

Hybrid-route perovskite deposition for upscalable monolithic two-terminal Perovskite/Si Tandem Solar Cells

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Keywords: Thin films, Perovskite, scalable hybrid deposition, perovskite/Si Tandem Solar Cells

Hybrid-route deposition process for monolithic two-terminal perovskite/Si tandem solar cells have recently raised much attention in PV community due to their compatibility to the textured silicon bottom cells [1-3]. This state-of-the-art technique combines vacuum evaporation (dry) and a wet process to convert an inorganic film into perovskite layer. The deposition of perovskite via such hybrid dry-wet route provides conformal, high throughput, uniform and scalable perovskite thin films [4]. However, most of the hybrid depositions method today employ the non-scalable wet processes in the second step for the conversion such as spincoating. Thus it is difficult to evaluate the scalability of tandem devices fabrication towards industrial mass production.

Herein, we report for the first time the use of slot-die coating as an upscalable technique for the PbI_2 conversion into perovskite. Using slot-die coating, we were able to deposit a homogeneous perovskite layer on a surface of above 25 cm^2 (see Fig. 1). Moreover, these perovskite layers showed conformity on the pyramidal texture present on silicon substrates surface. The final perovskite was the double cation mixed halide $\text{MA}_{0.3}\text{FA}_{0.7}\text{Pb}(\text{I}_{0.84}\text{Br}_{0.16})_3$. The phase compositions and the film morphologies were characterized using X-Ray diffraction and Scanning Electron Microscopy, respectively. Using UV-Vis spectrophotometry the optical properties were also investigated. The perovskite film was then implemented into a single junction cell, yielding a high performance with 16.23 % efficiency and with high stability at 14% (active area = 0.09 cm^2).

The fabrication of perovskite/Si tandem devices integrated the hybrid-deposited perovskite is ongoing. We aim to present in the final paper the performances of these tandems on large scale in order to allow further evaluating the applicability of this methodology to the upscaling perovskite/Si tandem devices.

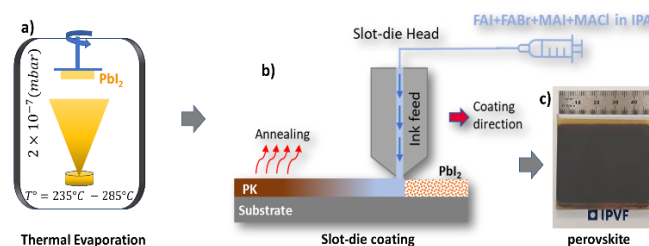


Figure 1: Hybrid dry-wet deposition for perovskite: (a) Step 1- thermal PbI_2 evaporation on the FTO substrate under high vacuum. (b) Step 2- Coating a 0.41M organic solution containing FAI, FABr, MAI, MACl (in IPA) on top of the inorganic PbI_2 scaffold using slot-die. (c) a large-area (25 cm^2) perovskite layer was finally obtained with high uniformity after annealing. For characterizations, this substrate was cut into four smaller pieces for cells.

References:

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