Fakultät für Mathematik und Physik
Albert-Ludwigs-Universität Freiburg
Physikalisches Institut

SONDERKOLLOQUIUM

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IM SEMINARRAUM GUSTAV-MIE-HAUS

NANOSTRUCTURED ORGANIC AND HYBRID ELECTRONIC MATERIALS FOR LIGHT HARVESTING

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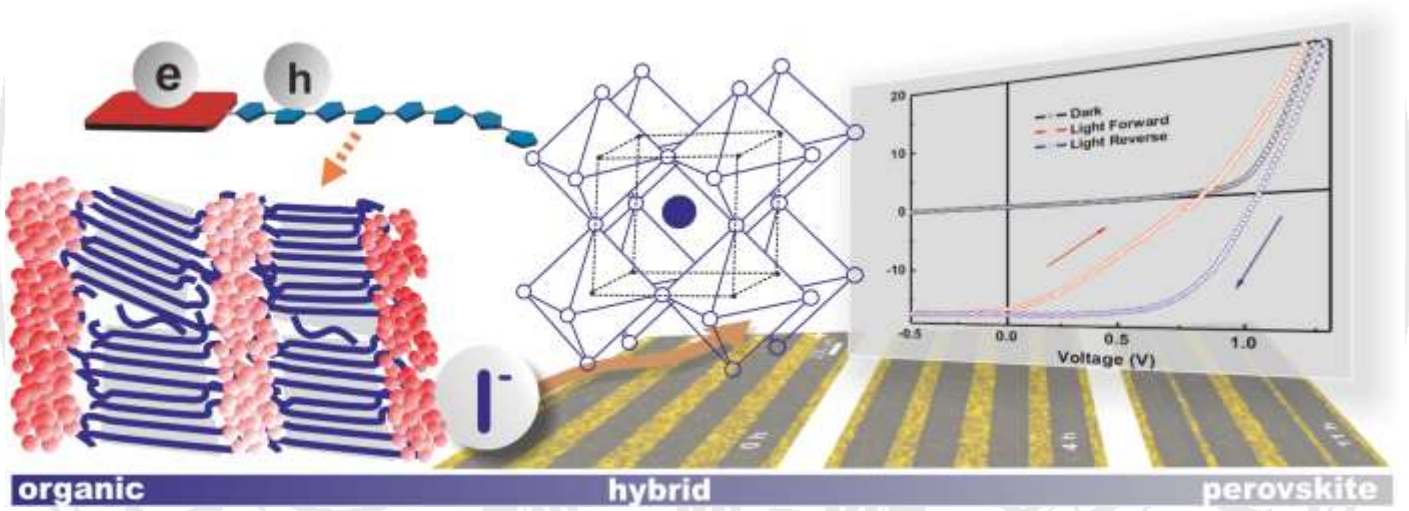
Macromolecular Chemistry I / PNS, Universität Bayreuth



I will overview on the research of organic and hybrid materials that can be used for light harvesting applications. In the first part of this presentation I will give an overview on functional nanostructures based on conjugated polymers. Conjugated polymers bear the potential for large area, printable and flexible electronic applications such as solar cells, transistors and sensors. In particular I will demonstrate poly hexylthiophene which is a ubiquitous hole transporting material and which has been thoroughly investigated and applied in photovoltaic devices for example. Even though P3HT has been studied intensively well-defined, defect-free and monodisperse P3HT has hardly been investigated. Low polydispersity P3HT with molecular weights for example lower than 20kg/mol allow the formation of fully-chain-extended crystals. These self-assemble into a periodic superstructure of amorphous and crystalline domains. From there on I will show techniques how to obtain well-ordered hybrid nanostructures with 10-nm length scales which are highly desired but currently lacking. We make use of the natural length scale (typically 10-15 nm) of the alternating crystalline (lamellar) and amorphous layers that are generally found in semi-crystalline polymers to direct the phase separation of organic materials or direct the growth of a semiconducting metal oxides.

In the second part of this presentation I will introduce the hybrid organic-inorganic perovskite materials based on methylammonium lead halide. Metal-halide perovskite light-absorbers have risen to the forefront of photovoltaic research offering potential low-cost fabrication with high power-conversion efficiency. Within only 3 years time from their appearance in photovoltaic cells, research groups have demonstrated that their power efficiency could be increased from only 3% to more than 20%. However, stability and the hysteresis in J-V curves, i.e. history dependence of the voltage applied is still matter of concern. In this respect, we study the temperature dependent dynamic processes in J-V curves, carry out electroabsorption (EA) spectroscopy measurements and analyse elemental compositions using XPS. We find that the device shows the temperature dependent behavior in the current decay and the shift of the built-in potential (VBI) during the voltage sweeping. We can attribute the origin of the hysteresis to the migration and accumulation of iodide ions at the perovskite/electrode interface, which lead to the modulation of the interfacial injection barriers.