

## DS 10 Thin organic films I

Time: Tuesday 09:30–11:00

Room: GER 38

DS 10.1 Tue 09:30 GER 38

**Application of infrared spectroscopic ellipsometry in studies of electrochemically grafted thin organic monolayers** — ●K. ROODENKO<sup>1</sup>, J. RAPPICH<sup>2</sup>, R. HUNGER<sup>3</sup>, M. GENSCH<sup>1</sup>, A.G. GÜELL<sup>4</sup>, TH. DITTRICH<sup>5</sup>, A. MERSON<sup>6</sup>, Y. SHAPIRA<sup>6</sup>, N. ESSER<sup>1</sup>, and K. HINRICH<sup>1</sup> — <sup>1</sup>ISAS-Institute for Analytical Sciences, Dept. Berlin, Albert-Einstein-Str. 9, 12489, Berlin, Germany — <sup>2</sup>Hahn-Meitner Institute Berlin GmbH, Abt. SE1, Kekulestr. 5, 12489 Berlin — <sup>3</sup>Institute of Material Science, TU Darmstadt, Petersenstr. 63, 64287 Darmstadt, Germany — <sup>4</sup>Dept. Química Física, Universitat de Barcelona, c/ Martí i Franques, 108028 — <sup>5</sup>Hahn-Meitner Institute Berlin GmbH, Abt. SE2, Glienicke Str. 100, 14109 Berlin — <sup>6</sup>Dept. of Physical-Electronics, Faculty of engineering, Tel-Aviv University, 69978, Tel-Aviv, Israel

Infrared spectroscopic ellipsometry (IR-SE) is a non-destructive method, which is based on measuring of changes in the polarization state of radiation upon reflection from a sample. When performed in the infrared spectral range, information on molecular composition and structure can be gained through the absorption bands of molecular vibrations. Due to its high sensitivity, this method was applied to study electrochemically grafted organic thin films, such as methoxybenzene and nitrobenzene, on silicon substrates. Formation of the organic layer was confirmed by this method [1], as well as the formation of silicon oxide under certain grafting conditions. A model for competing processes during electrochemical grafting was developed by cross-referencing the IRSE results with synchrotron XPS results.

[1]. M. Gensch et al, J. Vac. Sci. Technol. B 23, 1838 (2005)

DS 10.2 Tue 09:45 GER 38

**Systematic trends in the surface roughness of organic films** — ●PHENWISA NIYAMAKOM, MARYAM BEIGMOHAMADI, AZADEH FARAHZADI, STEPHAN KREMERS, THOMAS MICHELY, and MATTHIAS WUTTIG — I. Institute of Physics (IA) RWTH Aachen University 52056 Aachen, Germany

Depending on the specific application, different surface morphologies are required for organic thin films. For example, in optoelectronic applications, the absence of long-range order in amorphous films can result in smooth surfaces and efficient radiative recombination, which allows for the realization of high performance organic optoelectronic devices. In order to tailor surface morphologies and hence film properties, an understanding of thin film growth is very important. For the organic film investigated in this study, the film morphology and surface roughness was measured by X-ray reflectometry (XRR) and Atomic Force Microscopy (AFM). The surface morphologies were studied for films of N,N'-diphenyl-N,N'-bis(1-naphthyl)-1-1'-biphenyl-4,4'' diamine ( $\alpha$ -NPD), 4,4'-bis(2,2' diphenylvinyl)-1,1'-biphenyl (DPVBI) and 2,2',7,7'-tetrakis(2,2-diphenylvinyl)spiro-9,9'-bifluorene (Spiro-DPVBI). A clear difference in roughness of the different materials is observed and explained by a model. The influence of the deposition rate has been investigated in addition for films of N,N'-diphenyl-N,N'-bis(1-naphthyl)-1-1' biphenyl-4,4'' diamine ( $\alpha$ -NPD) and tris-(8-hydroxyquinoline)aluminum (Alq3).

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DS 10.3 Tue 10:00 GER 38

**XANES and resonant Auger measurements of benzo-annelated Copper Porphyrine molecules** — ●D. R. BATCHELOR<sup>1</sup>, D. POP<sup>2</sup>, A. SCHÖLL<sup>1</sup>, S. KERA<sup>3</sup>, B. WINTER<sup>2</sup>, W. FREYER<sup>2</sup>, and E. UMBACH<sup>1</sup> — <sup>1</sup>Exp.Physik II, Univ. Würzburg — <sup>2</sup>MBI für Nichtlineare Optik und Kurzzeitspektroskopie, Berlin — <sup>3</sup>Faculty of Engineering, Chiba University, Japan

High resolution x-ray absorption spectra from a family of linear benzo-annelated copper porphyrine molecules have been measured at the nitrogen K and copper L<sub>2,3</sub> edges in an effort to understand the charge transfer between the central copper atom and the conjugated ring of nitrogen atoms. The spectra are very distinctive showing a clear trend in energy structure and an energy shift of the main  $\pi^*$  resonances. Calculations using the STOBE code for both edges are able to reproduce the structure and shift well. Auger resonance experiments for copper phthalocyanine exhibit a large spectator shift and show that the main  $\pi^*$  resonance contains appreciable, if not dominating, orbital excitations besides those simply involving the LUMO. This is contrary to the normal interpretation of XANES data and demonstrates the complex nature of

the excitation and at the same time the wealth of information obtainable in such experiments.

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DS 10.4 Tue 10:15 GER 38

**Molecular Orientation of ZnPc grown on Silicon(111) Substrates and its Influence on the Optical Constants.** — ●SINDU JOHN LOUIS<sup>1</sup>, DANIEL LEHMANN<sup>1</sup>, KATY ROODENKO<sup>2</sup>, KARSTEN HINRICH<sup>2</sup>, NORBERT ESSER<sup>2</sup>, MARION FRIEDRICH<sup>1</sup>, and DIETRICH R. T. ZAHN<sup>1</sup> — <sup>1</sup>Chemnitz University of Technology, Semiconductor Physics, D-09107 Chemnitz, Germany — <sup>2</sup>ISAS - Institute for Analytical Sciences, Department Berlin, Albert-Einstein-Straße 9, 12489 Berlin, Germany.

To improve the electronic properties of opto-electronic devices, the molecular stacking and the optical constants of the organic compounds are of great interest. Thin films of ZnPc were prepared by Organic Molecular Beam Deposition (OMBD) on silicon substrates. Variable Angle Spectroscopic Ellipsometry (VASE) measurements in the infrared, visible and ultraviolet regions and infrared (IR) reflection measurements were used to study the samples.

From the ellipsometry data evaluation the film thickness, surface roughness and the ZnPc optical constants were determined. These optical constants depend strongly on the method of preparation. Together with the evaluation of infrared reflection spectra and of transmission spectra of KBr pellets with ZnPc powder these results show that the films are optically anisotropic. The results are used to extract the average molecular tilt angle and to generate optical constants and spectra for isotropic films and for films of molecules which are oriented perpendicular and parallel to the substrate surface.

DS 10.5 Tue 10:30 GER 38

**Ellipsometric Study of an Organic Template Effect** — ●OVIDIU D. GORDAN<sup>1</sup>, TAKEAKI SAKURAI<sup>2</sup>, KATSUHIRO AKIMOTO<sup>2</sup>, MARION FRIEDRICH<sup>1</sup>, and DIETRICH R. T. ZAHN<sup>1</sup> — <sup>1</sup>Chemnitz University of Technology, Semiconductor Physics, D-09107 Chemnitz, Germany — <sup>2</sup>Institute of Applied Physics, University of Tsukuba, Japan

The research of the last decade proved that organic materials can be used as a low cost alternative to inorganic semiconductors. However, optimizing the performance of the organic devices remains a challenging task, as the electronic and optical properties of the organic layers strongly depend on the preparation conditions and molecular orientation. It was already shown [1] that the molecular orientation can be controlled using an organic template layer.

In this work we demonstrate the template effect of 3,4,9,10-perylenetetracarboxylic dianhydride (PTCDA) on metal-free phthalocyanine H<sub>2</sub>Pc molecules studied by spectroscopic ellipsometry. From the differences [2] between in-plane and out-of-plane components of the dielectric function, the molecular orientation was deduced. It was found that the strong interaction of the PTCDA  $\pi$  orbitals with the H<sub>2</sub>Pc  $\pi$  orbitals modifies the growth mode of H<sub>2</sub>Pc molecules on PTCDA with respect to the growth on glass and oxidised silicon substrates.

[1] T. Sakurai, S. Kawai, J. Shibata, R. Fukasawa and K. Akimoto, Jpn. J. Appl. Phys. 44 (2005) 1982

[2] O. Gordan, M. Friedrich, D. R. T. Zahn, Organic Electronics 5 (2004) 291

DS 10.6 Tue 10:45 GER 38

**Real-time observation of organic semiconductor growth: Evolution of structure and surface morphology** — ●S. KOWARIK<sup>1,2</sup>, A. GERLACH<sup>1,2</sup>, S. SELLNER<sup>1</sup>, F. SCHREIBER<sup>1</sup>, J. PFLAUM<sup>3</sup>, L. CAVALCANTI<sup>4</sup>, and O. KONOVALOV<sup>4</sup> — <sup>1</sup>Institut für Angewandte Physik, Universität Tübingen, Auf der Morgenstelle 10, 72076 Tübingen — <sup>2</sup>Physical and Theoretical Chemistry Laboratories, Oxford University, South Parks Road Oxford OX1 3QZ — <sup>3</sup>Physikalisches Institut, Universität Stuttgart, Pfaffenwaldring 57, D-70550 Stuttgart — <sup>4</sup>ESRF, 6, rue Jules Horowitz-B.P.220, 38043, Grenoble, Cedex 9, France

We use in-situ real-time X-ray scattering during growth of the organic semiconductors rubrene and diindenoperylene (DIP) to study the evolution of the film structure with time. We manage to produce "movies" of the changes in reflectivity and grazing incidence diffraction (GID) during organic molecular beam deposition. These measurements yield structural and morphological information for a range of film thicknesses, and also contain information about the dynamics of growth. For DIP we identify

structural transitions during growth and follow the evolution of the surface morphology. For rubrene we find a relatively low surface roughness ( $\sigma$  below 15 Å for thicknesses up to at least 600 Å) and a significant delay in the onset of roughening with thickness. This anomalous behavior may be related to conformational changes in the early stages of the growth.