Processing of large area Perovskite-based Solar devices: high efficiency and stability assessment

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In the context of the increase of the photovoltaic (PV) technologies, the question of the cost remains central. Indeed, the price of the electricity reached by this technology remains high with regard to the conventional energies.
The current strategy to remain competitive articulates around two main strategies: the increase of the efficiency of the PV cells and the decrease of the costs linked to the raw material. In this context, our teams work to combine on one hand silicon heterojunction cells (SHJ) and on the other hand perovskite ($CH_3NH_3PbI_3$) ones to obtain a 2-terminal tandem device in standard architecture with the target of highly efficient conversion up to 30 %.
Perovskite Solar Cells (PSCs) have recently emerged as one of today's most promising upcoming photovoltaic technology. Thanks to a unique combination of attractive features (high efficiency, low-cost, tunable bandgap, etc.) and their potential ease of processing, PSCs have drawn a tremendous research interest over the last few years. Record efficiency has then been quickly increasing and performances over 23% are now achieved. Yet, a number of challenges are still to be met to ensure a bright industrial future for PSCs. Significantly improving device active area while maintaining similar initial power conversion efficiency and over time is probably one the most important.

The main focus of this work is to provide new processing routes combining coating and laser structuration towards the elaboration of highly efficient large area PSC device. In parallel the relevance of this work thus mainly lies in the selection of the best materials & architectures that led to the highest stability under temperature and illumination for large area device.
The developments performed allowed us to obtain 8-cells modules with efficiencies up to 14.9%, with best results at 15.9% (V_{oc}=8.31V, FF=72.1%). It is important to emphasis on the reduced losses from single cell of 20 mm^2 to module of 10 cm^2. First stability results were obtained under continuous illumination (AM1.5, 1000W/m^2) with limited losses after 1000hours, with for the best devices around 90 % remaining initial efficiency.