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

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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.

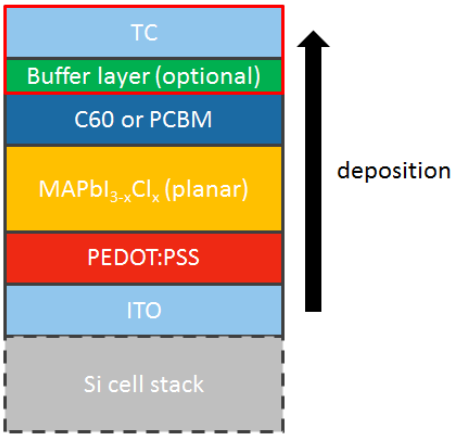

Figure 1 – $MAPbI_{3-x}Cl_x$ cell stack used in this work, with the focus of this contribution highlighted by the red frame.

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.

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

References

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