



**HAL**  
open science

## How to reconcile photovoltaic and photochromic properties in a solar cell? Contribution of photochromic organic dyes

Valid-Mwatati Mwalukuku, José-María Andrés Castán, Johan Liotier, Samuel Fauvel, Pascale Maldivi, Antonio J. Riquelme, Juan A. Anta, Renaud Demadrille

### ► To cite this version:

Valid-Mwatati Mwalukuku, José-María Andrés Castán, Johan Liotier, Samuel Fauvel, Pascale Maldivi, et al.. How to reconcile photovoltaic and photochromic properties in a solar cell? Contribution of photochromic organic dyes. CpiC-12 - Computing  $\pi$ -Conjugated Compound, Gabriele D'Avino; Xavier Blase; Luigi Genovese, May 2022, Grenoble, France. hal-04813225

**HAL Id: hal-04813225**

**<https://hal.science/hal-04813225v1>**

Submitted on 1 Dec 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

# How to reconcile photovoltaic and photochromic properties in a solar cell? Contribution of organic photochromic dyes.

**Valid M. Mwalukuku,<sup>a</sup> José-Maria Andres Castán,<sup>a</sup> Johan Liotier,<sup>a</sup>  
Samuel Fauvel,<sup>a</sup> Pascale Maldivi,<sup>a</sup> Antonio J. Riquelme,<sup>b</sup> Juan A. Anta,<sup>b</sup>  
Renaud Demadrille.<sup>\*a</sup>**

*a) Univ. Grenoble Alpes, CEA, CNRS, IRIG, SyMMES, F-38000 Grenoble*

*b) University Pablo de Olavide, 41013 Sevilla, Spain*

*\* [renaud.demadrille@cea.fr](mailto:renaud.demadrille@cea.fr)*

Among photovoltaic technologies, Dye-Sensitized Solar Cells (DSSC) are hybrid solar cells that contain a wide band-gap metal oxide semi-conductor usually photosensitized by an organic dye. In the last years, their power conversion efficiency has overcome 14% and they have demonstrated their capacity to perform under low-light environments. Besides their lifetime is demonstrated over 10 years.<sup>1</sup>

DSSCs can be semi-transparent and colourful which makes them interesting for use as windows or light-shading systems.<sup>1-2</sup> Unfortunately, when developing semi-transparent DSSCs, a trade-off has always to be found between transparency and efficiency. The colour and level of transparency are fixed during the fabrication process and they mainly rely on the choice of the photosensitizer and the thickness of the metal oxide mesoporous layer.

For the massive integration of DSSCs in buildings as windows, DSSCs showing variable and self-adaptable transparency with the daylight intensity would be very valuable. To tackle this challenge, we recently proposed a new approach based on the development of photochromic sensitizers. In this communication, we will present our strategy to design dyes reconciling photochromism and photovoltaic properties. We will discuss the structure-properties relationships of these photochromic molecules and we will show how they can be employed to develop a new generation of functional solar cells capable to change their colour, self-adjust their transparency and their photovoltaic energy conversion depending on the intensity of the daylight.<sup>3</sup> We will also discuss the factors influencing the photochromic behaviour and the photovoltaic properties of this new class of dyes in devices.<sup>4</sup>

## References

1. D. Joly, L. Pelleja, S. Narbey, F. Oswald, T. Meyer, Y. Kervella, P. Maldivi, J.N Clifford, E. Palomares, R. Demadrille, *Energy Environ. Sci.*, 8, 2010-2018, (2015)
2. M. Godfroy, J. Liotier, V. M. Mwalukuku, D. Joly, Q. Huaultme, L. Cabau, C. Aumaitre, Y. Kervella, S. Narbey, F. Oswald, E. Palomares, C. A. Gonzalez Flores, G. Oskam, R. Demadrille, *Sustainable Energy Fuels*, 5, 144, (2021).
3. Q. Huaultmé, V. M. Mwalukuku, D. Joly, J. Liotier, Y. Kervella, P. Maldivi, S. Narbey, F. Oswald, A. J. Riquelme, J. A. Anta, R. Demadrille, *Nature Energy*, 5, 468–477, (2020).
4. J. Liotier, V.M. Mwalukuku, S. Fauvel, A. J. Riquelme, J. A. Anta, P. Maldivi, R. Demadrille, *Sol. RRL*, 2100929, (2021).

This work was funded under the European Union's Horizon 2020 research and innovation program (grant agreement number 832606; project PISCO).