Toward High-Performance Single-Crystal Perovskite Solar Cells

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Most high-performance perovskite solar cells (PeSCs) nowadays are prepared using solution processes, such as spin-coating, and the films are mostly polycrystalline. However, the defects on the grain boundaries inevitably impede charge transport in the active layers, thereby degrading the device efficiencies. Ideally, PeSCs prepared with perovskite single crystals (SCs) should theoretically exhibit even higher efficiencies. Herein, we synthesis asymmetric perovskite SCs using space-confined crystallization methods. We also dope the interfacial layer, which behaves a hole-transport layer as well in our cells, with *p*-type organic molecules to reduce their resistances and find the power conversion efficiencies (PCEs) are significantly improved. At the optimal concentration, the PCE is improved to 14.99%; the champion PCE is up to 15.67%. Finally, asymmetric two-dimensional (2D) perovskite SCs are prepared for solar applications. We obtain thin-film crystals with vertically oriented 2D stacked structure, resulting in a power conversion efficiency (PCEs) of 14.74%. The PCE of the device with surface passivation even can reach higher than 16%.

Reference:

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Research Interest: Solar Cells; Organic Electronics; Low-Dimensional Nanomaterials