

Speaker Karlsruhe Days of Optics & Photonics 2021



Abstract: Charge Generation and Recombination in Non-Fullerene Acceptor Solar Cells

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In organic solar cells, the energetic landscape at the donor-acceptor interface provides the driving force for charge separation. The mechanism of charge separation has been intensively

investigated and debated, and with the recent development of high-efficiency non-fullerene acceptors (NFAs) now surpassing 18% power conversion efficiency, several of the earlier findings obtained on fullerene-based systems have to be revisited on NFA-based systems.

In this presentation, I will discuss our latest views on photophysical processes in NFA-based systems, which my group studies by combined steady-state and transient (ultrafast) spectroscopy. More precisely, we recently addressed the question, how much driving force is required to ensure complete exciton dissociation and efficient charge separation in blends of polymer and small molecular donors with NFAs, including some of the most recent state-of-the-art NFA-based material systems. Interestingly, it appears that it is primarily the ionization energy (IE) offset governing the exciton quenching and charge separation efficiency in NFA-based systems, while the interfacial electron affinity (EA) offset seems to be of lesser importance. The reasons for this observation and implications for future donor / acceptor material design strategies will be discussed.

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Biography:

Frédéric Laquai graduated in Chemistry from the University of Marburg, Germany, in 2003. He was awarded a doctoral degree in Physical Chemistry from the University of Mainz, Germany, in 2006. After a two-years postdoctoral stay at the Cavendish Laboratory in Cambridge (UK), he joined the Max Planck Society, Germany, as Independent Max Planck Research Group Leader at the Max Planck Institute for Polymer Research in Mainz. In February 2015, he moved to the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia as Associate Professor of Material Science and Engineering. In 2016, he was appointed the KAUST Solar Center's (KSC) Associate Director. Since July 2021, he is Full Professor of Applied Physics at KAUST and since August 2021, he is the KSC's Interim Center Director.

His research group focuses on studying photophysical processes in organic and inorganic-organic hybrid materials for photovoltaic and photocatalytic solar energy conversion, primarily by (ultrafast) time-resolved spectroscopic techniques. He has co-authored more than 170 peer-reviewed scientific publications and 3 book chapters.