OFFICIAL ABSTRACT and CERTIFICATION

Stability Enhancement of Perovskite Solar Cells Using Mixed Cation/Halide Perovskite

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Perovskite (PVSK) has emerged as a solar cell material rivaling those of silicon and quantum dots due to their increasing power conversion efficiency (PCE). PVSK however is limited because its common hybrid organic inorganic halide structure ABX3 structure (i.e. methylammonium lead iodide, MAPbI3) is unstable. To reduce degradation and enhance efficiency, Cs, formamidinium (FA) cations and a Br halide can be added to create a mixed cation/halide structure CsFAMAPbIxBr1-x. This study investigates a combination of Cs, FA, MA, and Br with a spin-coating method to optimize both efficiency and stability of the cell.
One-step spin coating was used to prepare the PVSK film. PbI2, MAI, CsI, FAI, and PbBr2 at a molar ratio of 1:.7:0.15:0.15 were placed in a mixed solvent of DMF and DMSO (8:2). Titanium dioxide was spin coated onto FTO substrates and annealed to form the electron transport layer (ETL).
UV-Visible Spectroscopy indicated that the changing of the cation/halide component did not influence the absorption of the photoactive layer. XRD results implicated that the mixed PVSK had two possible crystal phases (α and phases) compared to the single peak of MAPbI3 PVSK. After the optimization (changing temperature and time for the preferable crystallization), the mixed PVSK showed a strong alpha peak (photoactive) and negligible delta phase. PCE measurement indicated the mixed PVSK has higher PCE, probably due to increased grain size. Moisture and heat stability tests revealed enhanced structural stability against excessive heat, demonstrating that the mixed structure can generate better performance and enhanced durability

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