# FABRICATION AND CHARACTERIZATION OF LARGE-SCALE PEROVSKITE SOLAR CELLS

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In recent years, the perovskite hybrid solar cells (PSCs) are considered as one of the most promising technologies in the photovoltaic field[1]. Despite their interesting properties, the records reached in terms of efficiency are performed by laboratory scale cells (<1cm²); The efficiency reached by the lab-scale cells is 25,8%[2] while the large surface (802 cm²) reaches today 17,9%. Therefore, the transition from lab-scale device fabrication based on spin-coating deposition to industrial-scale production process typically requires the re-evaluation of many factors associated with device fabrication and characterization.

Efforts are being made to upscale the technology with a variety of techniques. The slot-die coating is a deposition method that meets the requirements of the industrial scale transition of perovskite (like roll-to-roll coating). It uses a moving meniscus liquid of the precursor ink to drive the spread of the liquid film across the substrate. It is than adaptable to the nature of the substrate and its size. A recent study published by Bernard et al[4], shows how the slot-die is powerful in depositing a homogenous and large size perovskite device. In the first part, the study aims at fabricating a one-step large band-gap perovskite solar module of 12-15cm².

The second part is dedicated to the development of a manufacturing process more accountable to industry by replacing the electron transport layer. Today the most common ETL is the titanium oxide. It is made of a superposition of a compact and mesoporous layer. Despite it wide uses and maturity, it has a lot of parameter that make it non-compatible with industry requirement. To overcome this limitation, we worked on its most promising alternative, planar tin-oxide ($SnO_2$). It is more stable and less energy consuming to manufacture. Therefore, an optimization of the ink composition is necessary to correctly crystallize our perovskite on the top of a planar layer instead of a mesoporous one.

In spin-coating, the crystallization in controlled by the anti-solvent washing. It allows compact morphology and a good orientation of perovskite crystal. The last part of this study is devoted to work on a new strategy to initiate the perovskite crystallization, which is the air-blade drying. It consists on blowing the perovskite surface by a Nitrogen gas just after it the deposition. Different parameters will be varied and characterized , like the drying speed, the nitrogen flow, and the drying distance. We will then determine the influence of each one in the perovskite morphology and the device performance.

[1] Ajay Kumar Jena, « Halide Perovskite Photovoltaics: Background, Status, and Future Prospects », *Chemical Reviews*, s. d., 68.

[2] Hanul Min, Do Yoon Lee, Junu Kim, Gwisu Kim, Kyoung Su Lee, Jongbeom Kim, Min Jae Paik, Young Ki Kim, Kwang S. Kim, Min Gyu Kim, Tae Joo Shin & Sang Il Seok, « Perovskite solar cells with atomically coherent interlayers on SnO2 electrodes », *Nature*, 2021.