Contribution ID: **232** Type: **Oral Presentation**

Ultrafast charge transfer processes in organic-dye sensitised solar cells

Tuesday, 8 July 2014 11:10 (20 minutes)

Abstract content
   (Max 300 words)
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Dye sensitised solar cells (DSSCs) convert solar energy to electrical energy through the use of a light absorbing dye sensitised onto the surface of a semiconductor. The semiconductor is a highly porous electrodeposited ZnO nanoparticle thin film. An indoline dye is adsorbed to the ZnO as a monolayer. The working cell is sandwiched between two FTO coated glass slides and the circuit is closed with a liquid electrolyte consisting of an iodide/triiodide redox couple. Electrons are photoexcited in the dye and then injected into the conduction band of the ZnO.

Three different indoline dye derivatives DN285, DN216 and DN91 were examined in order to compare their electron injection times. They differ from one another in terms of the alkyl chain length of the second carboxyl anchor group. The electron injection dynamics were measured in the context of fully operational organic-DSSCs with the use of transient absorption spectroscopy in a femtosecond laser pulses pump-probe setup. All the samples were pumped at 530 nm, near their maximum absorption wavelength, and probed with a white light supercontinuum. In addition, the cells were also probed with a compressed pulse of a nonlinear parametric optical amplifier (NOPA) at 650 nm and 700 nm wavelength in order to achieve a better time resolution. Additional measurements were taken under short circuit conditions and with applied external potentials of 1V and -1V in order to stop the electron current.

In macroscopic measurements, such as IV curves, the DSSCs sensitised with different organic dyes produce different short circuit currents. With the help of the transient absorption spectroscopy measurements, more insight can be gained into the fundamental charge transfer processes taking place after photoexcitation for the DSSCs sensitised with the three different dyes.

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Main supervisor (name and email)
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Session Classification: Photonics

Track Classification: Track C - Photonics