Palomares Research Group

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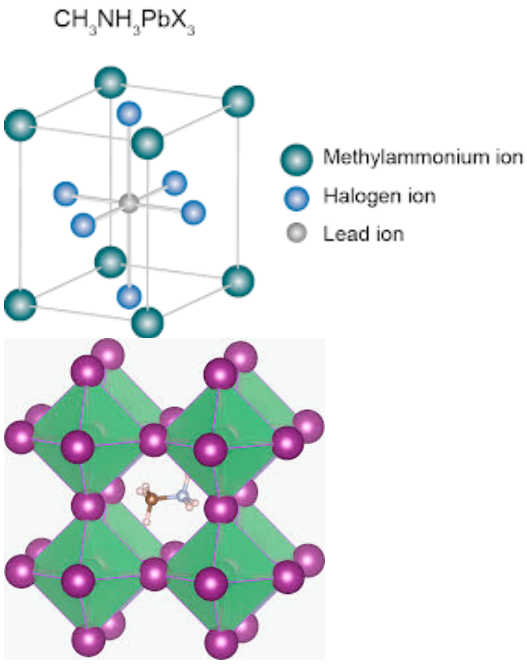
Abstract

The research on carbon neutral renewable energy sources based upon the combination of solution processing methods, nanostructured semiconductor inorganic materials and optoelectronic device physics is a powerful interdisciplinary platform for scientific research in the 21st Century. Since the group formation in 2006, our particular interest has been the development of earth abundant and molecular based solar cells 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 also are devoted to the development and study of novel materials for biomedical applications that advance on the application of nano-science to medicine.

During 2016 our group has focussed processing and fabrication of solar cells combining organic semiconductor molecules and hybrid perovskite semiconductors. **Scheme 1** the molecular structure of the methyl ammonium lead perovskite (MAPI) which has lead to efficiencies over 19% in our group. The highest efficiency reported is above 22% under standard measured conditions..



Scheme 1: Molecular structure and X-ray structure of the MAPI used in efficient perovskite solar cells.

Moreover, we have continued our work on the application of organic solar cell using biomimetic organic semiconductor molecules, such as porphyrins. **Figure 1.**

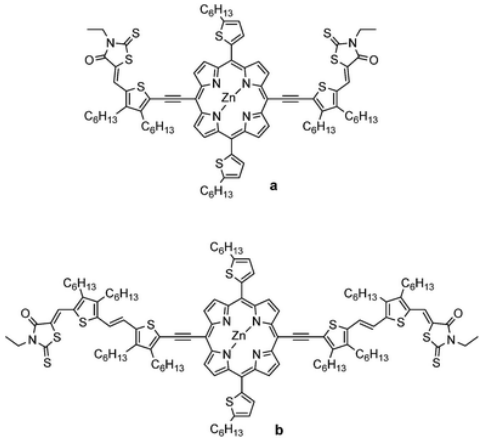


Figure 1. Molecular structures of two porphyrins used in organic solar cells as electron donor materials.

Our group has also started to investigate the use carbon dots as selective contact electrodes and light emitting materials (Figure 2) .

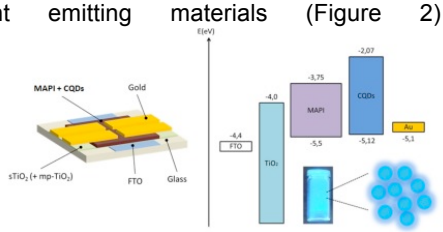
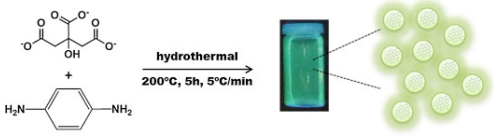


Figure 2. Hybrid solar cell using carbon dots as efficient selective contacts for electrons.

Carbon materials are attracting very much interest as they hold the promise for a new revolution in the new generation of electronics and opto-electronic devices.
Our group have developed an easy-to-use method that allows the synthesis of high purity C-dots (carbon dots) in large quantities (Scheme 1)



Scheme 1. Hydrothermal synthesis of luminescent C-dots at ICIQ.

Last but not least and looking into the future of perovskite materials , the group has started the synthesis of stable quantum dots with high luminescence properties to be used either in LED's and/or solar cells (Figure 3).

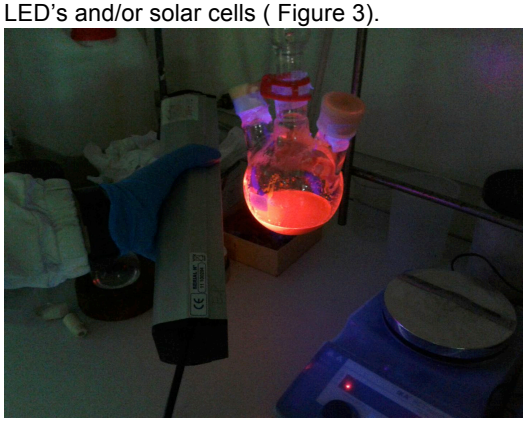


Figure 3. Luminescent perovskite quantum dots upon excitation using UV light.

Group Competitive Research Projects.

1. MINECO CTQ-2016-80042-R
2. EU-ERCstg PolyDot
3. 2014 SGR-project-763
4. MINECO Redes de excelencia. Red REFLEXIO.

Group Industrial Research Projects.

1. Solution processed devices-EURECAT
2. Synthesis of Quantum dots. Torrecid.

Articles

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2. Arrechea, Susana; Clifford, John N; Pellejà, Laia; Aljarilla, Ana; de la Cruz, Pilar; Palomares, Emilio; Langa, Fernando; ,**Charge recombination losses in thiophene-substituted porphyrin dye-sensitized solar cells** ,Dyes and Pigments,126,.147-153,2016.

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4. Reig, Marta; Bubniene, Giedre; Cambarau, Werther; Jankauskas, Vygintas; Getautis, Vytautas; Palomares, Emilio; Martínez-Ferrero, Eugenia; Velasco, Dolores; ,**New solution-processable carbazole derivatives as deep blue emitters for organic light-emitting diodes**, RSC Advances,6,11,9247-9253,2016.

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6. Paulo, Sofia; Stoica, Georgiana; Cambarau, Werther; Martinez-Ferrero, Eugenia; Palomares, Emilio; ,**Carbon quantum dots as new hole transport material for perovskite solar cells**, Synthetic Metals,222,,17-22,2016.

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8. Morán, Gabriela; Arrechea, Susana; de la Cruz, Pilar; Cuesta, Virginia; Biswas, Subhayan; Palomares, Emilio; Sharma, Ganesh D; Langa, Fernando; ,**CuSCN as selective contact in solution-processed small-molecule organic solar cells leads to over 7% efficient porphyrin-based device**, Journal of Materials Chemistry A,4,28,11009-11022,2016.

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10. Paulo, Sofia; Palomares, Emilio; Martinez-Ferrero, Eugenia; ,**Graphene and Carbon Quantum Dot-Based Materials in Photovoltaic Devices: From Synthesis to Applications**,Nanomaterials,6,9,157,2016.

11. Montcada, Núria F; Arrechea, Susana; Molina-Ontoria, Agustín; Aljarilla, Ana I; de la Cruz, Pilar; Echegoyen, Luis; Palomares, Emilio; Langa, Fernando; ,**High photo-current in solution processed organic solar cells based on a porphyrin core A-π-D-π-A as electron donor material**, Organic Electronics,38,,330-336,2016.

12. Arrechea, Susana; Aljarilla, Ana; de la Cruz, Pilar; Palomares, Emilio; Sharma, Ganesh D; Langa, Fernando; **,Efficiency improvement using bis (trifluoromethane) sulfonamide lithium salt as a chemical additive in porphyrin based organic solar cells**, Nanoscale,8,41,17953-17962,2016.

13. Wang, Suxiao; Ryan, James William; Singh, Amita; Beirne, Jason Gerard; Palomares, Emilio; Redmond, Gareth. **Encapsulation of MEH-PPV:PCBM Hybrids in the Cores of Block Copolymer Micellar Assemblies: Photoinduced Electron Transfer in a Nanoscale Donor-Acceptor System.** Langmuir, 32(1), 329-337, 2016.