

## Meniscus Guided Film Coating for Large-Area Perovskite Solar Cells

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**Abstract :** Perovskite solar cells (PSCs) have been gaining impressive progress with excellent power conversion efficiency (PCE) of 25.5% in small-area devices. However, the conventional film coating approach is not applicable to large-area module fabrication. Meniscus-guided coating, including blade coating, slot-die coating, and bar coating, is solution processing and promising for large-area and cost-effective film coating to industrial-scale PSCs. Here, we develop simple and scalable solution shearing (SS) and bar coating (BC) methods to coat all layers on large-area (10x10 cm<sup>2</sup>) substrate in FTO/c-TiO<sub>2</sub>/mp-TiO<sub>2</sub>/CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub>/Spiro-OMeTAD/Ag device structure, except the Ag electrode. All solution-sheared PSC exhibited a champion power conversion efficiency of 15.89% in the conational DMF/DMSO solvent. Whereas a very high PCE of 20.30% compared to the controlled spin-coated device (SC, 17.60%) was achieved from the large area sheared perovskite film in a green ACN/MA solvent. Similarly, a remarkable PCE of 18.50% was achieved for a device fabricated from a large-area perovskite film in a simpler and more compatible Bar-coating system. This strategy demonstrates the huge potential for module fabrication and future PSC commercialization.

**Keywords :** Perovskite solar cells, larger area film coating, meniscus-guided film coating, solution-shearing, bar-coating, power conversion efficiency

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