Design and fabrication of organic solar cells dedicated for a use at high temperatures for application in a hybrid PV-CSP systems

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Hybrid solar photovoltaic/thermal power systems offer the possibility of dispatchable, low-cost, efficient and reliable solar electricity production. However, the main part of the collected solar radiation is converted into heat, increasing PV-cell temperature and, therefore, reducing PV-cell efficiency. The recent theoretical studies have demonstrated the potential of this type of hybrid system with a possible compromise between the two systems (PV and CSP) at around 250°C. Another distinctive feature of this application is its dependence on the available solar spectrum, primarily focusing on the UV-Visible part of the solar spectrum for the PV component. As such, due to this specification, organic solar cells (OSCs) can be considered as interesting PV system to explore in combination with CSP. While photovoltaic conversion efficiencies of around 18% have been achieved for these types of devices, this morphology is generally thermodynamically unstable and leads to microstructural changes under thermal stress (phase segregation) that are detrimental to exciton dissociation, thus resulting in a rapid degradation of photoconversion efficiencies. In recent years, an elegant approach to overcome this instability involves the development of OSCs composed of a single component (SCOSCs).

We decide to exploit the SCOSCs approach in the development of PV system combining: 1) high stability at high temperature for compatibility with CSP system and 2) absorption in the UV-Visible region of solar spectrum. These SCOSCs will be developed from molecular architecture combining donor and acceptor moieties. Donor and acceptor units are chemically linked together in the same molecule and can self-organize into ordered structures that enables efficient charge transport and low charge recombination. The project is divided in 3 parts: 1) Design, synthesis and characterization of organic material for PV solar cells, 2) Fabrication and characterization of PV solar cells, 3) Optimizing of PV solar cells. Herein, we will describe the synthesis, the thermal, optical properties and preliminary photovoltaic properties of the material.

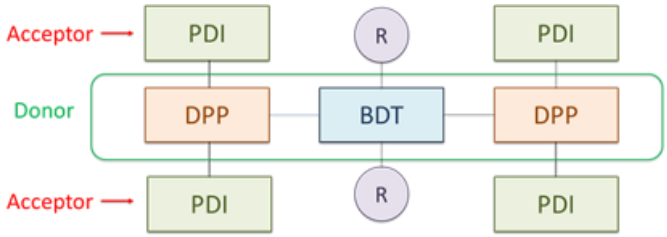

Fig. 1. Structure of material for PV organic solar cells

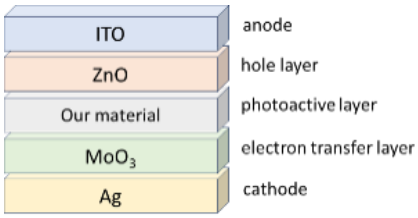

Fig. 2. Structure of PV organic solar cells