

DS 31: Organic thin films I

Time: Thursday 11:15–13:00

Location: H 0111

DS 31.1 Thu 11:15 H 0111

Development of a MOKE Spectrometer with Sensitivity in the Infrared Spectral Range — ●ALEXANDER KOPYLOV, MICHAEL FRONK, DIETRICH R.T. ZAHN, and GEORGETA SALVAN — Chemnitz University of Technology, 09107 Chemnitz, Germany

Magneto-optical spectroscopy can be used to assign the character and the symmetry of molecular states in molecules. This approach has been successfully applied using magnetic circular dichroism along the years. We previously showed that magneto-optical Kerr effect (MOKE) spectroscopy is a complementary tool which can be applied for paramagnetic or diamagnetic films on opaque substrates. In this work we present the development of a MOKE spectrometer for the IR to UV spectral range from 0.3 eV to 5.5 eV. This allows low energetic magneto-optical transitions to be probed as demonstrated by the example of manganese phthalocyanine, which has a gap between the lowest unoccupied molecular orbital and the highest unoccupied molecular orbital of only ~ 0.5 eV [1].

[1] M. Grobosch, B. Mahns, C. Loose, R. Friedrich, C. Schmidt, J. Kortus, and M. Knupfer, *Chemical Physics Letters* 505, 122 (2011).

DS 31.2 Thu 11:30 H 0111

Spectroscopic Ellipsometry and Magneto-optical Kerr Effect Spectroscopy Characterization of Phthalocyanine Thin Films on Ferromagnetic Substrates — ●MICHAEL FRONK, FRANCISC HAIDU, MICHAEL LUDEMANN, ALEXANDER KOPYLOV, CHRISTIAN SCHUBERT, MANFRED ALBRECHT, DIETRICH R.T. ZAHN, and GEORGETA SALVAN — Chemnitz University of Technology, Germany

Since many years organic complexes like phthalocyanines attract research interest due to their applicability in organic electronic devices such as OLEDs and OFETs. Already in the 1970s phthalocyanines were magneto-optically studied by means of magnetic circular dichroism (MCD) for the clarification of the electronic structure of the molecules in solution and in form of films on transparent substrates. Recently our group successfully applied the magneto-optical Kerr effect (MOKE) to measure organic films on opaque substrates [1]. However, in order to perform basic research with an eye on the application of organic complexes in spintronic devices, the challenge is to measure the magneto-optical response of dia- or paramagnetic molecules on ferromagnetic substrates with dominating signal contributions. In the present work ellipsometry is used to characterize the bare ferromagnetic substrates (LSMO and Co-Pt layered systems) as well as samples with films of CoPc and CuPc in terms of their dielectric functions. MOKE is measured at different magnetic field strengths in order to access the signal of the organic films which is the only field dependent contribution above the saturation field of the substrate.

[1] M. Fronk, et. al., *Phys. Rev. B* 79 (2009) 235305

DS 31.3 Thu 11:45 H 0111

Charge transfer at phthalocyanine heterojunctions — ●SUSI LINDNER, BENJAMIN MAHNS, and MARTIN KNUPFER — IFW Dresden, P.O. Box 270116, 01171 Dresden

Motivated by interesting electronic and magnetic properties of organic semiconductors like transition metal phthalocyanines we studied the organic-organic interfaces of CoPc, $F_{16}CoPc$ and $MnPc$ on various metal substrates (Au and Ag) by means of x-ray and ultra violet photoemission spectroscopy. We show that a charge transfer can be achieved at the interface between this well known molecules. Additionally, in this effect the transition metal center is mainly involved resulting in oxidized $Mn^{\delta+}Pc$ and reduced $F_{16}Co^{\delta-}Pc$, as well as $Co^{\delta-}Pc$ species.

This project is supported by the DFG (KN 393/14).

DS 31.4 Thu 12:00 H 0111

Hybrid solution/vacuum-processed bilayer heterojunction organic solar cells: Nucleation and growth of copper phthalocyanine from solution — ●FATEMEH GHANI¹, IVELIN BOCHUKOV², KONSTANTINOS FOSTIROPOULOS², and HANS RIEGLER¹ — ¹Max Planck Institute f. Colloid & Interfaces, Potsdam-Golm, Germany — ²Helmholtz-Zentrum, Berlin, Germany

Unsubstituted metal phthalocyanines (M-Pc) are used as electron donor in vacuum-processed organic solar cell (OSC). However, low cost wet-deposition techniques like spin coating provide several parameters

to produce appropriate structures concerning nucleation and growth from solution. But unfortunately fewer solvents for M-Pcs are known. Based on a detailed solubility study[1], we prepare solution-processed M-Pc films. Structures of particular interest are thin films of unsubstituted copper phthalocyanine (CuPc) deposited by spin coating or dip coating of the trifluoroacetic acid solution. By evaporation of the solvent, the molecules aggregate into bundles of fibers of 1-2 nm thickness and μm length on the substrate. We show that the size and form of the structures can be controlled systematically by varying nucleation and growth parameter such as temperature, solution concentration and solvent mixture. We used the solution-processed CuPc film in a hybrid solution/vacuum-processed OSC and studied the power efficiency as a function of CuPc film-thickness.

[1] Ghani, F.; Kristen, J.; Riegler, H., Solubility properties of unsubstituted metal phthalocyanines in different types of solvents, *J. Chem. Eng. Data* (in press).

DS 31.5 Thu 12:15 H 0111

Characterization of inorganic Surfaces modified by thiol-ene Polymer Grafting — ●CHRISTIAN KUTTNER¹, MORITZ TEBBE¹, MICHAELA EDER², HELMUT SCHLAAD², INGO BURGERT^{2,3}, and ANDREAS FERY¹ — ¹Physical Chemistry II, Bayreuth University, 95447 Bayreuth, Germany — ²Max-Planck Institute of Colloids and Interfaces, 14424 Potsdam, Germany — ³ETH Zurich, Institute for Building Materials & Empa, Wood Lab, 8093 Zurich, Switzerland

Control of the interfacial properties is crucial for inorganic-organic composites. We studied interactions between inorganic surfaces grafted with macromolecules and a given epoxy matrix. The aim was to develop a better understanding of adhesion principles in (fiber-reinforced) composites and thus optimizing composites.

Thiol-ene grafting was utilized to introduce a polymeric gradient on silica-like surfaces following a two-step approach by Schlaad et al. [1], which allows initiator-free grafting of macromolecules. Different grafting-techniques were tested for applicability and adapted to modify fiberglass. The resulting coatings were nano-structurally and nano-mechanically characterized. Layer morphology (AFM, SEM, SE) and swelling behavior (SE) were investigated. After embedding the modified fibers in an epoxy matrix, cross-sections were prepared for force-volume analysis. The stiffness distribution at the fiber-matrix interface was investigated. The interfacial shear strength between modified fibers and the epoxy matrix was measured by a pull-out experiment to benchmark the non-covalent fiber-matrix construction.

[1] Bertin A, Schlaad H; *Chem. Mater.* 2009, 21 (24), 5698

DS 31.6 Thu 12:30 H 0111

Structures of Chlorosilanes Self-Assembled on Oxide Surfaces — ●HANS-GEORG STEINRÜCK, MICHAEL KLIMCZAK, STEFAN GERTH, and ANDREAS MAGERL — Lehrstuhl für Kristallographie und Strukturphysik, Staudtstr. 3, D-91058 Erlangen

The topic of our recent research was to further investigate the bonding process of trichlorosilanes to oxide surfaces.

As a starting point octadecyltrichlorosilane (OTS, $C_{17}H_{37}Cl_3Si$) adsorbed on the amorphous native oxide of a silicon wafer was chosen. Using X-ray reflectivity measurements a densely packed uniform OTS self-assembled monolayer with thickness of ≈ 26 Å was found. This agrees well with several publications.

Starting from this observation, the substrate was systematically varied, by choosing (100) oriented single crystalline quartz (SiO_2) and (100) oriented single crystalline (Al_2O_3). Due to their crystal specific lattice parameters, a different surface coverage was expected.

To gather further insight, especially on the surface coverage and on the thickness of the monolayer, X-ray reflectivity measurements were performed for these two systems. It was found that the surface coverage on quartz is about 24% and on sapphire about 40% smaller than on the amorphous silicon dioxide. This leads to a tilt of the molecules of 30° and 45° respectively, away from the surface normal. This result can be attributed to the different distances of the bonding sites on the three substrates, which lead to unfavorable conditions for a densely packed monolayer on the crystalline substrates. Note that compared to the amorphous oxide possible bonding sites rectangular lattice of 5.17 Å \times 4.54 Å (SiO_2) and 4.76 Å \times 12.99 Å (Al_2O_3).

DS 31.7 Thu 12:45 H 0111

Depletion of Water on Self-assembled-Monolayers — •BASTIAN RÜCKERT, HANS-GEORG STEINRÜCK, MICHAEL KLIMCZAK, STEFAN GERTH, and ANDREAS MAGERL — Chair of Crystallography and Structural Physics

Octadecyltrichlorosilane ($\text{C}_{18}\text{H}_{37}\text{Cl}_3\text{Si}$, chain length 25 Å) selfassembled on the native oxide of a silicon wafer was chosen as a model system to investigate slip parameters and the influence of shear on hydrophobic surfaces. To gather insight on the structure of this monolayer, X-ray reflectivity (XRR) measurements were performed.

In contact to water a depletion layer of 3 Å with a reduced water

density of 60% was observed at the solid-liquid interface. Further it is shown that this depletion zone is independent on shear.

To investigate the impact of the chain length to the monolayer thickness and the depletion layer as a function of the applied shear the chain length of the molecules were systematically varied up to Triacetyltrichlorosilane ($\text{C}_{30}\text{H}_{61}\text{Cl}_3\text{Si}$, chain length 35 Å). Again a depletion layer had to be taken into account in order to describe the data.

Searching for any changes in the existing depletion layer or the layer system of Triacetyltrichlorosilane none were found. Even varying the shear rates neither of both showed changes in the interpreted data.