Highly-Efficient and Long-Term Stable Perovskite Solar Cells Enabled by A Novel Cross-Linkable n-Doped Hybrid Cathode Interfacial Layer

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A solution-processed cross-linkable hybrid composite film composed of N,N-dimethyl-N-octadecyl (3-aminopropyl)trimethoxysilyl chloride silane (DMOAP)-doped [6,6]-phenyl-C₆₁-butyric acid methyl ester (PC₆₁BM) is demonstrated as an effective cathode interfacial layer for perovskite solar cells (PeSCs). This cross-linkable DMOAP-doped layer exerts multi-positive effects for use in PeSCs, including excellent film coverage on the perovskite layer, good robustness against the undesirable reaction between the mobile iodide ions and Ag electrode, reasonable electrical conductivity, and fine tunability of the work-function of Ag electrode. With these desired interfacial properties, the resulting devices deliver a remarkable power conversion efficiency (PCE) of 18.06% with high reproducibility. Combining this novel interfacial layer with an effective thin-film encapsulation layer, the devices exhibit promising long-term ambient stability, with negligible (<5%) loss in PCE after more than 5000 hours of aging.

Introduction

Cost-effective highly-efficient next-generation photovoltaic & technology: hybrid lead halide perovskite solar cells (PeSCs)



- Despite PeSCs' promising performance, their stability and lifetime have been far from acceptable for practical use
- **U** Stability issues in commercialization of PeSCs:
 - \succ Extrinsic degradations caused by ambient H₂O/O₂
 - Intrinsic degradations caused by undesirable rxn between mobile halide ions & electrode (e.g., I⁻ and Ag) even under inert atmosphere









□ This work: we demonstrate highly-efficient & long-term stable PeSCs through the incorporation of:

- \succ Atomic-layer-deposited (ALD) Al₂O₃ film as the encapsulation layer \Rightarrow ambient H₂O/O₂-induced degradations \downarrow
- \succ Cross-linkable n-doped hybrid composite DMOAP-doped PC₆₁BM film as cathode interfacial layer \Rightarrow interfacial degradations \downarrow , PCE \uparrow /

