

Charge transport layers rafted by atomic layer deposition for large -area perovskite-based solar modules

Femi Mathew,¹ Damien Coutancier,^{1,2} Getaneh Gesesse,¹ Marion Provost,¹ Nadia Nazi,¹
Nathanaelle Schneider,^{1,2}

¹ Institut Photovoltaïque d'Ile-de-France (IPVF), 18 boulevard Thomas Gobert, 91120 Palaiseau

² CNRS, UMR 9006, Institut Photovoltaïque d'Ile-de-France (IPVF), 18 boulevard Thomas Gobert, 91120 Palaiseau

*Corresponding author: femi.mathew@ipvf.fr

References :

¹Afroz, M.; et al. Perovskite Solar Cells: Progress, Challenges, and Future Avenues to Clean Energy. *Solar Energy* 2025, 287, 113205.

²Tian, X. ; et al. Perspectives for Sustainability Analysis of Scalable Perovskite Photovoltaics. *Energy Environ. Sci.* 2025, 18 (1), 194–213.

³Park, H. H.; et al. Inorganic Materials by Atomic Layer Deposition for Perovskite Solar Cells. *Nanomaterials* 2021, 11 (1), 88.

⁴Park, H. H.; Fermin, D. J. Recent Developments in Atomic Layer Deposition of Functional Overlayers in Perovskite Solar Cells. *Nanomaterials* 2023, 13 (24), 3112.

⁵Seyisi, T.; et al. Major Challenges for Commercialization of Perovskite Solar Cells: A Critical Review. *Energy Reports* 2025, 13, 1400–1415.

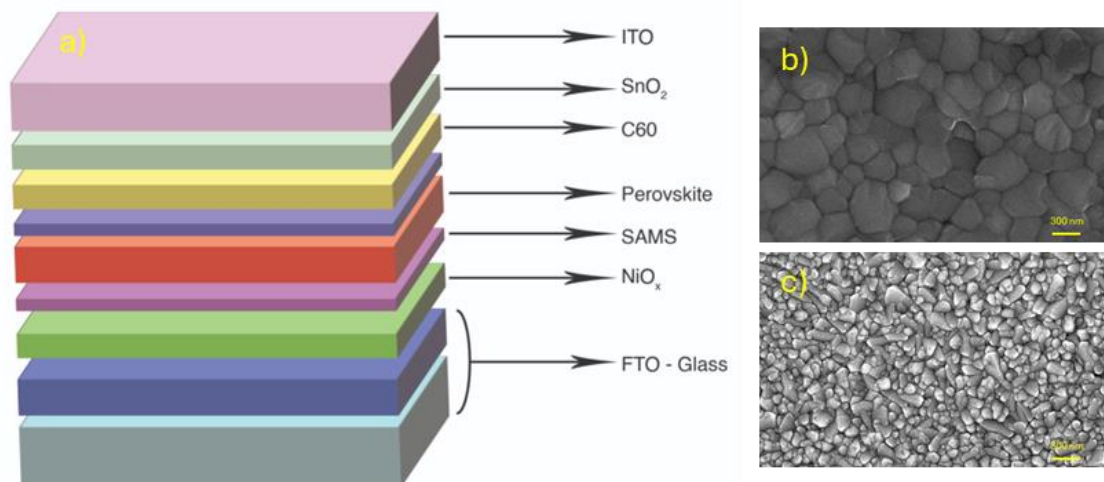


Fig 1. (a) Schematic of the perovskite device architecture used in this study. Scanning electron microscopy (SEM) images of (b) SnO₂ coated on C60/Perovskite/SAMs/NiO_x/FTO-glass and (c) NiO_x films deposited on FTO-glass.