

DS 5: Organic Thin Films, Organic-Inorganic Interfaces

Time: Monday 11:30–13:00

Location: H17

DS 5.1 Mon 11:30 H17

RuTPP thin films: morphology, dimerization and CO adsorption — ●JAKOB HAUNS¹, JOHANNES SEIBEL¹, ARTUR BÖTTCHER¹, LUKAS GERHARD², WULF WULFHEKEL², and MANFRED KAPPES¹ — ¹Institute of Physical Chemistry, KIT, 76131 Karlsruhe, Germany — ²Institute of Nanotechnology, KIT, 76344, Eggenstein-Leopoldshafen, Germany

Thin RuTPP-2H films were grown on HOPG under UHV conditions by applying the Low Energy Cluster Beam Deposition method, LECBD [1]. We used the mass-selected (RuTPP-2H)⁺ beam resulting from electron impact induced ionization and fragmentation of the effusive flux of RuTPP molecules. The morphology of the films grown here were systematically studied by means of STM, UPS, XPS and desorption spectroscopy. The temperature programmed desorption (TPD) spectra, taken for sub- and multilayers enable to determine the binding energies explaining the unique stability of the films. In particular this analysis revealed the thermally activated formation of stable desorbable dimers for layers thicker than one monolayer. By combining STM and UPS we found spectral markers for the monomers and dimers deposited on HOPG. XPS/UPS based study of the CO adsorption on RuTPP-2H submonolayers revealed pronounced modifications of the valence band. These findings are supported by extensive DFT calculations which enable to identify the major CO-(RuTPP-2H) binding sites.

[1] J. Weippert, et al., *J. Phys. Chem. C* 2018, 122, 28588*28600

DS 5.2 Mon 11:45 H17

Low-Temperature Atomic Layer Deposition of Al₂O₃ Thin Films on Spin-Coated Carbon Nanomembranes — ●JAN BIEDINGER, NATALIE FRESE, RAPHAEL DALPKE, BERNHARD KALTSCHMIDT, MARTIN WORTMANN, ANDREAS HÜTTEN, ARMIN GÖLZHÄUSER, and GÜNTER REISS — Bielefeld University, Germany

Carbon nanomembranes are stable, carbon-based 2D sheets that have been investigated in recent years due to their wide range of potential applications, in nanofiltration, nanoelectromechanical systems, microelectronics or energy storage [1]. Atomic layer deposition relies on alternating self-limiting gas-surface reactions, resulting in smooth, conformal and defect-free coatings with precise thickness control [2]. In the presented work, carbon nanomembranes were coated with aluminum oxide (Al₂O₃) via a thermal atomic layer deposition process at a substrate temperature of 60°C including the reactants trimethylaluminum and water. Structural and compositional investigations of these bilayer systems by atomic force, helium ion and transmission electron microscopy as well as depth profile X-ray photoelectron spectroscopy and energy dispersive X-ray analysis, respectively, reveal a homogeneous and conformal coating of the entire sample, resulting in effective surface modification. In addition, gas permeation measurements were carried out to explore potential applications of such hybrid membranes, demonstrating atomic layer deposition offers a simple way of tuning carbon nanomembranes.

[1] A. Turchanin and A. Gözlhäuser, *Adv. Mater.* 28, 6075 (2016)

[2] S. M. George, *Chem. Rev.* 110, 111 (2010)

DS 5.3 Mon 12:00 H17

Contact Primers: A new Approach to Reducing Contact Resistance in Organic Field-Effect Transistors — ●YURIH RADIEV and GREGOR WITTE — Molekulare Festkörperphysik, Philipps-Universität Marburg, Renthof 7, 35037 Marburg, Germany

Methods to reduce contact resistance have long been of interest to researchers that aim to improve performance of organic electronic devices. Caused by the injection barrier at the metal-organic semiconductor interface, contact resistance was shown to be one of the main obstacles on the way to producing high-frequency organic field-effect transistors (OFETs), limiting the switching frequency of such transistors to well below gigahertz range [1]. In this work we report on the contact primer method [2] – a method that allows selective modification of the work function of the electrodes in a bottom gate-bottom contact OFET structure. The modified work function reduces the charge carrier injection barrier and improves the morphology of the subsequently deposited thin film on top. We demonstrate this effect for both p- and n-type OFETs by employing various organic contact primer materials to increase and reduce the work function of gold elec-

trodes, respectively. Combining this device-oriented approach with a rigorous investigation of the employed material systems on model substrates, we are able to achieve deeper understanding of the phenomena that lead to a reduced contact resistance [3].

[1] U. Zschieschang, et al., *Adv. Func. Mater.* 30, 1903812 (2020).

[2] F. Widdascheck, et al., *Adv. Funct. Mater.* 29, 1808385 (2019).

[3] Y. Radiev, et al., *Org. Electron.* 89, 106030 (2021).

DS 5.4 Mon 12:15 H17

Patterned Growth of Organic Semiconductor Films by Electron Irradiation Induced F-Centers on Alkali Halide Substrates — ●DARIUS GÜNDER¹, VALENTIN DIEZ-CABANES², ANDREA HUTTNER¹, TOBIAS BREUER¹, VINCENT LEMAUR², JEROME CORNIL², and GREGOR WITTE¹ — ¹Molekulare Festkörperphysik, Philipps-Universität Marburg — ²Laboratory for Chemistry of Novel Materials, University of Mons

In this study, a new approach is introduced to control structural properties of organic films. Combining AFM, SEM and XRD we demonstrate that electron irradiation induced F-centers (halide vacancies) on KCl(100) surfaces strongly influence the molecular orientation and epitaxial alignment of dinaphthothienothiophene (DNNT) thin films. Due to electrostatic interactions between F-centers and interfacial DNNT molecules, as validated by DFT calculations, DNNT molecules adopt a recumbent molecular orientation and form elongated fibers instead of hexagonally shaped island with upright molecular orientation present on pristine KCl. Interestingly, both morphologies exhibit epitaxial alignments that are understood by higher-order commensurabilities. By inducing F-centers only at defined surface regions, this F-center controlled growth is utilized to achieve laterally patterned DNNT films that are even transferable to other substrates by a wet transfer process.

DS 5.5 Mon 12:30 H17

The Role of Molecular Packing in Strongly Coupled Metal-Organic Hybrid Structures — ●MAXIMILIAN RÖDEL¹, POLINA LISINETSKAYA², MAXIMILIAN RUDLOFF¹, THOMAS STARK³, JOCHEN MANARA³, ROLAND MITRIC², and JENS PFLAUM^{1,3} — ¹Experimental Physics VI, University of Würzburg, 97074 Würzburg — ²Institut für Physikalische und Theoretische Chemie, University of Würzburg, 97074 Würzburg — ³ZAE Bayern, 97074 Würzburg

The coupling between excited states in fluorinated zinc-phthalocyanine thin films (F_nZnPc, with n = 0,4,8,16) and surface plasmons in gold layers underneath enables unique insights in the resulting exciton-plasmon polariton coupling phenomena and their energetics. In particular, the increase of the molecular van der Waals radii by the degree of fluorination offers an additional degree of freedom to analyze the role of molecular orientation and aggregation on the resulting dispersion curves. As such, we were able to identify up to four anticrossings in the layered Au/F_nZnPc samples which can be attributed to: 1) a co-existing F₁₆ZnPc β-polymorph, 2) monomers, preferentially located at the metal interface, and 3) aggregated α-phase regions located within the F_nZnPc films. While energy and splitting of the monomer-related anticrossing are determined by the average tilting and the close proximity to the metal surface, the coupling associated with the aggregate can be consistently described by a change in F_nZnPc dipole density. Supported by structural data and TDDFT calculations in combinations with a Jaynes-Cummings model, Au/F_nZnPc bilayers prove to be a versatile platform to study the primary light-matter interactions.

DS 5.6 Mon 12:45 H17

Strong Quenching of Dye Fluorescence in Perylene Orange/TMDC Hybrid Structures — ●TIM VÖLZER, ALINA SCHUBERT, ERIK VON DER OELSCHNITZ, INGO BARKE, SYLVIA SPELLER, TOBIAS KORN, and STEFAN LOCHBRUNNER — Institut für Physik, Universität Rostock, Albert-Einstein-Str. 23, 18059 Rostock

While monolayer transition metal dichalcogenides (1L-TMDCs) have emerged as 2D semiconductors with multiple applications in optoelectronics, their combination with dye molecules to form promising hybrid structures, since they should allow charge transfer after optical excitation as required for photodetectors or solar cells. Here, we discuss the preparation of such systems, i.e. the deposition of perylene orange (PO) onto substrates by means of spin coating, stamping, and thermal vapor deposition (TVD) and compare these methods regard-

ing the quality of the dye layer and practicability of the process. For TVD-fabricated 1L-TMDC/PO hybrid structures, we observe a drastic quenching of the dye fluorescence in terms of both intensity and life-

time reduction for all used TMDCs compared to hBN/PO references. This quenching is attributed to electron or hole transfer depending on the energy levels of the molecule and the specific TMDC, respectively.