DS 35: Biomolecular and Functional Organic Layers I (Focused Session)

Time: Thursday 17:15–19:00 Location: H2

Topical Talk DS 35.1 Thu 17:15 H2

Surface enhanced infrared spectroscopy - pushing the detection limit towards zeptomolar sensitivity — •Frank Neubrech, Daniel Weber, Jörg Bochterle, and Annemarie Pucci — Kirchhoff - Institut für Physik, Universität Heidelberg

Surface enhanced infrared absorption (SEIRA) of molecules on metal films is known for many years but is still suffering from too small enhancement factors. Similar to surface enhanced Raman scattering, the electromagnetic field enhancement gives the main contribution to SEIRA signals. For adsorbates on metal nanoparticle-films average enhancement factors of more than three orders of magnitude were obtained. If metal nanoantennas are involved, the magnitude of the near-field amplitude at the fundamental (and also higher order) plasmon resonance reaches some ten times the external field value and therefore lowers the detection limit significantly. To analyse this kind of SEIRA quantitatively, well-defined monolayers of octadecanethiol on nanoantennas were investigated by means of infrared micro-spectroscopy. For individual nanoantennas, we have proven extraordinary enhancement factors up to 500 000 (ratio between enhanced infrared signal size and infrared absorption of the same number of molecules). The enhanced vibration signals show Fano-type line shapes due to dipolar coupling between molecular and plasmonic excitations.[1] Further increase of enhancement factors via near-field confinement in nanogaps of resonant nanoantenna arrays is under investigation.[2]

[1] F. Neubrech *et al*, Phys. Rev. Lett. 101, 157403, 2008.
[2] A. Pucci *et al*, submitted to Phys. Stat. Sol (B) 2009.

DS 35.2 Thu 17:45 H2

Optical Characterization of Cytosine Thin Films — •Dana M. Rosu, Simona Pop, Norbert Esser, and Karsten Hinrichs — ISAS - Institute for Analytical Sciences, Department Berlin, Albert-Einstein-Str. 9, 12489 Berlin, Germany

Due to their application in the fabrication of biomolecular electronic devices, the cytosine thin films are of high technological interest. Therefore, the understanding of the optical and structural properties of these films is important for the controlled design of cytosine thin films. In the present work, results of a complex study on thin films of cytosine on Si with a thickness between 10 nm and 125 nm are presented. The thin films were obtained by evaporation in high vacuum and investigated using different optical techniques. Thickness and dielectric function of the cytosine films were determined from VIS ellipsometric measurements while molecular orientation was studied by IR ellipsometry and reflectance anisotropy spectroscopy (RAS). Different organization of the molecules on the substrate is observed for different film thicknesses. The IR mapping ellipsometer [1], located at the BESSY II synchrotron facility was used in order to study the structural and thickness homogeneity of the samples.

References: [1]Gensch M., Esser N., Korte E. H., Schade U., Hinrichs K. Infrared Physics and Technology 2006, 49, 74

DS 35.3 Thu 18:00 H2

IR Spectroscopic Characterization of Carboxyl Acid-terminated Au Surfaces: Towards Biosensors — •Guoguang Sun[1], Marc Hovestädt[2], Xin Zhang[3], Dana Maria Rosu[1], Bernhard Ay[2], Rudolf Volkmer[2], Jörg Rappich[3], and Karsten Hinrichs[1] — [1]ISAS- Institute for Analytical Sciences, Department Berlin, Albert-Einstein-Str. 9, 12489 Berlin, Germany — [2]Charité Universitätsmedizin Berlin, Institut für Medizinische Immunologie, Abteilung Molekulare Bibliotheken, Hessische Str. 3-4 , 10115 Berlin, Germany — [3]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Insitut für Silizium-Photovoltaik, Kekuléstr. 5, 12489 Berlin, Germany

Specific vibrational bands (C=O, amide I and amide II) were used for interpretation of IR spectra of the thin films (d<10 nm) achieved in every preparation step. The molecular interactions between the functional groups on the surface and the selected peptide as well as anti-glutathione S-transferase (GST) antibody were proved by IR ellipsometry spectra. The characteristic IR-spectra after antibody adsorption suggest that an IR-based biosensor could probably be built for an application.

DS 35.4 Thu 18:15 H2

Optical Properties of Thin Films of ZnTPP oligomers — •Simona Pop[1], Mathias Senge[2], Oliver Locos[2], Karsten Hinrichs[1], Xin Zhang[3], Jörg Rappich[3], Christoph Cobet[1], and Norbert Esser[1] — [1]ISAS-Institute for Analytical Sciences, Albert-Einstein-Str.9, D-12489 Berlin, Germany — [2]School of Chemistry, SFI Tetrapyrrole Laboratory, Trinity College Dublin, Dublin 2, Ireland — [3]Helmholtz-Zentrum Berlin for Materials and Energy GmbH, Institute for Silicon Photovoltaics, Kekuléstrasse 5, D-12489 Berlin, Germany

Porphyrin oligomers are of great interest for technological applications such as biosensors, solar cells and OFETs (organic field-effect transistors). These materials exhibit extraordinary optical and electronic properties due to the π-conjugation. The main characteristics of these oligomers as a consequence of π-conjugation are the high polarisabilities and low energy electronic transitions. Here, thin films of ZnTPP (zinc tetraphenylporphyrin) monomer and dimer were investigated by means of spectroscopic ellipsometry. In the case of the π-conjugated ZnTPP dimer, the porphyrin units are connected through an ethylene bridge. The films were prepared by means of spin-coating method on silicon substrates. The dielectric functions of ZnTPP monomer and dimer are derived from ellipsometrical measurements by employing a three-phase optical model. As expected, the ZnTPP dimer films exhibit a strong red-shift of the first absorption structure, namely Q-band, compared to the monomer case. The spectral changes observed for the ZnTPP dimer films can be interpreted in terms of strong electronic interactions and weak electrostatic ones.

Topical Talk DS 35.5 Thu 18:30 H2

Infrared spectroscopic ellipsometry for the in-situ investigation of responsive polymer brushes — •Dennis Aulich[1], Eva Bittrich[2], Klaus-Jochen Eichhorn[2], Petra Uhlmann[2], Manfred Stamm[2], Martin Brücher[3], Roland Hergenröder[3], Olha Hoy[4], Igor Luzinov[4], Norbert Esser[1], and Karsten Hinrichs[1] — [1]Leibniz-Institut für Analytische Wissenschaften - ISAS - e.V., Albert-Einstein-Str. 9, 12489 Berlin — [2]Leibniz-Institut für Polymerforschung Dresden e.V., Hohe Str. 6, 01069 Dresden — [3]Leibniz-Institut für Analytische Wissenschaften - ISAS - e.V., Otto-Hahn-Str. 6b, 44227 Dortmund — [4]School of Materials Science and Engineering, Clemson University, Clemson, SC 29634-0971, USA

Responsive polymer brushes offer a wide range of applications. Due to the possibility of changing the surface properties by external stimuli such as pH, solvent, temperature or electric field, mixed polymer brushes can control protein adsorption, wettability or adhesion of a surface. In order to understand the complex behavior of this surface functionalization, the single mechanisms like switching of polymer brushes and the adsorption of protein layers have to be well investigated. Infrared Spectroscopic Ellipsometry (IRSE) is a suitable method for in-situ measurements of polymer brush systems in solution and gives direct insight into the response of the brush to external stimuli by observation of the dissociation of charged groups in the polymer material. Various brush systems were investigated with in-situ IRSE and compared with additional methods such as VIS-ellipsometry, x-ray standing waves and contact angle measurements.