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Title | Development of photochromic photosensitizers for a new generation of solar cells with dynamic optical properties

Abstract | Among emerging photovoltaic technologies, Dye-Sensitized Solar Cells (DSSCs) have already demonstrated power conversion efficiencies (PCEs) over 15%, and good stability with lifetimes over 10 years. These devices can be colourful and semi-transparent, which makes them very appealing for Building-Integrated Photovoltaics (BIPV).[1] However, for integration as windows, a trade-off has often to be found between transparency and efficiency.[2]

In this communication, we will present our work aiming at developing photochromic dyes specifically designed for use in photovoltaic devices. We will present the synthetic routes to access to these photochromic photosensitizers and we will detail their optoelectronic properties. We will show that we can use them to fabricate a new generation of semi-transparent solar cells and modules capable of self-adjusting their optical transparency and their photovoltaic energy conversion as a function of light intensity. [3-4-5] (Figure 1)

The structure-properties relationships of this new class of functional photosensitizer will be discussed and we will present strategies to improve their coloration-discoloration kinetics, optical properties and photovoltaic performances. [6-7]

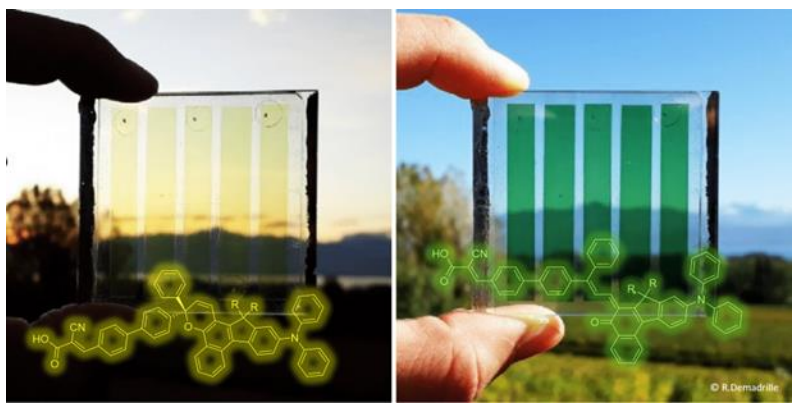

Figure 1: Example of 23cm² mini-module based on a photochromic dye under various sunlight conditions (developed in collaboration with Solaronix Company)

Keywords: Photochromic dyes, Dye-sensitized solar cells, Photovoltaics

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Bio | Dr Renaud DEMADRILLE is Director of Research and team leader at the Atomic and Alternative Energies Commission (CEA) in France. He received his PhD in organic chemistry in 2000 from the University of Aix-Marseille II in France with a grant from PPG Industries and Essilor International. After his PhD, he spent one year in the R&D department of an international chemical company to work on the development of functional polymer materials and the understanding of their degradation process. Then he joined CEA as a postdoctoral fellow to synthesize semiconducting polymers for organic photovoltaics before being appointed in 2005 as a permanent researcher. His research focuses on the synthesis and the characterization of new pi-conjugated molecules and macromolecules for organic and hybrid photovoltaics and thermoelectricity. In 2018, he was recipient of the chemistry energy prize of the French Society of Chemistry, and in 2019, he was awarded an ERC “Advanced Grant” to develop photochromic solar cells. Since 2020, he is Associate Editor of two journal from the Royal Society of Chemistry: Journal of Materials Chemistry C and Materials Advances.

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