Organic solar cells developments at XLIM Research Institute, Limoges

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Our group (10 permanents and 10 students researchers), is mainly involved in fundamental and experimental research on organic electronics [1] through device realization (OLEDs, OFETs, OPVs), optoelectronic characterization and device modeling.
Especially, we are actively implicated in organic solar cells since 2002, through national funding from ADEME-CEA (CSPVP 2003-5), ANR (NANORGYSOL 2005-7, CONAPOSOL 2006-9), and DGA (2006-8), and we are members of the CNRS network "NANORGASOL".
Device fabrication, as well as many photo-physical characterizations are performed on site under inert atmosphere in glove boxes : physical vapor deposition (cosublimation), spin coating, I-V measurements under AM1.5 simulated solar emission , IPCE, transient photovoltage, etc…
More precisely, we focused our research on donor acceptor active layers based on small molecules (CuPC, thiophene and fluorenone based molecules as donors, C_{60} and perylene derivatives as acceptors).
Our domains of interest and main achievements concern:
- the control of the active layer morphology (bilayers, multilayers and coevaporated layers) through a fine control of the deposition parameters: in the case of small molecule based solar cells, multilayers devices can behave like bulk heterojunctions and showed better power conversion efficiencies [2,3].
- electrode optimisation: ITO anodes obtained by ion beam sputtering (IBS) allowed a better optimization of single planar heterojunctions by reducing the amount of PEDOT:PSS needed as interlayer , giving rise to power conversion efficiency enhancements from 0.7 to 1.9 % [4].
- device modelling: electromagnetic modelisation of the active area allowed us (collaboration with ERT Photovoltaïque, University of Angers) to further optimize the device design in order to enhance power conversion efficiencies [5,6].
Nowadays new design of the devices can improve device stability, with a tenfold lifetime enhancement in open air.

Our current work focuses on polymer / carbon nanotube composites, which can potentially show improved transport properties of charge carriers, especially through electrical orientation of the nanotubes.
A last, our very recent studies on P3HT-PCBM blends allowed us to achieve organic solar cells with power conversion efficiencies in the order of 5 %.

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