



**HAL**  
open science

## Push-pull photochromic dyes for use in semi-transparent solar cells with dynamic optical properties

S. Fauvel, A. J. Riquelme, J. Liotier, J.-M. Andres Castán, V. M. Mwalukuku, Y. Kervella, C. Aumaître, S. Narbey, P. Maldivi, Renaud Demadrille

### ► To cite this version:

S. Fauvel, A. J. Riquelme, J. Liotier, J.-M. Andres Castán, V. M. Mwalukuku, et al.. Push-pull photochromic dyes for use in semi-transparent solar cells with dynamic optical properties. Photosciences 2024 - Réunion des sociétés françaises de photobiologie, photochimie, photophysique et des photosciences., May 2024, Grenoble, France. hal-04754727

**HAL Id: hal-04754727**

**<https://hal.science/hal-04754727v1>**

Submitted on 26 Oct 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.

Public Domain

## Push-pull photochromic dyes for use in semi-transparent solar cells with dynamic optical properties

S. Fauvel<sup>1</sup>, A. J. Riquelme<sup>1</sup>, J. Liotier<sup>1</sup>, J.-M. Andres Castán<sup>1</sup>, V. M. Mwalukuku<sup>1</sup>, Y. Kervella<sup>1</sup>, C. Aumaître<sup>1</sup>, S. Narbey<sup>2</sup>, P. Maldivi<sup>1</sup>, R. Demadrille<sup>1\*</sup>

<sup>1</sup> Univ. Grenoble Alpes, CEA, CNRS, Grenoble INP, IRIG, SyMMES, Grenoble, France

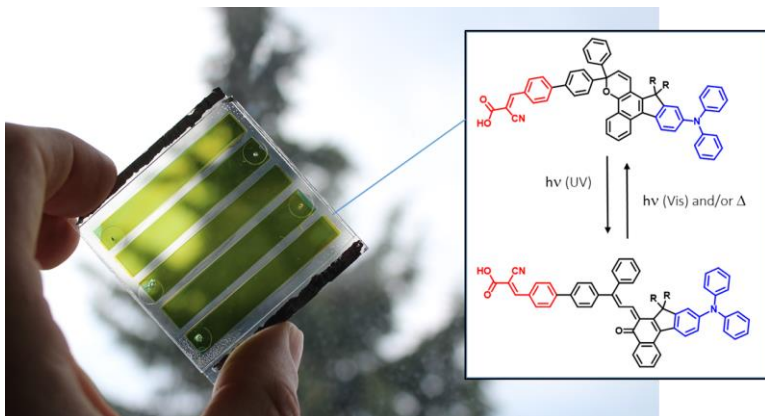
<sup>2</sup> Solaronix SA, Aubonne, Vaud, Switzerland

Email: renaud.demadrille@cea.fr

Photochromic solar cells are a new type of photovoltaic device with dynamic optical properties that could potentially be used in glazing and buildings in the future. These solar cells exhibit changes in colour, transparency and photovoltaic performance in response to sunlight conditions.

In 2020, we have shown that the design of push-pull photochromic photosensitizers of the diphenyl-naphthopyran series and their use in a dye-sensitised solar cell configuration is an effective strategy for achieving solar cells with light-driven optical properties. This approach resulted in excellent reversibility of the colouring and decolouring process, as well as efficiencies of the order of 4% for the solar cells. We have also shown that these dyes can be used to fabricate semi-transparent mini-modules with a maximum power output of the order of 35mW. [1]

Recently, we have sought to develop push-pull photochromic dyes with faster bleaching kinetics and better optical properties. In this work, we will outline the synthetic routes used to prepare these photochromic dyes and detail their optoelectronic properties and structure-property relationships [2-3]. In particular, we will show that by appropriate molecular design, it is possible to obtain molecules that exhibit a better photochromic behaviour in devices [4]. We will also present the synthesis and characterisation of new dyes that show a better tuning of their spectra to the photopic response of the human eye allowing producing semi-transparent mini-module with an average visible transmittance varying between 66% and 50% and a colour-rendering index of around 95 in both the uncoloured and coloured states. [5]



**Figure:** Image of a semi-transparent mini-module based on a push-pull photochromic dye.

### Acknowledgements

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

### References

1. Q. Hualmé et al. *Nature Energy*. **2020**, 5, 468-477
2. J. Liotier et al., *Solar RRL*. **2021**, 2100929
3. J.M. Andres-Castán., *Mater. Chem. Front.*, **2022**, 6, 2994-3005
4. V. M. Mwalukuku et al. *Adv. Energy Mater.*, **2023**, 2203651
5. S. Fauvel et al. *Chem. Sci.*, **2023**, 14, 8497–8506.