Inkjet-Printing of Large Polymer Solar Cells. A long & winding road.

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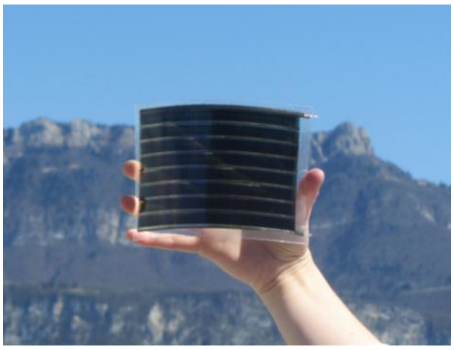
Among all the 3rd generation solar technologies, Polymer Solar Cells (PSCs) have emerged as a very promising alternative for solar energy conversion. Thanks to their unique combination of attractive features (low-cost, light weight, flexibility etc.) and incomparable ease of processing, PSCs have drawn a tremendous research interest over the last decade. Record efficiency has then been continuously increasing and two-digit performances are now achieved. Unfortunately, most of the worlwide current research is still focusing on small area lab-scale devices (ca 10 mm²) built on glass substrates using spin-coating as the main fabrication method. No matter how promising their efficiency is, these devices are of course very far from any practical application. Until now, very few groups have been able to demonstrate large scale all-solution processed PSCs. [1] To a very large extent, these modules were prepared *via* a combination of slot-die coating and screen-printing while less attention has been paid to inkjet printing. [2] In that context, it is only very recently that the first fully inkjet printed solar cells were demonstrated. [3] Being a drop-on-demand deposition technique, inkjet printing allows both for a parcimonious use of materials and direct patterning. Tuning the device layout then does not require any hardware modification making this technique an elegant solution to manufacture customized devices.

We here demonstrate the processing of 15 x 10 cm² organic PV modules entirely *via* inkjet printing and showing power conversion effciency greater than 4% (Figure 1). After some first series of experiments on a lab-scale printer (Dimatix DMP 2600, 16 nozzles heads) all the different layers were finally printed using 128, 256 or 1024 nozzles printheads using a pilot printer (Ceradrop X-series) and halogen-free solvents only.



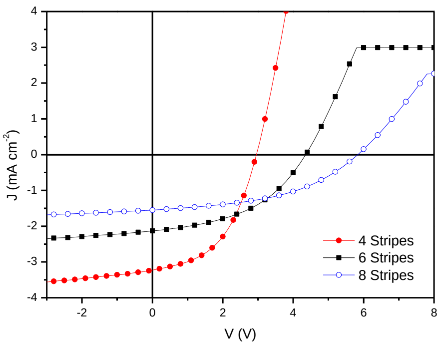


Fig. 1: Picture of fully printed devices and corresponding J(V) curve

We detail the problems that had to be overcome when going from small area spin-coated devices to large-area printed ones using the following architecture :

PET / TCO / ZnO / Polymer : PCBM / PEDOT:PSS / Ag

Among the numerous issues that were met and solved, we can for instance quote :

- The fine tuning of zinc oxide solid content to get defect-free layers
- The replacement of chlorinated solvent used for the active layer
- Water-based PEDOT:PSS ink wetting on top of the hydrophobic active layer
- PEDOT:PSS and silver top electrode electrical matching

References

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