Push-Pull dyes for p-type Grätzel cells: a time resolved fluorescence study

Valentin Mafféïs[1], Thomas Gustavsson[1], Bruno Jousselme[1]

[1]*Université Paris Saclay, CEA, CNRS, Institut Rayonnement Matière de Saclay, F-91191 Gif-sur-Yvette, France*

E-mail: valentin.maffeis@cea.fr

The efficiency of dye sensitized solar cells may be improved by using a photo-cathode based on a p-type semi-conductor in addition to the well-optimized photo-anode. The main limitation of such tandem cells is the low photocurrent in the photo-cathode, due to the fact that the kinetics of charge injection, charge recombination and dye regeneration are not well adjusted. A better understanding of how the sensitizer's structure influences these dynamics is therefore needed. With this in mind, we have undertaken a study of a novel organic dye with a donor/acceptor π-bridged structure based on naphthalimide[1] and triphenylamine moieties,[2] suitable for photocathode sensitization. We have investigated its photodynamics in solution by time-resolved fluorescence spectroscopy from the fs to the ns timescale using two different detection techniques; fluorescence upconversion and time-correlated single photon counting.

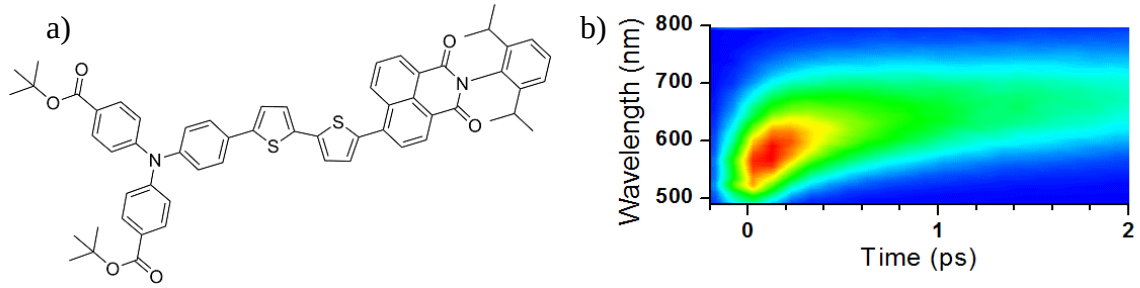

Figure 1. a) Structure and b) Time-resolved fluorescence spectra in DMF of the dye studied.

We found that the excitation of the first ππ* state leads to a branching between an intramolecular charge transfer state (ICT), with an efficient non radiative relaxation path ($\tau < 100$ ps), and a less charged state which lifetime is on the ns timescale. The branching ratio depends on the solvent polarity. Moving to mesoporous oxides films, which cannot be considered as a homogenous environment and are optically dense, we use a setup based on reflexion geometry. This allows fluorescence studies of opaque and scattering surfaces with femtosecond time resolution, ideal for the study of the fast dynamics involved in model solar cells.

Funding: DSM-energie E113-9_FLUMVIR CEA Saclay

Acknowledgement: Thanks to Jean-Manuel Raimundo and Romain Brisse for the synthesis.

References:

[1] T. Inari, M. Yamano, A. Hirano, K. Sugawa, J. Otsuki, *J. Phys. Chem. C*, **2014**, 118, 5178

[2] E. Ishow, G. Clavier, F. Miomandre, M. Rebarz, G. Buntinx, O. Poizat, *Phys. Chem. Chem. Phys.*, **2013**, 15, 13922