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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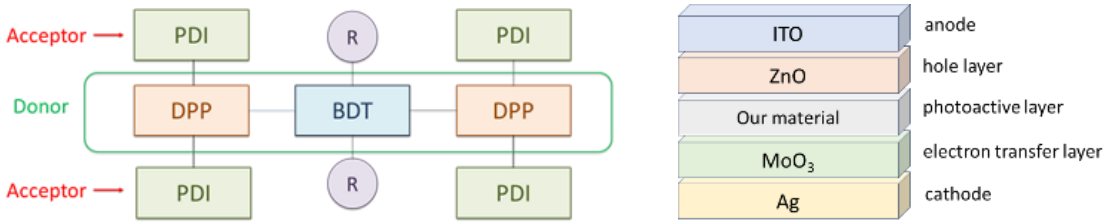
Hybrid solar photovoltaic/thermal power systems offer the possibility of dispatchable, low-cost, efficient and reliable solar electricity production. However, the main part of the collected solar radiation is converted into heat, increasing PV-cell temperature and, therefore, reducing PV-cell efficiency. 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. 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, their morphology is generally thermodynamically unstable (phase segregation), which is detrimental to exciton dissociation, resulting in a rapid degradation of photoconversion efficiency. 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 πcombining: 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 which are chemically linked together in the same molecule and can self-organize into ordered structures that enables efficient charge transport and low charge recombination. For the first material, we follow the concept of combination of PDI (perylene diimide) as an acceptor with DPP (diketopyrrolopyrrole) and BDT (benzodithiophene) as a donor based on the reported superior electron-transporting properties. The project couples 2 parts: 1) Design, synthesis and characterization of two types of organic material for PV solar cells: small molecules and polymers and 2) Fabrication and characterization of PV solar cells. Herein, we will describe the synthesis, the thermal, optical properties and preliminary photovoltaic properties of our material.



Key Words: Organic solar cells (OSCs), photovoltaic, single component organic solar cells (SCOSCs), π-conjugated materials