CPP 7: Composites and Functional Polymer Hybrids II

Time: Monday 15:00–16:00 Location: H 0106

CPP 7.1 Mon 15:00 H 0106

Tracking the morphology evolution of functional magnetic hybrid diblock copolymer-nanoparticle thin films by in situ GISAXS — •Christopher R. Everett[1], Guangjiu Pan[1], Manuel A. Reus[1], David P. Kosbahn[1], Aidin Lak[2], Frank Hartmann[3], Martin Bitsch[3], Markus Gallei[3], Matthias Opel[4], Matthias Schwartzkopf[5], and Peter Müller-Buschbaum[1,6] — [1]TUM School of Natural Sciences, Chair for Functional Materials, 85748 Garching — [2]TU Braunschweig, Institute for Electrical Measurement Science and Fundamental Electrical Engineering, 38106 Braunschweig, Germany — [3]Saarland University, LS Polymer Chemistry, 66123 Saarbrücken, Germany — [4]Walther-Meissner-Insitut, Bayerische Akademie der Wissenschaften, 85748 Garching — [5]DESY, 22607 Hamburg — [6]MLZ, TUM, 85748 Garching

Binary diblock copolymer-nanoparticle (DBC-NP) composites are well-established materials with significant research focused on controlling the localization of the nanoparticles into one particular polymer domain. Using this knowledge as a foundation, we investigate the fabrication of ternary DBC-NP-NP composites with two distinct types of NPs. Thin hybrid films composed of PS-b-PMMA, cobalt ferrite (CoFe2O4) NPs, and nickel oxide (NiO) NPs are fabricated by a slot-die coating technique. NP segregation during the drying process is investigated with grazing incidence small-angle X-ray scattering (GISAXS). The magnetic properties of the films are probed with a SQUID magnetometer and the ternary films show enhanced magnetic coercivity and remanence compared to the single-NP films.

CPP 7.2 Mon 15:15 H 0106

Probing Water Adsorption Mechanism in Hierarchical MOFs by In Situ Positron Annihilation Lifetime Spectroscopy — •Ahmed G. Attallah[1], Volodymyr Bon[2], Kartik Maity[1], Eric Hirschmann[1], Maik Butterling[1], Andreas Wagner[1], and Stefan Kaskel[2] — [1]Institute of Radiation Physics, Hemholtz-Zentrum Dresden-Rossendorf — [2]Chair of Inorganic Chemistry I, Technische Universität Dresden, Bergstrasse 66, Dresden D-01062, Germany

Metal-organic frameworks (MOFs) offer promise in atmospheric water harvesting due to their adjustable hydrophilicity, yet understanding water sorption mechanisms remains limited. Conventional scattering techniques struggle to pinpoint water molecule positions at high loads, posing a challenge. Our proposition introduces in situ positron annihilation lifetime spectroscopy (PALS) as a valuable method to probe water adsorption mechanisms in MOFs. We employed DUT-67-Zr and DUT-67-Hf as model systems with hierarchical pore structures and tunability via metal center and linker length variations, notable for high water uptake and enhanced stability. PALS effectively identifies stepwise filling of distinct pore sizes by water molecules in both MOFs. It elucidates pore-filling dynamics as it tracks water loading by observing changes in positron lifetime and intensity, offering insights into water-framework interactions and mobility. Our findings highlight PALS as a potent tool for investigating MOFs during water loading, facilitating new perspectives for optimizing these materials in water harvesting applications.

CPP 7.3 Mon 15:30 H 0106

Thickness-dependent efficiency of fully sprayed organic thin film thermoelectrics — •Benedikt Sochor[1,2], Simon Schraad[1,3], Linus Huber[4], Alexander Hexemer[2], Tim Laarmann[1,5], Sarathlal Koyiloth Vayalil[1,6], Peter Müller-Buschbaum[4,7], and Stephan V. Roth[1,8] — [1]Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany — [2]Advanced Light Source, Lawrence Berkeley National Laboratory, 6 Cyclotron Rd, Berkeley, 94720, CA, USA — [3]University Hamburg, Department of Physics, Notkestr. 85, 22607 Hamburg, Germany — [4]TUM School of Natural Sciences, Chair for Functional Materials, James-Franck-Str. 1, 85748 Garching, Germany — [5]The Hamburg Centre for Ultrafast Imaging CUI, Luruper Chaussee 149, 22761 Hamburg, Germany — [6]UPES, Applied Science Cluster, 248007 Dehradun, India — [7]MLZ, TUM, Lichtenbergstr. 1, 85748 Garching, Germany — [8]KTH Royal Institute of Technology, Teknikringen 56-58, 100 44 Stockholm, Sweden

Flexible organic electronics are one of the most sought-after devices in the field of photovoltaics, sensors, smart wearables or energy harvesting. This study focuses on the relationship between thickness and thermoelectric efficiency of thin films based on the semiconducting polymer poly (3-hexylthiophene-2,5-diyl) (P3HT), which shows potential as thermoelectric generators in the ambient temperature regime when doped with chloroauric acid ($HAuCl_4$). Using ellipsometry and reflectivity data as well as thermoelectric characterizations, optimal film parameters for thermoelectric thin film devices were identified.

CPP 7.4 Mon 15:45 H 0106

Higher-order modes of deformation of magnetic gels and elastomers — •Lukas Fischer and Andreas M. Menzel — Institut für Physik, Otto-von-Guericke-Universität Magdeburg, Magdeburg, Germany

Magnetic gels and elastomers - soft composite materials, consisting of a soft elastic matrix with enclosed magnetizable particles - mainly react to applied external magnetic fields by changing their rheological properties (magnetorheological effect) or by overall deformations (magnetostrictive effect). So far, mostly volume changes and straight elongation or contraction along the magnetic field direction have been the focus of previous studies in the latter case.

For spherical model systems of magnetic gels and elastomers, we evaluate, based on an analytical theory, the magnetostrictive deviation in shape of the surface [1]. We characterize these deformations by a mode expansion, going beyond the previously mentioned deformational modes. The relative importance of the resulting modes crucially depends on the employed arrangement of the magnetizable particles within the elastic material.

Our goal is to offer a collection of those arrangements with their corresponding deformational modes. Therefore, if a certain deformational mode is required, it is possible to choose that arrangement that best suits this need from the collection. In this way, we hope to support the path of these materials towards actual applications.

[1] L. Fischer, A. M. Menzel, arXiv preprint arXiv:2310.16833 (2023).