FULLY AIR-PROCESSED SLOT-DIE COATING FOR SEMI-TRANSPARENT PEROVSKITE SUBMODULES TOWARDS BIFACIAL 4-TERMINAL PEROVSKITE/SILICON TANDEMS

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Perovskite/silicon solar tandem has garnered significant interest from the photovoltaic community in recent years. Efforts have been directed towards enhancing the power conversion efficiency of this tandem at the laboratory scale, resulting in the achievement of a 34.6% efficiency.[1] However, transitioning this technology to commercialization remains challenging, particularly regarding the scalability of perovskite deposition techniques. While nitrogen-glove boxes have been utilized for upscaling in laboratory settings, they are not feasible for industrial fabrication compared to air-processed approaches.[2] In this work, we fabricated the perovskite top submodule using the slot-die coating technique in ambient air with controlled relative humidity below 20%. The wet perovskite ink was coated onto the substrate, followed by nitrogen quenching to partially crystallize the film before a hard annealing (see Fig. 1). The coating parameters are carefully optimized to achieve uniformity on different areas from 50cm², 100cm² to 225cm². Subsequently, these substrates were divided into smaller cells, which exhibited efficiencies exceeding 20%. Furthermore, we fabricated 9.3% efficient P-I-N semi-transparent perovskite top submodules with an aperture area of 64 cm², which were then encapsulated and used as filtered windows for silicon submodule measurements. This work showcases a fabrication process utilizing scalable slot-die coating and fully developed devices in ambient air, towards the industrialization of 4-terminal perovskite/silicon tandem solar cells.

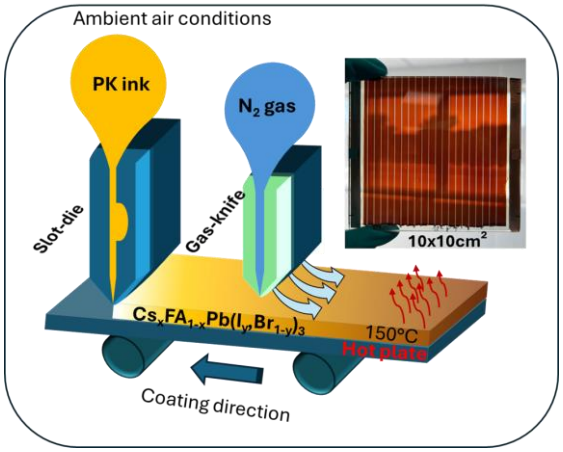

***Figure 1**: Air-knife-assisted Slot-die coating in ambient atmospheric conditions and pictures of the fabricated 10x10cm² semi-transparent perovskite submodule.*

[1] https://www.longi.com/en/news/2024-snec-silicon-perovskite-tandem-solar-cells-new-world-efficiency/ (accessed 18 September 2024).
[2] S.W. Kim, S.J. Moon, S.H. Kim, J.J. Yoo, D. Kim, B.S. Kim, N.J. Jeon, Reducing Humidity Dependency of Ambient-Air-Processed Wide-Bandgap Inverted Perovskite Solar Cells, ACS Energy Lett. 8 (2023) 4777–4781.