

Low-temperature deposition of transparent conductive layers for perovskite-silicon tandem cells

Jonas van Stappen, Chloé Dindault, Tiphaine Bourgeteau, Heejae Lee, Denis Tondelier, Bernard Geffroy, Yvan Bonnassieux

► **To cite this version:**

Jonas van Stappen, Chloé Dindault, Tiphaine Bourgeteau, Heejae Lee, Denis Tondelier, et al.. Low-temperature deposition of transparent conductive layers for perovskite-silicon tandem cells. SPIC 2017 (Science et Technologie des Systèmes pi-Conjugués), Oct 2017, Limoges, France. cea-02340816

HAL Id: cea-02340816

<https://hal-cea.archives-ouvertes.fr/cea-02340816>

Submitted on 31 Oct 2019

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Low-temperature deposition of transparent conductive layers for perovskite-silicon tandem cells

Jonas van Stappen,^{1,*} Chloé Dindault,^{1,2} Tiphaine Bourgeteau,¹ Heejae Lee,¹ Denis Tondelier,^{1,*} Bernard Geffroy,^{1,3} Yvan Bonnassieux¹

¹ LPICM, CNRS, Ecole Polytechnique, Université Paris-Saclay, 91128 Palaiseau Cedex, France

² Institut Photovoltaïque d'Île de France (IPVF), 92160 Antony, France

³ LICSEN, NIMBE, CEA, CNRS, Université Paris-Saclay, CEA Saclay, 91191 Gif-sur-Yvette Cedex, France

* Corresponding authors, mail: jonas-viktor.van-stappen@polytechnique.edu and denis.tondelier@polytechnique.edu

Since 2013, single-junction research-cell power conversion efficiencies of perovskite cells have risen by about 8%_{abs} to 22.1%, while multicrystalline silicon and monocrystalline silicon efficiencies have risen by less than 2%_{abs} and less than 1%_{abs}, respectively [1]. Tandem cells with a perovskite top cell and a silicon bottom cell, recently achieving 23.6% in two-terminal configuration, present a promising alternative to further increase the relatively stagnant performance of already highly-optimized single-junction silicon cells [2]. To facilitate such an advance, methods to deposit high-quality transparent conductors (TCs) which do not subject the perovskite layer to degradation during deposition need to be found.

We utilize a spin-coating solution deposition process optimized for high reproducibility, yielding the single-junction MAPbI_{3-x}Cl_x perovskite cell stack shown in Figure 1, with an average efficiency of 7.94 ± 0.68 % with a non-transparent electrode. Two different TC electrodes are tested on these cells: evaporated thin-film semi-transparent Ag layers and low-temperature RF-sputtered indium tin oxide layers. For the latter, buffer layers of either thin-film Ag, Ag/BCP, Ag nanowires or interlinked PCBM are used to protect the organic layer stack from sputtering damage.

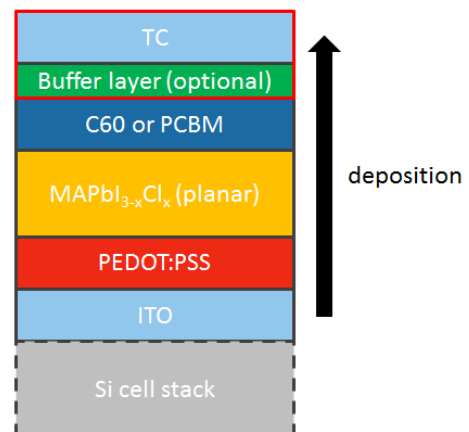


Figure 1 – MAPbI_{3-x}Cl_x cell stack used in this work, with the focus of this contribution highlighted by the red frame.

By comparing transparency and efficiency, we will identify the most suitable approach.

References

- [1] M. A. Green, K. Emery, Y. Hishikawa, W. Warta, E. D. Dunlop, D. H. Levi and A. W. Y. Ho-Baillie, Solar cell efficiency tables (version 49). *Prog. Photovolt: Res. Appl.* (2017), 25: 3–13. doi: 10.1002/pip.2855
- [2] K. A. Bush, A. F. Palmstrom, Z. J. Yu, M. Boccard, R. Cheacharoen, J. P. Mailoa, D. P. McMeekin, R. L. Z. Hoyer, C. D. Bailie, T. Leijtens, I. M. Peters, M. C. Minichetti, N. Rolston, R. Prasanna, S. Sofia, D. Harwood, W. Ma, F. Moghadam, H. J. Snaith, T. Buonassisi, Z. C. Holman, S. F. Bent, M. D. McGehee, *Nat. Energy* (2017), 2: 17009. doi: 10.1038/nenergy.2017.9