Polymer-based bulk-heterojunction solar cells

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Solar energy is an abundant and renewable source of energy. In 2017, the part of renewable energy generated by photovoltaic technologies represented only 1.5% of our global electricity production[1]. Addressing the challenge of converting solar energy efficiently into electricity by developing low-cost technologies is a hot research topic. While crystalline silicon massively dominates the market, a wide range of emerging technologies based on abundant materials are now emerging including hybrid organic-inorganic, fully organic and dye sensitized solar cells.

Organic bulk-heterojunction solar cells also known as polymer solar cells, which traditionally consist of a blend of electron donor polymers and acceptor fullerene derivatives, can notably be mentioned[2].

After a brief lecture explaining the basic principles and the key parameters in organic solar cells, the students will fabricate solar cells using device fabrication techniques available at the CEA Hybriden Facilities.

This practical project will focus on the preparation of the adequate substrates (Glass and Indium Tin Oxyde) and the deposition of interfacial layer (PEDOT-PSS) by wet processing to improve the electrical performances of the devices. The students will prepare the formulations for the deposition of the active layers that consist in a blend of conjugated polymer donor such as Poly(3-hexythiophene) (P3HT) with a fullerene acceptor like [6, 6]-phenyl-C61-butyric acid methyl ester (PCBM) or a non-fullerene acceptor molecule. They will also perform the thermal evaporation of the cathode material (Ca/Al or Ag).

After the fabrication of the devices, they will measure electrical properties of their solar cells in a glove box under solar simulator and see how they perform under standard illumination (after calibration of the equipment).

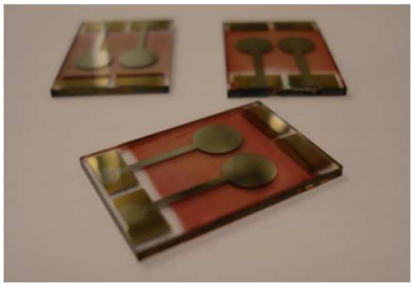

Figure 1: Standard bulk hetero-junctions solar cells made during this practical.

(1) Canadian Electronic Library (Firm). *Renewables 2017: Global Status Report.*; 2017.
(2) Caffy, F.; Delbosc, N.; Chávez, P.; Lévêque, P.; Faure-Vincent, J.; Travers, J.-P.; Djurado, D.; Pécaut, J.; Grévin, B.; Lemaitre, N.; et al. Synthesis, Optoelectronic Properties and Photovoltaic Performances of Wide Band-Gap Copolymers Based on Dibenzosilole and Quinoxaline Units, Rivals to P3HT. *Polym. Chem.* **2016**, *7* (25), 4160–4175.

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