UPSCALE OF PEROVSKITE SOLAR CELLS: IMPACTS OF DRYING PROCESSES ON GROWTH MECANISMS AND LAYER PROPERTIES OF THE ASBORBER LAYER

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For the past few years, perovskite solar cells have known a tremendous development among photovoltaic technologies. Since 2012, their performances rapidly increased from 2% to 25,2% efficiency. Nonetheless, most of the research occurs on lab scale substrates with an active area in the range of 0.1 cm². One challenge for the future of perovskite solar cells is the device up-dimensioning to modules, larger than 1m². To do so, it first requires a better understanding and a good control of nucleation and growth mechanisms, but also the development of large scale fabrication processes, including deposition and drying methods.

Fabrication of a thin film on large-scale by solution coating is very demanding. To address this issue, various techniques have been previously developed, such as blade-coating, screen printing or slot-die coating. However, none of this processes have achieved the small-scale performances yet. For now, the best efficiency for slot-die coated perovskite reached 15,6% [1] on lab-scale cell and 10,1% for a 160 cm² module [2]. To enhance the performances, it is necessary to deeply understand the influence of coating processes and drying system of upscale systems.

Using a slot-die coating system to deposit a wet thin film, we compared different drying systems and mechanisms, including vacuum evaporation, air blade and thermal annealing, to appreciate the evaporation rate influence. Depending on the drying system, we noticed wide changes on the absorber properties. We further focused on the improvement of uniformity, thickness and crystallization rate by tailoring the coating and drying parameters.

Finally, we study how the perovskite ink composition can be improved to make it more compatible with a slot-die coating system and it eases the fabrication of a more uniform and efficient thin film, playing on solvents ratio and adding additives or surfactants.

Through this work, we aim to demonstrate the influence of drying method on the absorber properties and how it is possible to control it to achieve high quality perovskite layers by slot-die system.

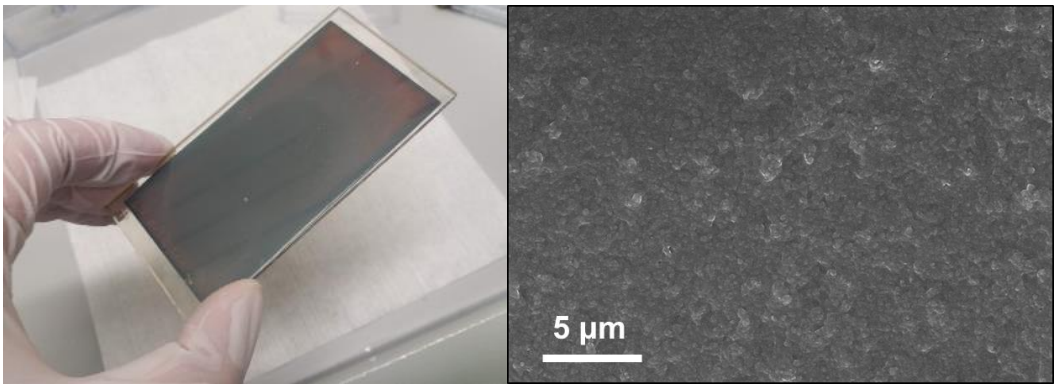

Figure 1 : Left, 5x10 cm² slot die coated perovskite. Right, SEM picture of the perovskite layer

[1] C. ZUO, and al. Nano Energy, 46, 185–192, (2018).

[2] Solliance (2018)