

# Tuning electron transfer rates at QD-oxide interfaces

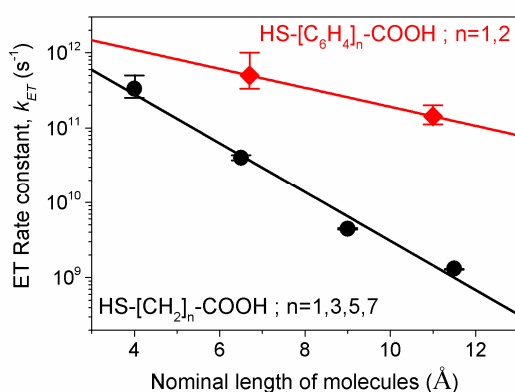
Hai Wang<sup>1,2</sup>, Erik McNellis<sup>1</sup>, Mischa Bonn<sup>1</sup> and Enrique Cánovas<sup>1,\*</sup>

<sup>1</sup> Max Planck Institute for Polymer Research, Mainz, Germany;

<sup>2</sup> Graduate School Material Science in Mainz, University of Mainz, Mainz, Germany.

\*canovas@mpip-mainz.mpg.de

Achieving ultrafast electron transfer (ET) from a sensitizer (donor) to an oxide contact (acceptor) allows boosting efficiencies of novel sensitized solar cells. Ultrafast charge transfer implies that competing recombination processes within the donor can be by-passed (boosting solar cell photocurrent) and that ET can be achieved at no energy cost (boosting solar cell voltage). In this work we control ET rates in donor-bridge-acceptor systems by tuning the electronic coupling strength through the use of selected molecular bridges. Our results, exploiting optical pump-THz probe measurements, show how ET processes can be sped up (or slowed down) on donor-acceptor systems by proper tuning of interfacial chemistry. We prove that commonly employed molecular bridges (based on n-methylene  $[\text{CH}_2]_n$  and n-phenylene  $[\text{C}_6\text{H}_4]_n$  backbones) basically impose a barrier potential for current flow between the quantum dot donor and the oxide acceptor. In this case, the ET process occurs via tunnelling and the ET rates are faster for shorter-unsaturated bridges.



Estimated ET rate constants vs molecular bridge length for n-methylene and n-phenylene based bridges sandwiched in between CdSe QDs and  $\text{SnO}_2$  oxide particles. Solid lines are best fits to  $k_{ET}(d) = k_{ET}(0) \exp[-\beta d]$ . For a given donor-acceptor distance ET rates are faster for unsaturated bridges.

## Reference

Hai Wang, Erik R. McNellis, Sachin Kinge, Mischa Bonn, and Enrique Cánovas, "Tuning Electron Transfer Rates through Molecular Bridges in Quantum Dot Sensitized Oxides" NanoLetters (2013) | DOI: 10.1021/nl402820v