

KFM 31: Electrical, Dielectrical and Optical Properties of Thin Films (joint session CPP/KFM)

Time: Friday 11:30–12:30

Location: H38

KFM 31.1 Fri 11:30 H38

Mechanical nanoscale polarization switching in ferroelectric polymer films — ●KATHRIN DÖRR, MARTIN KOCH, DIANA RATA, and ROBERT ROTH — MLU Halle-Wittenberg

Ferroelectric polymer films offer strong advantages like mechanical flexibility, biocompatibility, optical transparency and low-cost processing. However, their dielectric or piezoelectric performance is often inferior to that of oxide ferroelectric materials. Key to that is the electric dipolar order which is naturally lower in semicrystalline polymers than in crystalline ferroelectrics. We introduce the reorientation and alignment of the electric polarization in thin films utilizing the mechanical effect of an unbiased scanning force microscopy tip, providing a versatile tool for nanoscale domain writing [1]. Thin films (50 - 150 nm) of P(VDF-TrFE) (78:22) on graphite were prepared with dense (110)-oriented beta-phase lamellae randomly oriented in the film plane. Domain patterns with resolution down to 50 nm have been written with four (out of six possible) local polarization orientations. Written domains show excellent long-time stability. We discuss a ferroelastic origin of the mechanical polarization switching and make suggestions for how to utilize the domain patterns in thin film devices. [1] Adv. Electron. Mater. 2022, 2101416

KFM 31.2 Fri 11:45 H38

In-situ investigations of morphology degradation and oxidation level changes in EMIM DCA post-treated PEDOT:PSS thin films upon external influence — ●ANNA LENA OECHSLE¹, JULIAN E. HEGER¹, NIAN LI¹, SHANSHAN YIN¹, SIGRID BERNSTORFF², and PETER MÜLLER-BUSCHBAUM^{1,3} — ¹TU München, Physik-Department, LS Funktionelle Materialien, 85748 Garching — ²ELETTRA, 34149 Basovizza TS, Italy — ³MLZ, TU München, 85748 Garching

Nowadays thermoelectric generators are considered a promising technique for heat waste recovery as they enable a direct conversion of a temperature gradient into electrical power. Especially, organic thermoelectric polymers are attractive, owning some advantages like low cost, lightness and high mechanical flexibility, low or no toxicity, as well as a usually low thermal conductivity. In our work we show the positive effect of ionic liquid (IL) treatment on the thermoelectric properties, Seebeck coefficient and electrical conductivity, of semi-conducting PEDOT:PSS thin films. Furthermore with different in-situ experiments like GISAXS (grazing incidence small angle x-ray scattering), UV-Vis, and conductivity measurements we examine the inner film morphology and oxidation level changes upon operation at different ambient conditions.

KFM 31.3 Fri 12:00 H38

Improvement of TE properties of PEDOT:PSS films via DMSO addition and DMSO/salt post-treatment resolved from a fundamental view — ●SUO TU¹, TING TIAN¹, ANNA LENA OECHSLE¹, SHANSHAN YIN¹, XINYU JIANG¹, WEI CAO¹, NIAN LI¹, MANUEL A. REUS¹, LENNART K. REB¹, SHUJIN HOU², ALEXANDR S. BANDARENKA², MATTHIAS SCHWARTZKOPF³, STEPHAN V. ROTH³, and PETER MÜLLER-BUSCHBAUM^{1,4} — ¹TU München, Physik-Department, LS Funktionelle Materialien, 85748 Garching — ²TU München, Physik-Department, Physik der Energiewandlung und -speicherung, 85748 Garching — ³DESY, 22607 Hamburg — ⁴MLZ, TU München, 85748 Garching

The combination of DMSO-solvent doping and physical-chemical DMSO/salt de-doping in a sequence has been used to improve the thermoelectric PEDOT:PSS films. The initial DMSO-doping treatment induces a distinct phase separation by facilitating the aggregation of the PEDOT molecules. At the same time, the subsequent DMSO/salt de-doping post-treatment strengthens the selective removal of the surplus non-conductive PSS chains. Substantial alterations in the oxidation level, chain conformations, PEDOT crystallites and their preferential orientation are observed upon treatment on the molecular level. At the mesoscale level, the purification and densification of PEDOT-rich domains enable the realization of inter-grain coupling by the formation of the electronically well-percolated network. Thereby, both electrical conductivity and Seebeck coefficient are optimized.

KFM 31.4 Fri 12:15 H38

Exciton dynamics in surface-mounted metal-organic frameworks: A femtosecond transient absorption study — ●VIPILAN SIVANESAN¹, MARTIN RICHTER¹, DEBKUMAR RANA¹, RITESH HALDAR², CHRISTOPH WÖLL², and PETRA TEGEDER¹ — ¹Physikalisch-Chemisches Institut, Universität Heidelberg, Germany — ²Institute of Functional Interfaces, Karlsruhe Institute of Technology, Germany

For the optimization of organic optoelectronic devices, it is important to understand the ultrafast electronically excited state dynamics in organic semiconductors after optical excitation. For instance, different molecular packing and relative orientations of the optically active chromophores can affect the excitonic coupling strength. This can be studied in crystalline molecular assemblies by integrating these chromophores into surface-mounted metal-organic frameworks (SURMOFs) as organic linkers. Varying the side-groups of the molecules enables to engineer the crystal structure to tune the excitonic coupling. To analyse the influence of this crystal engineering on the ultrafast dynamics we investigated thin films of chromophore functionalized Zn-SURMOF by means of femtosecond transient absorption.