28% are expensive and limited to a submillimetre scale. In contrast, cost-effective radioisotope thermoelectric generators reach efficiencies around 6-7%, but require high working temperatures and large volumes. Here, we fabricated radiovoltaic (RV) cells from methylammonium-formamidinium lead iodide ($MAFAPbI_3$) perovskite single crystals grown by a facile inverse temperature crystallisation method. The best-performing cell achieves a power conversion efficiency of 10.1% under X-ray irradiation with energies up to 20 keV, setting a record value for X-ray/gamma-voltaic, outperforming most RV semiconductor cells and approaching the Shockley–Queisser limits for X-ray radiation of 12.8%, calculated for the $MAFAPbI_3$ bandgap. These results pave the path toward low-cost, highly efficient perovskite-based nuclear batteries.

Conflicts of Interest

Authors declare no conflict of interest.

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