Large area Perovskite-based Solar Modules *via* Laser-Scribing

Ibrahim Bulut[1], Matthieu Manceau[1] and Solenn Berson[1]
[1] *Univ. Grenoble Alpes, INES, F-73375 Le Bourget du Lac, France*
CEA, LITEN, Department of Solar Technologies, F-73375 Le Bourget du Lac, France
haciibrahim.bulut@cea.fr

Over the last few years perovskite solar cells (PSCs) have attracted a considerable amount of research and record efficiency has then been quickly increasing. Performance well over 20% are now achieved, but yet, a number of challenges are still to be met to ensure a bright industrial future for PSCs. While few groups have been able to demonstrate large scale PSCs [1,2] most of the worldwide current research is indeed focusing on small area lab-scale devices (ca 10 mm² or below). The main focus of this work is then to provide new processing routes towards the large scale fabrication of efficient solar modules. When going from cells to modules one of the most important challenges relates to the serial association of the multiple cells. The so-called "interconnection or dead" areas do not actually contribute to the power conversion and obviously limit the device power output. In order to reduce these "dead" regions and increase the Geometrical Fill Factor (GFF), which is defined by the ratio of the active area on the total area of the system, the patterning of photovoltaic modules must involve high resolution techniques. Yet, the classical coating/printing technologies exhibit moderate resolution and not allow for the achievement of GFF over 80%. Using laser ablation to structure the different layers, which were previously deposited on the whole surface, is therefore a promising alternative way to manufacture high-GFF solar modules. This processing has already been used successfully to manufacture thin film photovoltaic modules such as CIGS or OPV devices.

Basing up on a low-temperature process enabling 10 cm² modules with efficiencies greater than 12% but with GFF below 50%, we propose to present our current advances in development of modules structured with a picosecond laser. Different laser-patterned structures, materials and coating processes were investigated. Opportunities, challenges, issues and performances will be discussed with the support of different electrical and optical characterization techniques such as contact resistance measurements, microscope images and calculation of power losses caused by the interconnections.

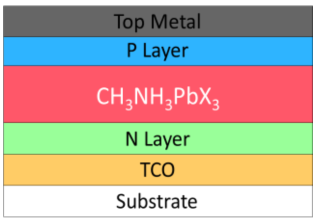

Figure 1. Typical cross-section scheme of the processed devices

References

[1] S. Razza et al, *Journal of Power Sources* (2014), 277, 286-291
[2] IMEC, Press Communicate (May 2016)