FABRICATION OF LARGE-SCALE PEROVSKITE SOLAR CELLS

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For the past few years, perovskite solar cells have known a tremendous development among photovoltaic technologies. Since 2012, their performances go from 2% to 23,3% recently. Nonetheless, for now, most of the production occurs on lab scale substrates with an aperture area in the range of 0.1 cm². One challenge for the future of perovskite solar cells is the device up-dimensioning to modules. It requires a better understanding and good control of nucleation and growth mechanisms. The development of large scale processes for fabrication and rapid film drying methods is one key to achieve high performances in wafer-size scale.

We herein propose a review of the main issues of perovskite upscaling by placing a particular emphasizes on the coating and drying processes. In our work, we managed to study the different possibilities of ink deposition, and isolated the most promising ones for perovskite fabrication, namely blade-coating and slot-die coating. We selected the slot-die system for further experimental researches. This method can coat a very specific amount of perovskite ink upon the substrate while controlling accurately the layer thickness and its homogeneity. Since 2015, several groups have managed to upscale the perovskite devices using a slot-die coater. The best result so far on large surface has been achieved by Solliance for a 144 cm² aperture area module of 14,5% (13,8% stabilized)[1] and achieved 15,57 % on lab-scale cells[2].

In addition to the coating, we propose a review of different ink engineering methods. The focus is made on the coordination of the perovskite with several additives. The creation of complexes can slow down nucleation and growth processes and allow us to enlarge the ink processing window. Besides, we established a list of various surfactants who can operate simultaneously to enhance the coverage and thickness homogeneity of the coated layer.

Finally, we realized an investigation on the current drying system. We designed a horizontal air blow system, associated to an annealing plate under vacuum to enhance the solvent evaporation after deposition. The first results towards larger area perovskite solar cells by using slot-die coating will be presented.

1. *https://www.solliance.eu/*
2. *C. ZUO, and al. One-step roll-to-roll air processed high efficiency perovskite solar cells. Nano Energy, 46, 185–192, (2018).*