DS 19: Symposium: In situ Optics II

Time: Wednesday 17:15–18:45 Location: H34

Invited Talk DS 19.1 Wed 17:15 H34

Optical in-situ diagnostics of device growth in MOVPE — •Martin Zorn[1], Frank Brunner[1], Thomas Zettler[2], and Markus Weyers[1] — [1]Ferdinand-Braun-Institut für Höchstfrequenztechnik (FBH), Gustav-Kirchhoff-Str. 4, 12489 Berlin, Germany — [2]LayTec GmbH, Helmholtzstr. 13-14, 10587 Berlin, Germany

Metal-organic vapour phase (MOVPE) growth of semiconductor device structures is the fundamental technique for the fabrication of todays micro- and opto-electronic devices. The monitoring and control of these growth processes in gas phase environment is highly desired and can only be done by optical technologies.

Here, we report on *in-situ* diagnostics in MOVPE using normalized reflectance (R), reflectance anisotropy spectroscopy (RAS), optical curvature measurements and emissivity-corrected pyrometry.

In GaAs-based layer structures crucial layer properties like composition, doping, and strain can be determined *in-situ*. For example, the optical RAS fingerprint of a laser structure includes information about doping and composition. Growth of lattice matched material like AlGaInP on GaAs can be controlled by a combination of reflectance and curvature measurements.

For GaN-based epitaxy *in-situ* temperature and strain measurements play a crucial role in optimizing the growth process. Sensor based strain engineering of the layer structures is state-of-the-art for yield-enhancement. Recently, reflectance measurements at 400 nm and 950 nm have shown to give direct insight into the growth of (Al,In,Ga)N heterostructures.

Invited Talk DS 19.2 Wed 17:45 H34

In-situ investigations of electronic and structural properties of Si surfaces during electrochemical surface functionalization — •Jörg Rappich[1], Florent Yang[1], Katy Roodenko[2], Aleix Güell[3], Carl Matthias Intelmann[1], Thomas Dittrich[4], and Karsten Hinrichs[2] — [1]Hahn-Meitner-Institut Berlin GmbH, Abt. SE1, Kekuléstr. 5, 12489 Berlin — [2]ISAS - Institute for Analytical Sciences, Department Berlin, Albert-Einstein-Str. 9, 12489 Berlin — [3]Department of Physical Chemistry, University of Barcelona, C/Martí i Franquès, 1, E-08028 Barcelona (Spain) — [4]Hahn-Meitner-Institut Berlin GmbH, Abt. SE2, Glienicker Str. 100, 14109 Berlin

In-situ investigations of Si surfaces are of high scientific relevance in order to understand the electrochemical surface processing during oxide formation and etch-back, the transformation towards H-termination and grafting of organic molecules on (111) and (100) oriented surfaces. These surface modifications have an impact on the electronic surface properties such as surface recombination velocity and band-bending. For characterisation of electronic properties and identification of changes in the type of surface species pulsed photoluminescence, pulsed photo-voltage and infrared spectroscopic measurements (multiple and single reflection geometry) have been applied. Experimental results are discussed with respect to surface passivation, structural modification and functionalization.

Invited Talk DS 19.3 Wed 18:15 H34

Water at model membranes: structure, dynamics and biomolecular sensing — •Mischa Bonn — FOM-Institute for Atomic and Molecular Physics, Kruislaan 407; NL- 1098 SJ, Amsterdam

Lipids form the basic building blocks of cell membranes. Thanks to their bipolar nature (lipids consist of a polar head group and a long apolar tail), they possess the ability to self-organize and thus form the boundary of living cells. The interaction of lipids with water drives the self-assembly process and water is therefore an essential ingredient of a biological membrane. It has been a challenge to elucidate the role of water in biomolecular processes, including those occurring at the membrane surface.

Vibrational spectroscopies have been shown to be very useful for the study of water, as the O - H stretch vibration of water is a very sensitive reporter of the local environment of the water molecule. The nonlinear vibrational spectroscopic technique of sum frequency generation (SFG) further allows us to distinguish bulk water near the membrane from water physically bound to the membrane. This unique surface specificity enables the detailed study of membrane-bound water. Moreover, we can investigate the femtosecond dynamics of interfacial water molecules, as we use femtosecond laser pulses in our experiments.

We find that, although the SFG spectra of interfacial water at the membrane-water interface very closely resembles that of interfacial water at the air-water and air-quartz interfaces, the vibrational dynamics are markedly different. Whereas for both the air-water and air-quartz interfaces, the surface water molecules exchange energy very rapidly with the bulk, this is not the case for membrane-bound water. This is the first direct experimental evidence that membrane-bound water is an inherent part of the membrane: water at the membrane interface does not just terminate the bulk.

We further show that the preferential adsorption of DNA to a lipid monolayer on water, results in dramatic changes in the interfacial water structure. In this way, the water molecules, which are interrogated with SFG, act as highly sensitive reporters for the presence of DNA, constituting a novel, non-invasive method for label-free detection of DNA with very high (picomolar) sensitivity. The approach we present is very simple and it can easily be extended to be specific towards unique DNA sequences.