SONDERKOLLOQUIUM

AM 11. JANUAR 2016 UM 15 UHR S.T.

IM SEMINARRAUM GUSTAV-MIE-HAUS

ORGANIC-INORGANIC SYSTEMS FOR HIGH-VOLTAGE SOLAR CELLS

Dr. Wolfgang Tress

École Polytechnique Fédérale de Lausanne EPFL

Efficient solar cells need to transform the absorbed photon flux into an electron flux that can be extracted at high electrochemical energy, i.e. at high voltage. Thus, loss of electrons and holes by recombination should be avoided. However, in particular for classical organic solar cells strong non-radiative recombination is a severe but poorly understood problem.
In this talk I discuss the effects of different recombination mechanisms on the open-circuit voltage, using electroluminescence and Fourier-transform photocurrent spectroscopy measurements to distinguish radiative, direct, defect, and surface recombination. I present evidence for delocalized electronic states in organic semiconductors, which is an unexpected discovery, as charge carriers are commonly assumed to be strongly localized on a single molecule.
Five years ago, a novel organic-inorganic material emerged for solar cells: perovskites. Devices fabricated with low-cost solution processing reached a power-conversion efficiency of 21 %. I describe the optoelectronic properties of this material, which is characterized by a high nano-crystallinity. Large emission yields allow for an open-circuit voltage of 1.2 V. Reversible instabilities within the material cause hysteresis in the current-voltage relation, which is explained by a model based on ionic motion.
I conclude with an estimation of the potential of perovskite materials to reach theoretical efficiency limits and their suitability to realize new solar cell concepts.