

Scalable graphene interface engineering in perovskite solar cells

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Hybrid Perovskite Solar Cells (PSCs) exhibit certified power conversion efficiency exceeding 22% and represent a viable solution process photovoltaic (PV) technology for low cost/high efficient PV modules as well as for integration with conventional silicon PV for tandem cells. In their structure, ultrathin interlayers are often used to improve the device performance and long-term stability. Interlayers can modify absorber films morphology [1], they can reduce trap states at layer interfaces [2] as well as help to make ohmic contact by changing the electrode work function [3]. Scalable and low-cost techniques are required for introducing interlayers into PSC structure, by ensuring high power supplied/fabrication cost ratio, comparable with the already developed thin-film PV technologies.

In this work, graphene interface engineering via spray coating of graphene-doped mesoporous TiO₂ (Gr-mTiO₂) is demonstrated to improve the PSCs performance and stability under operative conditions. The results underline how the implementation of sprayed Gr-mTiO₂ as a scaffold in PSCs can significantly improve the cell short circuit-current and consequently power conversion efficiency up to 17.5% (average PCE of 16.8%) by surpassing the one for PSC based on doped spin-coated mTiO₂ scaffold. The demonstrated feasibility of PSCs fabrication by using uniform spray deposited mesoporous film on large-area 21×24cm² provides a viable route to easy scale-up the PSCs realization process. According to electro-optical and transient measurements,

the presence of graphene flakes in TiO₂ scaffold tunes the morphology of perovskite crystals, by enhancing electron injection from the perovskite to electron transport layer [4]. Finally, introducing graphene into mTiO₂ lead to an enhancement of light soaking stability at maximum power point since the decreased charge accumulation at the mTiO₂/perovskite interface [5].

References

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Figures

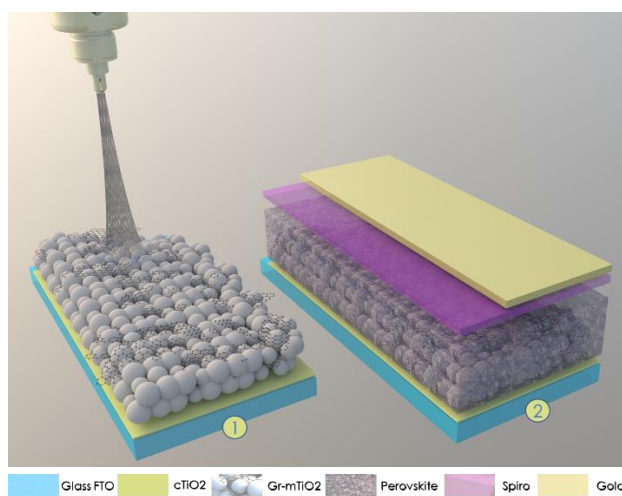


Figure 1: 1) Spray coating of Gr-mTiO₂
2) Structure of PSC