DS 18: Symposium: In situ Optics I

Time: Wednesday 15:00–17:00 Location: H34

Invited Talk DS 18.1 Wed 15:00 H34

Analysis of protein layer structure using real-time ellipsometry — •Hans Arwin — Laboratory of Applied Optics, Department of Physics, Chemistry and Biology, Linköping University, SE-581 83 Linköping, Sweden

A thickness resolution in the sub-nm range and its in situ capability make spectroscopic ellipsometry (SE) suitable for studies of thin organic layers. Here SE used in internal reflection mode is reviewed and it is shown that SE exhibits pm-sensitivity for protein adsorption on thin metal layers if used at surface plasmon resonance conditions. With such large sensitivity a determination of the microstructure of adsorbed protein layers, e. g. in terms of mass distribution perpendicular to a surface, is within reach. Another implication is an increased sensitivity in biosensor applications.

The molecular structure of surface-bound proteins can be analyzed with SE in the infrared spectral region by determining the refractive index N=n+ik. In this way thermally induced structural changes can be monitored. This is of importance for future devices containing protein layers for which thermal stability is important. Studies on protein multilayers show that heating above 100 degrees influences the amide bands and at 200 degrees layer degradation seen as irreversible changes in n and k occur. Methodology and results from recent studies of effects of heating proteins monolayers are presented and possibilities to perform real-time in situ infrared SE is discussed.

Invited Talk DS 18.2 Wed 15:30 H34

Optical Spectroscopy with high Spatial Resolution — •Wolfgang Richter, Eugen Speiser, Benjamin Buick, and Silvano Del Gobbo — U Roma2 "Tor Vergata", Roma, Italy

Optical spectroscopy, energetically and interactionwise, is one of the ideal experimental tools to study the physical properties of materials. On the other hand, the properties of such materials are modified nowadays in a controlled manner by reducing the physical size in one or more dimensions down into the nanometer scale. For such a situation, standard optical equipment has a non-sufficient spatial resolution, because it detects the secondary radiation from the sample in distances much larger than the wavelength (Far-Field) which gives at best (confocal microscope) a spatial resolution of several 100 nm using visible light. The reason for this limited resolution is that finer details of the sample are carried only in the evanescent fields, detectable only in subwavelength distance from the sample (Near-Field). By putting, however, a Nano-sized structure (small aperture, sharp metallic tip) within wavelength distance near the sample the evanescent waves can be converted into propagating waves which then can be detected in far field. This is the scope of Near Field Optics or Nano-Optics. While this secondary radiation is widely used for nanoscale imaging (Near Field Optical Microscopy) we will concentrate here on optical spectroscopy with nanoscale spatial resolution. We will focus especially the apertureless techniques, with their definite intensity advantage and concentrate mainly on Raman scattering. The experimental considerations and measurements on semiconductor nanorods will be discussed.

Invited Talk DS 18.3 Wed 16:00 H34

Surface enhanced Raman spectroscopy as a probe for studying metal/organic interfaces — •Georgeta Salvan and Dietrich Zahn — Chemnitz University of Technology, D-09107 Chemnitz, Germany

The physical and chemical properties of the interfaces between metallic contacts and organic semiconductor films in hybrid devices such as organic light emitting diodes, organic solar cells or organic field effect transistors influence significantly the device performance. In this work the metal film growth is assessed by in situ monitoring of the Raman scattering by the internal and collective vibrational modes in crystalline organic semiconductor layers. As model systems molecular layers of two perylene derivatives, viz. 3,4,9,10-perylene-tetracarboxylic dianhydride (PTCDA) and dimethyl 3,4,9,10-perylene-tetracarboxylic diimide (DiMe-PTCDI) grown on sulfur passivated GaAs(100) substrates were investigated. Silver, known to form rather inert contacts, magnesium, known as a very reactive metal, and indium, a metal with intermediate reactivity, were deposited each by thermal evaporation under ultra-high vacuum conditions. The experiments benefit from a strong enhancement of the scattering intensity of internal molecular modes induced by the metals layers, known as Surface Enhanced Raman Scattering (SERS). The analysis of the spectral evolution with the metal thickness allows to extract information on the chemical aspects of the interface formation, on the diffusion length of the metal atoms into the organic layers as well as on the morphology of the growing metallic layers.

Invited Talk DS 18.4 Wed 16:30 H34

In-situ monitoring of stress evolution in growing group-III-nitride layers — •Alois Krost, Armin Dadgar, Rainer Clos, Gunther Strassburger, and Fabian Schulze — Institute of Experimental Physics, Otto-von-Guericke-University Magdeburg

Strains and stresses in heteroepitaxy are omnipresent but until recently, due to a lack of in-situ access, the potential problems were often not observed at the source: Stress can lead to misfit dislocations or cracking of layers as well as strongly curved wafers after epitaxy, which has to be avoided for high quality devices. An in-situ sensor monitoring stress is not only useful for monitoring strain during the growth of highly mismatched systems as Group-III-Nitrides, which are usually grown on heterosubstrates, but also for strain balanced Quantum-Wells or Bragg mirrors. It is a very useful tool, especially in difficult to control systems as GaN-on-Si, where tensile thermal strain leads to cracking for layers even below 1 μm in thickness. Therefore to apply strain engineering methods and optimize growth an in-situ stress sensor is prerequisite. We will show how stress can be determined during epitaxy and that not only film stress but also the composition of ternary alloys can be determined exactly. We will discuss the limits of Stoney's equation, usually applied to calculate film stress, and present an analytical method for the determination of wafer curvature and elastic stress also in the non-linear range.