DS 16: Layer Properties: Electrical, Optical, and Mechanical Properties I

Time: Monday 17:00–18:30 Location: CHE 91

DS 16.1 Mon 17:00 CHE 91

On the depolarization in granular thin films: A systematic Mueller-Matrix approach. — •Bruno Gompf, Maximilian Gill, Martin Dressel, and Audrey Berrier — 1. Physikalisches Institut and Research Center SCoPE, Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart, Germany

Optical reflection or transmission measurements are usually described in the framework of Fresnel's equations, whereas the scattering of light on spherical particles is treated by Mie-theory. But what happens when strongly scattering dielectric Mie-particles form a thin film? To our eyes these granular films appear white. But how do they depolarize light? The polarization state of light is described by its Stokes vector, which can be visualized on a Poincare sphere. The interaction with the sample leads to a jump from one point of the Poincare sphere to another point (or area). Mueller-matrices allow a model-free description of this jump. Here we present systematic transmission and reflection Mueller-matrix ellipsometric measurements on strongly scattering granular BaSO4 thin films of different thicknesses. The depolarizing behavior is characterized via a comparative study of the respective differential-, product-, and sum-decomposition of the measured Mueller-matrices. The result of the different decompositions, together with the correlation effects reveals the underlying physical processes of depolarization.

DS 16.2 Mon 17:15 CHE 91

Synthesis, crystal growth and characterization of less-known vanadium-based TMDC compounds — •Konstantin Nikonov[1,3], Niels Ehlen[1], Boris Senkovskiy[1], Alexander Fedorov[1,2], Nihit Saigal[1], Wouter Jolie[1], Timo Knispel[1], Maria Brekhovskikh[3], and Alexander Grueneis[1] — [1]II. Physikalisches Institut, Universitaet zu Koeln, Germany — [2]IFW Dresden, Germany — [3]IGIC RAS, Moscow, Russia

Layered transition metal dichalcogenides are a very popular class of materials due to vast diversity of their electronic properties and layered structure, which makes it some kind of intermediate between 3D and 2D materials. Their begavior may vary from semiconducting, as in MoS_2, to metallic or semimetallic, as in VSe_2 or $ZrSe_2$. Various phenomena such as superconductivity and charge dencity waves can be observed in different TMDC under suitable conditions.

Despite long history of research, many of TMDC systems still were not studied by modern methods of solid state physics. Vanadium-based TMDC, such as VSe_2 and VTe_2 avoided close scientific attention due to difficult process of their synthesis and crystal growth.

In this work we aim to fill knowledge gap in vanadium-based systems, such as VSe_2 and VTe_2 and further investigate this group of layered materials.

DS 16.3 Mon 17:30 CHE 91

The study of interaction, nonlinear and dissipation effects in nanomembranes by investigating the dispersion relations of bending waves — •Fan Yang[1], Reimar Waitz[2], and Elke Scheer[1] — [1]Universität Konstanz, Konstanz 78457, Germany. — [2]Rational AG, 86889 Landsberg am Lech, Germany.

Deciphering the mode shapes of vibrations of nanopatterned membranes is paving the way for applications of nanoscale membranes which rely on particular properties of vibrational excitations. The mode shape of bending waves in thin membranes is measured as a function of space and time, using a phase-shift interferometer with continuous and stroboscopic light. We develop a method to separate the contribution of the excitation system from the measured amplitude in order to obtain the contribution of the membrane itself. The eigen-frequencies and the Q factor of the membrane can be obtained as well. With this method we are able to determine the dispersion relation of membrane oscillations in a frequency range from their ground mode up to 12 MHz. For membranes with an inhomogeneous stress, an algorithm to obtain a map of the lateral stress tensor components is presented. The study of the temperature dependent vibration behavior reveals an expected temperature dependence of the mechanical properties of a prestressed nanomembrane. Mechanical properties of different designed nanopattern-membranes are investigated by using our method.

DS 16.4 Mon 17:45 CHE 91

Optical Characterization of Anisotropic Thiophene-Phenylene Co-oligomer Micro Crystals by Spectroscopic Imaging Ellipsometry — •Christian Röling[1], Elena Y. Poimanova[2], and Vladimir V. Bruevich[3] — [1]Stresemannstrasse 30, 37079 Göttingen — [2]Donetsk National University, Department of Chemistry, Ukraine — [3]International Laser Center & Physics Faculty, M.V. Lomonosov Moscow State University, Vorobyevy gory, Moscow

Here we demonstrate Imaging Ellipsometry as a combination of microscopy and ellipsometry to characterize even micro-sized thin film crystals on plane surface regarding anisotropy, optical properties, crystalline domains and thickness. The semiconducting thiophene-phenylene co-oligomer 1,4-bis(5'-hexyl-[2,2'-bithiophen]-5-yl)benzene (dHex-TTPTT) crystals were grown by solvent based self-assembly technique on silicon substrate with 300 nm thermally silicon dioxide. The ellipsometric measurements were performed with an Ep4-SE (Accurion). In an ellipsometric high-contrast image of the complete sample we have localized high quality single crystals. After demonstrating the biaxial anisotropy of the crystal by using Müller-Matrix imaging ellipsometry we determined the optical axes by rotating the sample and performed spectroscopic measurements (λ = 400-700 nm) in 5 nm intervals. The optical properties were described by using a Lorentz term in the Ep4-Model. After determining the dispersion of the crystals we converted a recorded Delta and Psi-map into a 2D thickness image. Based on a quantitative analysis of the resulting thickness map we have calculated the height of a molecular layer (3.49 nm).

DS 16.5 Mon 18:00 CHE 91

Investigation of Indirect Excitons in Bulk *2H*-MoS2 Using Transmission Electron Energy-Loss Spectroscopy — •Carsten Habenicht, Martin Knupfer, Roman Schuster, and Bernd Büchner — Leibniz Institute for Solid State and Materials Research, Dresden, Germany

Two-dimensional transition metal dichalcogenides are promising materials for applications in electronics, optoelectronics and photovoltaics among others. The design of efficient devices requires a detailed knowledge of the charge carrier dynamics in those materials, including the occurrence of excitons. We have investigated the indirect excitonic transistions in bulk *2H*-MoS2 using transmission electron energy-loss spectroscopy. The electron energy-loss spectra of *2H*-MoS2 in the (100) and (110) directions were measured for various momentum transfers up to values corresponding to the distances between the center of the Brillouin zone and their respective edges in reciprocal space. The results allow the identification of a number of indirect excitons and to a limited extent their energy-momentum dispersion. For example, an excitonic transition from a K point to an adjacent K point of the Brillouin zone were observed.

DS 16.6 Mon 18:15 CHE 91

Electronic properties of few-layer phosphorene from first-principles calculations — •Bukyoung Jhun and Cheol-Hwan Park — Department of Physics and Astronomy, Seoul National University, Seoul 08826, Korea

Phosphorene, a recently synthesized two dimensional material, has attracted a wide attention due to its numerous extraordinary physical properties such as spatially anistropic electrical and thermal conductance[1], superconductivity[2], and electronic topological transition tunable by electric field[3]. Because of the extraordinary properties, it is considered useful in opto-elctronics and electronics. We studied the electronic properties of multi-layer phosphorene in various environments by means of density-functional theory calculations. We expect the results to be helpful in interpreting experiments on the material and in designing phosphorene-based devices.

Reference

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[2] Y. F. Ge, W. H. Wan, F. Yang, and Y. G. Yao, "The strain effect on superconductivity in phosphorene: a first-principles prediction," New Journal of Physics 17 (2015).

[3] Q. H. Liu, X. W. Zhang, L. B. Abdalla, A. Fazzio, and A. Zunger, "Switching a Normal Insulator into a Topological Insulator via Electric Field with Application to Phosphorene," Nano Letters 15 (2), 1222-1228 (2015).