Electrospray-Assisted Fabrication of Highly Stable and Efficient Perovskite Solar Cells (PV-3)

A joint India-U.S. research consortium funded under the *Joint Clean Energy Research & Development Center (JCERDC)*

Scientific Achievement:

An aerosol-based method (electrospray deposition) is demonstrated to fabricate a stable $CH_3NH_3PbI_3$-based perovskite layer at ambient humidity (30%–50% relative humidity). Subsequently, perovskite solar cells with 0.1-cm² area and ~12% efficiency were fabricated, which retain 75% of their initial efficiency (average over various devices) for 5.5 months.

Significance and Impact:

The method developed is scalable to fabricated large-area stable perovskite solar cells.

Research Details:

- A two-step process was followed to fabricate a stable perovskite layer: PbI_2 was deposited using spin coating, and then CH_3NH_3I (MAI) was electrosprayed on PbI_2-coated substrate at room temperature (Fig. 1).
- Devices were kept at ambient conditions and tested periodically to investigate their stability (Fig. 2a).
- Key mechanism for improved stability is the precise control of the reaction between the two precursors (PbI_2 and MAI), which results in smooth and moisture-resistant perovskite film, compare to the spin-coating method.

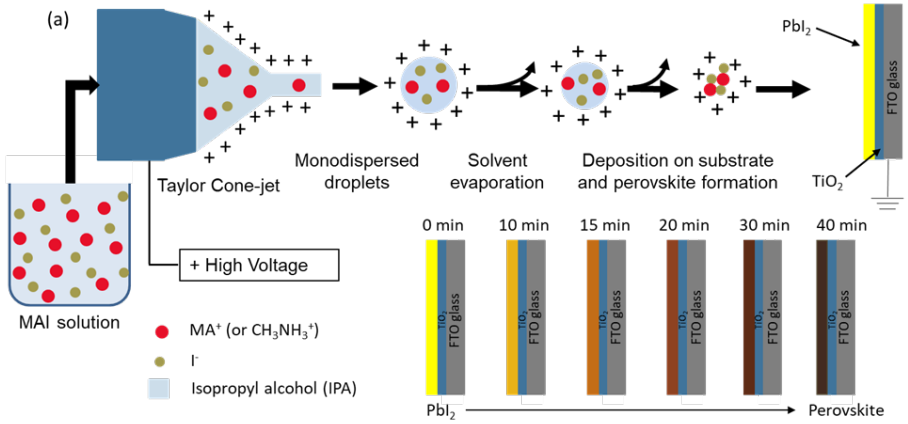

Figure 1. Schematic of electrospray-assisted fabrication of perovskite layer.

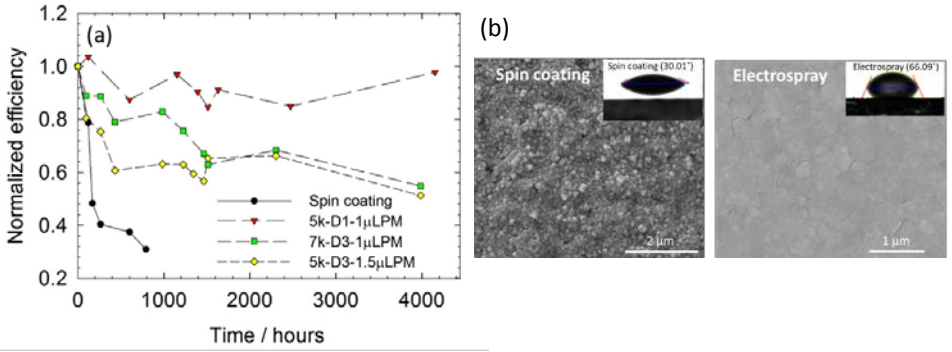

Figure 2. (a) Stability of the perovskite solar cells fabricated using electrospray at various conditions and spin-coating methods. (b) Surface morphology of perovskite film fabricated with spin coating (left) and electrospray (right); the inset shows the contact angle of water on the respective perovskite film.

Publication(s): S. Kavadiya, D.M. Niedzwiedzki, S. Huang, and P. Biswas, Electrospray-Assisted Fabrication of Highly Stable and Efficient Perovskite Solar Cells at Ambient Conditions, *Advanced Energy Materials*, 1700210, 2017.

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