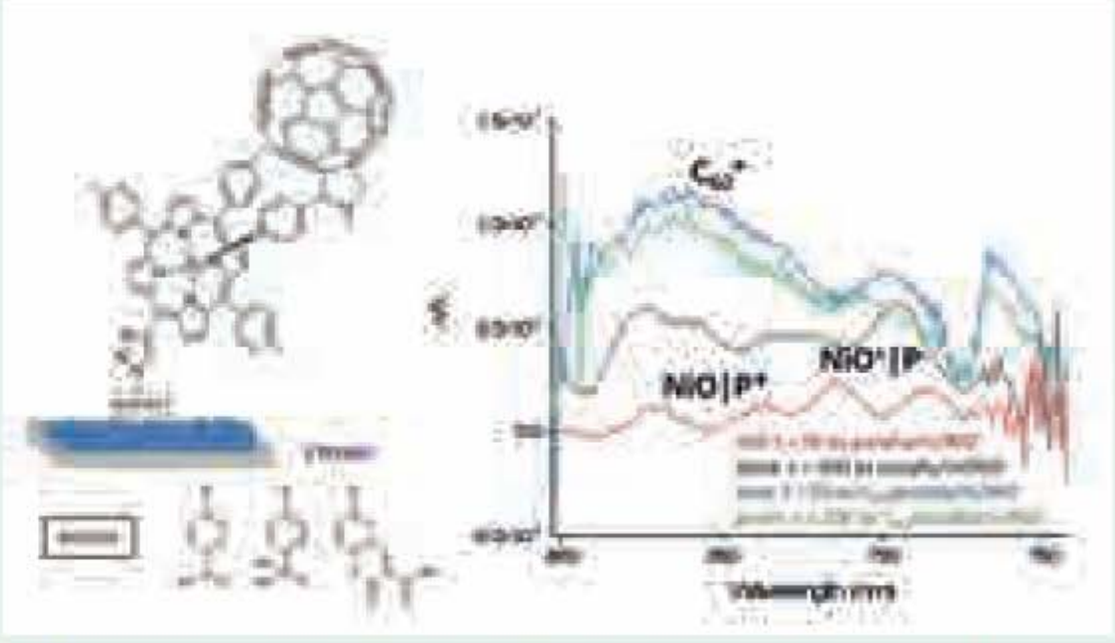
Probing Charge-transfer Dynamics of Porphyrin-C_{60} Dyes and Bodipy Polymers for Solid State Tandem Solar Cells

E.A. Gibson, G.H. Summers, F.A. Black *(Energy Materials Laboratory, Newcastle University, UK)*

I.P. Clark, I. Sazanovich *(Central Laser Facility, STFC Rutherford Appleton Laboratory, Harwell Campus, Didcot, UK)*

A series of zinc tetraphenyl porphyrin photosensitizers furnished with three different anchoring groups, benzoic acid, phenylphosphonate and coumarin-3-carboxylic acid were prepared using 'click' methodology. Their adsorption behaviour on the electrode surface, kinetics of charge-separation at the dye-electrode and dye-redox mediator interfaces and performance in solar cells is described. The photocurrent of the p-DSCs increased with increasing dye loading and corresponding light harvesting efficiency of the electrodes. Coordinating the zinc to a pyridyl-functionalised fullerene (C_{60}PPy) extended the charge-separated state lifetime from ca. 200 ps to 4 ns and a positive improvement in the absorbed photon to current conversion efficiency (APCE) was observed. Finally, we confirmed the viability of electron transfer from the appended C_{60}PPy to PCBM, a typical electron transporting layer in organic photovoltaics. This has implications for assembling efficient solid-state tandem solar cells in the future.



Left: Porphyrin-Fullerene conjugates for investigation in this project. The porphyrins on the left are functionalised with different anchoring groups to compare the effect of anchoring on electron transfer from NiO to the Porphyrin. The C_{60} derivative is coordinated through the Zn.
Right: Representative spectra at selected time delays of porphyrin 3 (coumarin anchor) anchored to NiO in the presence and absence of C_{60} to show the relevant intermediates in the cascade.

Contact: E.A. Gibson (elizabeth.gibson@newcastle.ac.uk)