Ultrafast Dynamics at Nano-Structured Hybrid Photovoltaic Interfaces

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In hybrid photovoltaic devices with nano-structured absorber interlayers embedded between low-cost electron and hole conducting electrodes the main functional constraints are relocated to the charge separating interface. A critical factor is the reduced lifetime of the photo-carriers subject to premature recombination mediated by an increased number of electronic states at the enhanced inner surface. For an advanced understanding and design of efficient light harvesting thin-film architectures it is appropriate to determine the reaction dynamics at the interface and to identify the principal loss channels competing with charge carrier escape. Femtosecond VIS-NIR transient absorption (TA) spectroscopy and time-resolved optical pump terahertz probe conductivity (OPTP) is applied to organic, inorganic/organic and semiconductor hybrid films to characterize the temporal behavior and as a feedback tool for the differently prepared structures and substructures. The non-contact laser spectroscopy gives valuable insight into charge carrier lifetimes that sensitively depend upon the chemical composition, preparation parameters (i.e. temperature induced topology) and energy level line-up of the photo-active hybrid film.

“The Ultrafast Temporal and Spectral Characterization of Electron Injection from Perylene Derivatives into ZnO and TiO2 Colloidal Films”
J. M. Szarko, A. Neubauer, A. Bartelt, L. Socaciu-Siebert, F. Birkner, K. Schwarzburg, T. Hannappel, R. Eichberger;
J. Phys. Chem. C 112, 10542 (2008)

"Influence of TiO2/Perylene Interface Modifications on Electron Injection and Recombination Dynamics"
A Bartelt, R. Schütz, A. Neubauer, T. Hannappel, R. Eichberger;
J. Phys. Chem. C 113, 2123 (2009)