Sonderforschungsbereich TRR 160
Kohärente Manipulation wechselwirkender Spinanregungen
in maßgeschneiderten Halbleitern
Integrated Research Training Group (IRTG)
Magnetic Condensed Matter - Synthesis, Spectroscopy
and Modelling

Seminarankündigung

Dienstag, 14.01.2020, 14:00 Uhr
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“Triplet Dynamics in Photovoltaic Materials Measured with Time Resolved X-Ray Spectroscopies”

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Abstract:

Singlet exciton fission (SF) is a multiexciton generation process in organic molecules, where an optically excited singlet exciton is converted into two triplet excitons. The exploitation of this mechanism has been shown capable of boosting the efficiency of solar energy conversion, and it has been proposed as a mean for exceeding the Shockley-Queisser limit of efficiency of solar cells. In the last decade, several studies have investigated different chromophores to identify the ones suitable to produce high yield SF and long living triplets. Such studies spanned from the fundamental to the applicative approach, also dealing with the optimization of the interfaces with the other materials in the device in order to achieve an overall increased efficiency of the charge transport. In particular, the study of the dynamics of the triplet states, when formed and transported across all the interfaces, is crucial for modelling the charge transport properties in a working device. Here we present a new experimental approach to measure the triplet dynamics at the picosecond timescale, that uses the advantage of chemical sensitivity with respect to conventional optical techniques, thus offering the possibility of tracking the dynamics of the triplet states across different materials. We exploit the chemical selectivity of X-ray absorption spectroscopy (XAS) and X-ray photoemission (XPS) in an optical pump/X-ray probe experiment at a pump-probe setup that we developed at the Elettra synchrotron. We studied triplet dynamics in pentacene thin films (the prototypical singlet fission material) with lifetime of about 300ps and exciton dynamics in tetracene/CuPc thin films.