Hybrid-route Perovskite deposition towards Two-terminal Monolithic Perovskite/Si Tandem Solar Cells

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Hybrid deposition process for Monolithic Two-terminal Perovskite/Si tandem solar cells (PK/Si TSCs) have recently raised much attention in PV community due to their compatibility to Silicon bottom cells [1-3]. The holding record PK/Si tandem cell of 25.2% efficiency used this route was reported in 2018 [1]. The state-of-the-art technique uses thermal evaporation (PVD) as the basic dry step before converting into PK through wet process. The deposition of PK via hybrid dry-wet route provides conformal, high throughput and scalable thin films [4]. However, very few experimental results obtained on such PK layers are available in the literature and it is currently difficult to evaluate the potential towards industrial production.

In this work, we report the first PK absorber layer fabricated using this method. Inorganic Lead(II) iodide (PbI_2) layers were first deposited by evaporation then being converted into PK using spin coating/slot-die coating on a large scale 5x5 cm² substrate. On the other hand, we also fabricated the same PK using full-wet process for comparison. The compositions of PK were detected using X-Ray diffraction. PK thin-film morphologies were then imaged using SEM (Scanning Electron Microscopy). We found that hybrid-route deposition yields higher cristalinity and conformal PK on FTO glass whereas full-wet PK films were rougher with larger grains and not fully cover the surface (voids) (see Fig.1). By using UV-Vis spectrophotometry, we observed that the absorption onsets of two sample are close to each other, indicating similar optical bandgaps (~1,59 eV) and structures obtained.

The fabrication of solar cell devices using the hybrid-processed PK is ongoing. We aim to present in the final paper the performance of these cells in order to allow further investigating the application of this methodology to Pk/Si tandem devices.

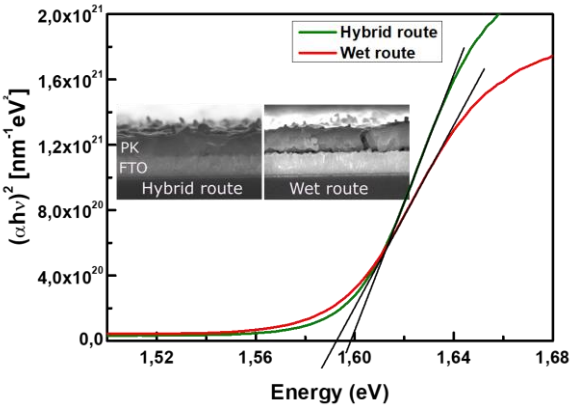

Figure 1: Tauc plots of PK deposited via Hybrid and Full-wet route on FTO glass yield quite similar bandgaps. Inset the SEM images showing different morphologies of the two configurations.

References:

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