DS 23: Optical Analysis of Thin Films (Reflection, Ellipsometry, Raman, IR-DUV Spectroscopy, ...)

Time: Thursday 10:45–12:15 Location: H14

DS 23.1 Thu 10:45 H14

Raman characterisation of composite thin films of PEDOT:PSS and Cu2ZnSnS4 nanocrystals — •Yevhenii Havryliuk[1,2,3], Volodymyr Dzhagan[3], Oleksandr Selyshchev[1,2], and Dietrich R.T. Zahn[1,2] — [1]Semiconductor Physics, Chemnitz University of Technology, Chemnitz, Germany — [2]Center for Materials, Architectures, and Integration of Nanomembranes (MAIN), Chemnitz, Germany — [3]V.E. Lashkaryov Institute of Semiconductor Physics NAS of Ukraine, Kyiv, Ukraine

The increasing demand for renewable energy sources powers the high research interest in the fields of photovoltaics and thermoelectrics. One of the materials promising in these fields are Cu2ZnSnS4 (CZTS) family compounds. CZTS nanocrystals (NCs) for third generation photovoltaics can be obtained by low-temperature "green" colloidal synthesis. Another material widely studied especially for thermoelectric applications is PEDOT:PSS. Usually these two materials are used as separate layers in devices. However, using them in a composite layer probably can reveal even more interesting properties. Therefore, we investigated such composite films with different polymer/NC ratios. Raman spectroscopy was used as a main characterization method. We detected the modification of the structure of PEDOT:PSS films upon incorporation of NCs and found that the formation of the CZTS NCs films using a drop-casting method occurs differently in the presence of even a small amount of PEDOT:PSS. The change in the stability of the PEDOT:PSS/CZTS composite under intense laser irradiation, in comparison with the pure components, was also investigated.

DS 23.2 Thu 11:00 H14

dielectric function of Al(1-x)ScxN obtained by spectroscopic ellipsometry. — •Younes Slimi[1], Rebecca Petrich[1], Rüdiger Schmidt-Grund[1], Hauke-Lars Honig[2], Christina Helm[3], Heike Bartsch[3], Jens Müller[3], Peter Schaaf[2], and Stefan Krischok[1] — [1]Fachgebiet Technische Physik I, IMN Macro Nano, Technische Universität Ilmenau, 98693 Ilmenau — [2]Fachgebiet Werkstoffe der Elektrotechnik, Institut für Werkstofftechnik und Institut für Mikro-und Nanotechnologien MacroNano, Technische Universität Ilmenau, 98693 Ilmenau — [3]Fachgebiet Elektroniktechnologie, Technische Universität Ilmenau, IMN Macro Nano, 98693 Ilmenau

Scandium Aluminum Nitride alloy (ScxAl1-xN) thin films were prepared via the sputtering technique. The samples then were measured by spectroscopic ellipsometry (SE) and analysed to determine the sample's dielectric function (DE) by means of numeric b-spline and line shape model dielectric functions. We found a redshift of the bandgap (Eg) and an increasing refractive index with increasing Sc content. As AlN is hexagonal and ScN cubic, the birefringence also reduces when Sc is incorporated into the alloy. Therefore, the samples were measured with XRD and EDX to determine the crystal structure and lattice constant as a function of Sc percentage.

DS 23.3 Thu 11:15 H14

Analysis of CVD coatings with Raman spectroscopy — •Maximilian von Roeder, Peter J. Klar, and Sangam Chatterjee — Institute of Experimental Physics I, Giessen, Germany

The interphase between fibre and matrix is an important component in the preparation of ceramic matrix composites. The understanding of the nature of the coating is crucial for the optimization of CMC materials. Chemical vapour infiltration is the most frequent method of fibre coating. Homogenity, low error density and controlled thickness are the key properties that the coating has to satisfy. Most characterization methods for the coating are very local probes. We applied rough Raman mapping measurements together with principal component analysis to get a broader picture for a larger sample. We studied SiC Hi-Nicalon S fibres with BN/SiC and C coating prepared by chemical vapour infiltration. With a data filtering algorithm to erase the raman spectra of the background we were able to obtain a colour coded maps of the samples. We tested this method with different samples where we introduced errors of different magnitude to determine the sensitivity of the approach. This method provides a quick and easy way to examine a sample with the extensions up to a few centimeters. In this fashion it is possible to study a larger fraction of a prepared material which leads to a higher reliability in quality control.

DS 23.4 Thu 11:30 H14

Time-resolved femtosecond ellipsometry — •Shirly Espinoza — ELI Beamlines, Institute of Physics, Czech Academy of Science, Prague, Czech Republic

The ellipsometry technique is well extend for the study of thin film material. Thanks to femtosecond pulse lasers, we developed a time-resolved femtosecond ellipsometry technique, where a pump beam from any wavelength between 200 nm and 2000 nm excite the material and second pulse, the probe beam, with a continuous spectrum from 350 nm * 750 nm measure the dielectric function of the material. The pump and the probe beam can be separated in time from femtoseconds until nanoseconds generating a time-scan of the relaxation of the material. The time-resolved ellipsometry technique is available to the scientific community at the user-oriented infrastructure ELI Beamlines located few kilometers from Prague, Czech Republic. Examples of successful experiments will be presented and the details of how to apply for beamtime will be shared.

DS 23.5 Thu 11:45 H14

Chalcogenides for Photonic Applications in the Visible — •Felix Hoff[1], Carl-Friedrich Schoen[1], Maximilian Mueller[1], Yiming Zhou[1], Peter Kerres[1], Häser Maria[1], and Matthias Wuttig[1,2,3] — [1]I. Institute of Physics (IA), RWTH Aachen University — [2]Juelich-Aachen Research Alliance (JARA FIT and JARA HPC) — [3]PGI 10 (Green IT), Forschungszentrum Juelich GmbH

Due to its large bandgap, the chalcogenide phase-change material (PCM) Sb_2S_3 is interesting for photonic applications, such as photonic switches in the visible range. Recent publications report contradictory findings concerning the switching speed. Since this property is decisive for many applications, it is important to better understand the crystallization process. To understand glass dynamics and crystallization kinetics, calorimetric measurements were performed. In addition, the optical properties were measured by optical spectroscopy and Ellipsometry. Supporting density functional theory (DFT) calculations are used and a comparison with typical PCMs is made. Sb_2S_3 has significant optical contrast in the visible spectral range, but lower maximum contrast than typical PCMs. It has been shown that crystallization takes significantly longer and has a broader stochastic distribution than for typical PCMs. Furthermore, crystallization occurs from the undercooled liquid phase for a range of heating rates which span over six orders of magnitude, so the glass transition could be studied. Our observations can be explained by the covalent bonding of Sb_2S_3. They can be understood in the context of a quantum mechanical map, which can be utilized to design materials for photonic applications.

DS 23.6 Thu 12:00 H14

IR dual-comb polarimetry of a nanofiber scaffold — •Karsten Hinrichs[1], Brianna Blevins[2,3], Andreas Furchner[4], Nataraja Sekhar Yadavalli[2,3], Sergiy Minko[2,3,5], Raphael Horvath[6], and Markus Mangold[6] — [1]Leibniz-Institut für Analytische Wissenschaften - ISAS e.V., Schwarzschildstraße 8, 12489 Berlin, Germany — [2]Nanostructured Materials Laboratory, The University of Georgia — [3]Department of Chemistry, The University of Georgia — [4]Helmholtz-Zentrum Berlin für Materialien und Energie GmbH, Division Energy and Information, Schwarzschildstraße 8, 12489 Berlin, Germany — [5]Department of Textile, Fiber, and Polymer Sciences, The University of Georgia, Athens, Georgia 30602, United States — [6]IRsweep AG, Laubisruetistrasse 44, 8712 Staefa, Switzerland

In this study the transmission properties of an anisotropic nanofiber scaffold are investigated non-invasively under ambient conditions by IR dual-comb polarimetry (DCP). Good agreement between DCP and classical FTIR polarimetry is found for amplitude and phase measurements at various azimuthal sample rotations, proving DCP as a new method for the study of such anisotropic samples in very short measurement times. A spectral information in the range of 1200 cm-1 to 1300 cm-1 can be achieved in 0.065 ms at 1.4 cm-1 spectral resolution showing the potential for imaging applications, time resolved studies and hyperspectral spectroscopy of anisotropic samples. We acknowledge financial support by the EU through EFRE 1.8/13 and the Horizon 2020 grant 820419 and by the BMBF through CatLab (03EW0015A).