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# Large area Perovskite Solar Cells: Fabrication and Stability

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## Abstract

A new promising class of light harvesting materials, namely the hybrid organic halide based perovskites, have been recently employed to realize high efficiency photovoltaic solar cells. This kind of crystalline material shows broad absorption in the visible spectrum (direct energy gap down to 1.55 eV), good electron and hole conductivity, delivering also high open circuit voltages. Small area Perovskite Solar Cells (PSCs) have now reached a certified record efficiency 21% [2].

In this communication we present the efforts made to fabricate large area Perovskites modules. Two deposition techniques were used, namely spin-coating for substrates up to 100 cm<sup>2</sup> and air-jet assisted blade coating for larger substrates. [2] The latter process is based on an optimized air-flow assisted blade coating of PbI<sub>2</sub> in a two-step perovskite deposition procedure. The blade coating was also used to deposit the hole transporting layer. Optimizing the temperature and the intensity of the air flow, we were able to deposit P3HT and Spiro-OMeTAD over an active area of about 100 cm<sup>2</sup>. The final layout of modules was obtained by laser ablation to remove PbI<sub>2</sub>, CH<sub>3</sub>NH<sub>3</sub>PbI<sub>3</sub> and also the HTM layers, achieving an aperture ratio over 70%. Using the P3HT we obtained a module efficiency, on active area, of 4.3%, while with Spiro-OMeTAD the efficiency improved till 9.3%. Moreover, a full printable module was realized using as counter electrode PEDOT:PSS modified with ethylene glycol layer, and deposited via spray coating. The efficiency of the full printable module was 2.5% for 80 cm<sup>2</sup> active area. Spin-coating devices with a substrate area of 100 cm<sup>2</sup> and an active area of 60 cm<sup>2</sup> were also fabricated and the effect of Graphene related materials were investigated. The work function of GO after the intercalation of Li atoms (4.3eV) exhibits a good matching with the TiO<sub>2</sub> conduction band and allows for an enhancement of the electron injection from the perovskite to the m-TiO<sub>2</sub> [3] resulting in an improved efficiency of all the modules with respect to references without GO-Li.

The manufacture of all devices was performed in air using several measures aimed to prevent the perovskite degradation and to lengthen shelf life and efficiency. Detailed in-situ temperature TEM analyses were performed to assess the influence of temperature on PSCs. [4]

## References

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- 1) National Renewable Energy Laboratory, access on 30/3/2015, <http://www.nrel.gov/ncpv/images/efficiencychart>.
- 2) S. Razza et al. Journal of Power Sources, vol. 277, p. 286–291, 2015.
- 3) Agresti et al. Adv. Funct. Mater. 2016, DOI: 10.1002/adfm.201504949
- 4) G. Divitini et al. Nature Energy 15012 , 1, 2016