CPP 22: Electrical, Dielectrical and Optical Properties of Thin Films

Time: Monday 15:00–16:15 Location: ZEU 114

CPP 22.1 Mon 15:00 ZEU 114

Ionic liquid post-treatment of PEDOT:PSS thin films to increase their thermoelectric properties — •Anna Lena Oechsle[1], Julian Heger[1], Nian Li[1], Shanshan Yin[1], Hartmut Stadler[2], Sigrid Bernstorff[3], and Peter Müller-Buschbaum[1] — [1]TU München, Physik-Department, LS Funktionelle Materialien, 85748 Garching, Germany — [2]Bruker, AXS Advanced X-ray Solutions GmbH, 76187 Karlsruhe, Germany — [3]ELETTRA Sincrotrone Trieste S. C. p. A., AREA Science Park Basovizza, 34149 Trieste, Italy

In times of constantly increasing energy demand, climate change and scarcity of fossil resources thermoelectric materials are of great interest as they enable waste heat recovery and the use of solar thermal energy. In particular thermoelectric polymers are attractive, as in contrast to so far used inorganic materials, they own some advantages like low cost, high mechanical flexibility, low or no toxicity, light weight and intrinsically low thermal conductivity. Thermoelectric properties of materials can generally be evaluated by the so called power factor. This parameter depends on the Seebeck coefficient S and the electrical conductivity σ, which again are affected by the electronic and morphological features of the polymer. In terms of improving both S and σ simultaneously we post-treat fabricated PEDOT:PSS thin films with ionic liquids (ILs). By performing measurements of the Seebeck coefficient, the electrical conductivity, UV-Vis, layer thickness changes and determination of the structure we attempt to find the influence of ILs on the morphology-function relation of the PEDOT:PSS thin films.

CPP 22.2 Mon 15:15 ZEU 114

Printed colloidal PbS quantum dots solids for optoelectronics — •Wei Chen[1], Haodong Tang[2], Nian Li[1], Manuel Andree Scheel[1], Yue Xie[2], Volker Körstgens[1], Matthias Schwartzkopf[3], Stephan Roth[3], Kai Wang[2], Xiao Wei Sun[2], and Peter Müller-Buschbaum[1] — [1]Lehrstuhl für Funktionelle Materialien, Physik Department, Technische Universität München, 85748 Garching, Germany — [2]SUSTech, 518055 Shenzhen, China — [3]DESY, 22607 Hamburg, Germany

Colloidal PbS quantum dots (QDs) are attractive in photovoltaics applications due to not only the larger spectral range for the photon-electron response but also the compatibilities with various thin-film deposition methods, including spray and printing depositions. In this work, we use a slot-die coating method for particle deposition integrated with a layer-by-layer method for ligand exchange treatment to fabricate QDs planar structured solar cells with larger effective areas and less waste of QDs than commonly applied deposition methods. The particle kinetics of QDs during the printing deposition for pristine QD films is studied by time-resolved grazing-incidence small-angle X-ray scattering (GISAXS). Further, the surface morphologies and the inner structures of ligand exchanged QDs solid are studied by scanning electron microscope, atomic force microscope, and GIWAXS. Moreover, the time-resolved photoluminescence spectroscopy with spectral mapping is used to compare and discuss the charge carrier dynamics of ligand exchanged QD solids made by printing and regularly spin-coating deposition methods respectively.

CPP 22.3 Mon 15:30 ZEU 114

Ultrathin electrically conductive films created from different polycations and oxidized carbon nanotubes for bioelectrical applications — •Sven Neuber, Peter Nestler, Annekatrin Sill, Heiko Ahrens, and Christiane A. Helm — Institute of Physics, University of Greifswald, 17489 Greifswald, Germany

Surface functionalization by ultrathin films is becoming increasingly important for technological and biological applications such as the electrically active implants. nm-thick films were made by sequential adsorption of different polycations (strong polycation PDADMA; weak polycations PAH and branched PEI) and oxidized carbon nanotubes (CNT). The degree of oxidation of CNTs was determined by XPS and UV-vis absorption spectroscopy. Quartz crystal microbalance and ellipsometry have shown that film structure depends on the used polycation. Films from strong polycation PDADMA/CNT (9 layer CNTs) are more compact, thinner (d = 33.88 nm), less rough (Rq = 13.87 nm) and more electrical conductive (σ = 60.6 mΩ-1m-1) compared to films from weak polycations like PEI/CNT (9 layer CNTs, d = 42.5nm, Rq = 20.25 nm, σ = 16.4 mΩ-1m-1). AFM images show that the films have a network structure with random nanopores, making them ideal structures for biomedical applications.

CPP 22.4 Mon 15:45 ZEU 114

Investigation on Light-Matter Interactions in Tunable Colloidal Nanocavities — •Fabian R. Gossler[1] and Tobias A.F. König[1,2] — [1]Leibniz-Institut für Polymerforschung Dresden e.V., Hohe Straße 6, 01069 Dresden — [2]TU Dresden, 01069 Dresden

For large-scale fabrication of optical circuits, tailored subwavelength structures are required to modulate the refractive index. Here, we introduce a colloid-to-film-coupled nanocavity whose refractive index can be tailored by various materials, shapes, and cavity volumes.[1,2] With this colloidal nanocavity setup, the refractive index can be adjusted over a wide visible wavelength range. For many nanophotonic applications, specific values for the extinction coefficient are crucial to achieve optical loss and gain. We employed bottom-up self-assembly techniques to sandwich optically active ternary metalchalcogenides between a metallic mirror and plasmonic colloids. The spectral overlap between the cavity resonance and the broadband emitter makes it possible to study the tunable radiative properties statistically. For flat cavity geometries of silver nanocubes with sub-10 nm metallic gap, we found a fluorescence enhancement factor beyond 1000 for 100 cavities and a 112 meV Rabi splitting. In addition, we used gold spheres to extend the refractive index range. By this easily scalable colloidal nanocavity setup, gain and loss building blocks are now available, thereby leading to new generation of optical devices. [1] F. Goßler et al., The Journal of Physical Chemistry C 2019 123 (11), 6745-6752 [2] M. Mayer et al., Advanced Optical Materials 2019, 7, 1800564.

CPP 22.5 Mon 16:00 ZEU 114

Optical band structures of self-assembled colloidal metasurfaces — •Olha Aftenieva[1] and Tobias A.F. König[1,2] — [1]Leibniz-Institut für Polymerforschung Dresden e. V., Institute of Physical Chemistry and Polymer Physics, Dresden, Germany — [2]Technical University of Dresden, Physical Chemistry, 01062 Dresden, Germany

In order to obtain mixed plasmon states from the periodic arrangement we follow the concept of colloidal metasurface [König, Fery et al. Adv. Optical Mater. 2018, 1800564]. We avail of the rational design of such structures through numerical simulation, colloidal self-assembly manufacturing, and spectroscopic evaluation to obtain the optical band structures. This contribution will focus on the quantitative characterization of the interaction between Bragg diffraction and plasmonic modes by angle-resolved spectroscopy. The energy-momentum measurements are supported by the finite-difference time-domain (FDTD) simulations. Such a unique assembly of colloidal nanoparticles at a flat interface allows accessing subwavelength polaritonic states that go beyond conventional optics.