Synthesis and Characterization of Functional Organic Dyes for Applications in Hybrid Photovoltaic Cells

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Stage pouvant se poursuivre en thèse : Oui

Résumé :

Dye-sensitized solar cells (DSSC) are photovoltaic devices that can be manufactured using low-cost processing techniques, besides they can achieve relatively high power conversion efficiencies compared to other emerging technologies. Recently DSSC technology has proven its potential at the industrial level through the development of semi-transparent colorful, efficient and stable solar panels that have been integrated in buildings. Typically, these solar cells are composed by four major components: a mesoporous metal oxide deposited onto a transparent electrode (photo-anode), a sensitizer (organic dye), an electrolyte that is usually a liquid and a counter electrode. The organic dye is probably the most important element of these solar cells since it is responsible for the absorption of light and the injection of the electrons in the metal oxide semiconductor. Usually the dyes that are employed in DSSC are based on Ruthenium complexes, however due to the low natural abundance of Ruthenium it is mandatory to develop alternative dyes without rare elements for future application of the technology.

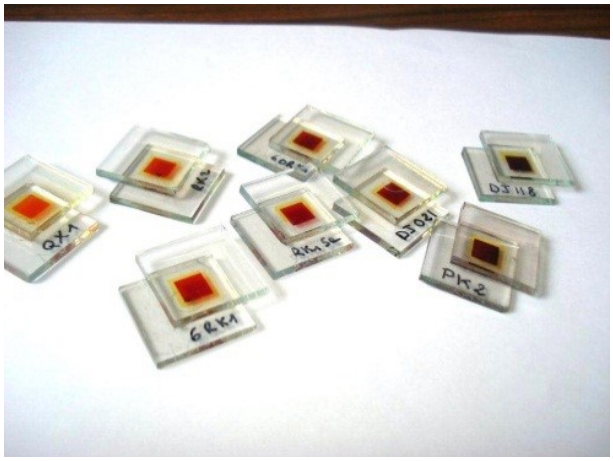
This subject deals with the development of a new class of organic dyes for solar energy conversion. The candidate will develop synthetic strategy to obtain new organic dyes, he/she will characterize the dyes before to use them in devices.

Sujet détaillé :

In this project we propose to design and develop new class of organic dyes to be integrated in hybrid solar cells. In the first part of this project the candidate will develop original synthetic strategies to obtain pi-conjugated molecules based on a specific class heterocyclic chromophores developed recently in our laboratory (patent pending). Then he/she will study the optoelectronic properties of the dyes under various conditions using a large palette of techniques available in the laboratory. He/She will use UV-Vis spectroscopy to study the optical properties of the compounds in solution and after grafting on TiO2 mesoporous electrodes. The candidate will employ electrochemistry to determine the energy levels positions of the molecules. The most promising dyes will then be employed to fabricate testing devices in order to evaluate their photovoltaic performances under various illumination conditions.

[1] Joly D, et al. "Metal free organic sensitisers with narrow absorption in the visible for solar cells exceeding 10% efficiency". Energy & Environmental Sciences, 2015, DOI: 10.1039/C5EE00444F
http://pubs.rsc.org/en/content/articlelanding/2015/ee/c5ee00444f

[2] D. Joly, et al. « A Robust Organic Dye for Dye Sensitized Solar Cells Based on Iodine/Iodide Electrolytes Combining High Efficiency and Outstanding Stability» , Sci. Rep. , 2014, DOI:10.1038/srep04033.
http://www.nature.com/srep/2014/140207/srep04033/full/srep04033.html



Compétences requises :

Synthetic organic chemistry, Physico-Chemistry, Spectroscopy, Organic and hybrid electronics