Palomares Research Group

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Visiting students: Tsung-Yu Hsieh / David Millan (July-Dec.) / Eyyup Yalcin (May-Aug.) /Abdel Nazeer Soliman (July) / Caner Carakaya (May-July) Raimon Terricabres (July-Aug.)
Visiting postdocs: Mustafa Can (March-Aug.)

Abstract

The research on materials for energy and bio-applications are at the central core of our research. Since the group formation in 2006, our particular interest has been the development of third generation solar cells (DSSC, OPV, QDSC and Perovskite materials) and the detailed study of the interfacial charge transfer reactions that limit the efficiency on these novel generation of solar cells.
On the other hand, we are devoted also to the development and study of novel fluorescence semiconductor materials for biomedical applications that advance on the application of nano-science to medicine.

During 2017 our group has focussed on the synthesis and characterization of organic semiconductor molecules that can be used as hole transport materials in solution processed perovskite solar cells. **Scheme 1** illustrates the molecular structure of one of the different families of molecules that we have synthesised.

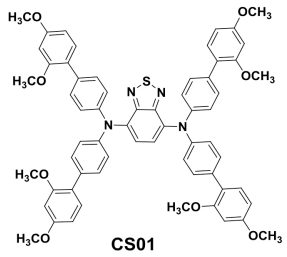

Figure 1: Benzothiadiazole as central core for efficient electron donor in bulk-heterojunction organic solar cells.

Moreover, we have continued our work on the application of dye sensitized solar cells to reach above 10% light-to-energy conversion target using our organic dues as part of our deliverable list in our MICINN (CTQ2016-80042-R) project and collaboration with CEA (France) **Figure 2.**

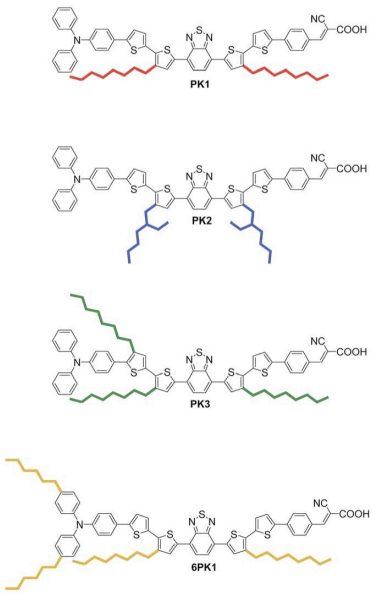

Figure 2. The set of organic dyes studied.

Palomares group has also achieved within (CTQ2016-80042-R) record efficiencies for methyl ammonium lead iodide (MAPI) perovskite solar cells using different semiconductor polymers as HTM (Hole Transport Materials). The MAPI, when processed either from solution leads to a solid with perovskite structure; for this reason these novel type of solar cells are known as perovskite solar cells.

The group has focused not only on making the most efficiency devices (19% under sun-simulated conditions of 100mW/cm^2@ 1.5 AM G) but also to characterize for the first time the interfacial charge transfer recombination reactions that prevent the MAPI perovskite solar cell to reach its maximum theoretical efficiency of 25%. **Figure 3** illustrated several current vs voltage curves for MAPI perovskite solar cells and Al_2O_3 /m-TiO_2 modified MAPI solar cells.

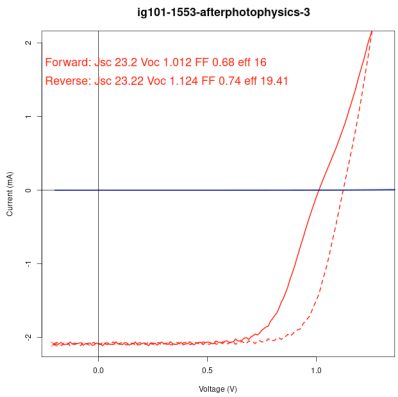

Figure 3. Current density vs voltage curve at 1 sun (100mW/cm^2@ 1.5 AM G) and in the dark for a perovskite solar cell fabricated at ICIQ from solution processed methods.

Group Competitive Research Projects.

1. AGAUR-SGR-2014-763
2. MICINN CTQ-2016-80042R
3. SGR-project-207 2009
4. La Caixa Impuls 2017-2018

Group Industrial Research Projects.

1. HYPRINT-Torrecid
2. Perovskite materials. EURECAT.

Articles

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L Buglioni, P Riente, E Palomares, MA Pericàs.
European Journal of Organic Chemistry **2017** (46), 6986-6990.

‘Dithienylpyrazine-based photosensitizers: Effect of swapping a connecting unit on optoelectronic properties and photovoltaic performances’
M Godfroy, et al.
Dyes and Pigments, **2017**, 146, 352-360

‘Understanding the limiting factors of solvent annealed Small molecule bulk heterojunction organic solar cells from a chemical perspective’
A Viterisi, et al.
ChemSusChem, **2017**,10, 3118-3134.

‘Charge Injection, Carriers Recombination and HOMO Energy Level Relationship in Perovskite Solar Cells’
J Jiménez-López, W Cambarau, L Cabau, E Palomares
Scientific reports, **2017**, 7 (1), 6101.

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Advanced Energy Materials, **2017**, 7 (10)

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M Méndez, E Palomares.
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‘Side chain engineering of organic sensitizers for dye-sensitized solar cells: a strategy to improve performances and stability’
D Joly, M Godfroy, L Pellejà, Y Kervella, P Maldivi, S Narbey, F Oswald
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‘Cyclopentadithiophene organic core in small molecule organic solar cells: morphological control of carrier recombination’
R Domínguez, NF Montcada, P de la Cruz, E Palomares, F Langa.
Physical Chemistry Chemical Physics, **2017**, 19 (5), 3640-3648