DS 1 Optical properties of thin films I

Time: Monday 09:30–11:00 Room: GER 37

DS 1.1 Mon 09:30 GER 37

Spectroscopic ellipsometry of ZnO thin films grown by pulsed reactive magnetron sputtering at elevated temperatures — •M. Vinnichenko[1,2], A. Rogozin[1], N. Shevchenko[1], M. Ozerov[2], A. Kolitsch[1], and W. Möller[1] — [1]Institut für Ionenstrahlphysik und Materialforschung, Forchungszentrum Rossendorf, P.F. 510119, 01314 Dresden, Germany — [2]Division of Optics, Department of Physics, National Kyiv Taras Shevchenko University, 01033 Kyiv, Ukraine

Understanding of the growth process of undoped ZnO thin films is important for optoelectronic applications of the material. In this study, ZnO layers were deposited at single crystalline Al_2O_3 (0001) substrates by pulsed reactive magnetron sputtering. Oxygen partial pressure, base pressure and the substrate temperature (Ts) were varied systematically. The films were characterized by spectroscopic ellipsometry (SE), Seebeck effect measurements and X-ray diffraction (XRD). SE data were analyzed by using graded layer model for the film with Lorentz oscillator parameterization of the ZnO optical constants. The films produced at low temperatures always have negative Seebeck voltage, while at Ts>540 °C it changes to low positive values, which, however, degrade to negative values within several hours. The Lorentz oscillator broadening for the films grown at these temperatures increases with oxygen flow which points to a formation of more disordered structure inside ZnO grains in this case. XRD analysis yields decreasing grain size and increasing rocking curve full width on a half maximum with oxygen flow enhancement at the same Ts.

DS 1.2 Mon 09:45 GER 37

Optical properties of oxide films heavily doped with Ytterbium ions — •Georgiy Malashkevich[1], Oksana Chukova[2], Volodymyr Degoda[2], Sergiy Nedilko[2], and Sergiy Yablochkov[2] — [1]Institute of Molecular and Atomic Physics of BAS, 68, Skarini Ave., Minsk, Belarus — [2]Kyiv National Taras Shevchenko University, 2, block 1, acad. Hlushkov Ave., 03680, Kyiv, Ukraine

The films doped with ytterbium ions can find application in quantum electronics, e.g. as materials for UV- and near IR planar lasers, in scintillation technique as fast detectors of ionising radiations, including detection of neutrinos, etc.

The ytterbium ions are characterized by quasi-absence of cross-relaxation. Efficiency of the Yb^{3+} ions inner emission from 2F5/2 level and charge transfer luminescence are determined by nonradiation and radiation excitation, energy transfer from charge transfer state to the $^2F_{5/2}$ level of the Yb^{3+}, by rate of direct inner excitation and transfer of excitation from electron-hole pairs created under high energy excitation, as well as by cooperative processes and formation of paired centers.

The spectral-luminescent properties and processes of intra-center excitations transfer in $CeO_2H : Yb$ oxide nanoparticles and complicated $[FeO_6] : Yb$ centers in the nano-structured films created by the selection the redox conditions and buffer elements have been investigated. The noble metals (Ag^0, Au^0 and Pt^0) nanoparticles with different sizes and shapes in the films have been formed and their influence on hysteretic behaviour of cooperative luminescence from pairs of the Yb^{3+} ions was investigated. This work is supported by STCU Project 2042.

DS 1.3 Mon 10:00 GER 37

Optical properties of noble metal alloy nanocomposites prepared by vapor phase co-deposition. — •Haile Takele, Venkata Sai Kiran Chakravadhanula, Henry Greve, Vladmir Zaporjtchenko, and Franz Faupel — Lehrstuhl für Materialverbunde, Technische Fakultät der CAU Kiel, Kaiserstr. 2, 24143 Kiel, Germany.

Ag-Au and Ag-Cu nanoparticles have been prepared in a Teflon AF matrixes, by co-deposition of the components from three different evaporators in a high vacuum. The microstructure of the nanocomposites, alloy formation, and there optical properties were investigated by using TEM, XRD, and UV-Visble spectroscopy, respectively. A complete alloy formation of Ag-Au nanoparticles in a Teflon AF matrix provides a single surface plasmon resonance (SPR) that allows tuning over a large range of the visible spectrum. The resonance wavelength of Ag-Au alloy nanocomposites were defined by varying the ratio of the Ag and Au volume fraction at a constant metal volume fraction in the composites. Moreover, multiple resonance wavelengths were observed from immiscible elements of Ag-Cu alloy nanoparticles in a Teflon matrix. The effect of substrate temperature during deposition and post deposition annealing on the alloy formation and nanocomposite morphology were studied as well.

DS 1.4 Mon 10:15 GER 37

Size and Surroundings Dependence of the Optical Interband Excitations in Silver Nanoparticles — •Uwe Kreibig and Almuth Hilger — I. Institute of Physics (IA) RWTH Aachen University D-52056 Aachen, Germany

Ag nanoparticles (2 nm mean diameter) were produced by our thermal evaporation cluster source THECLA. By expansion into UHV a free particle beam was created which could be embedded in different co-evaporated dielectric embedding media. The optical absorption was measured in the VIS-nearUV region, and, by Kramers-Kronig analysis, the average dielectric function of the particle material was determined. The susceptibility of the 4d-5sp interband transition edge could then be separated by subtracting the Drude-Sommerfeld contribution. Two essential results will be discussed: 1) The fine structure of the interband transition edge of the free nanoparticles differs markedly from bulk Ag. 2) The deviations from the bulk Ag spectrum depend clearly on the kind of embedding medium, applied. They are larger for LiF than for SiO_2 but both are smaller than for the free particles.

DS 1.5 Mon 10:30 GER 37

Vapor induced changes in optical and electrical properties of quasi 2-dimensional metal/polymer nanocomposites near the percolation threshold for sensor applications — •Christian Pochstein, Vladimir Zaporojtchenko, Henry Greve, and Franz Faupel — Lehrstuhl für Materialverbunde, Technische Fakultät der CAU Kiel, Kaiserstr. 2, 24143 Kiel, Germany

Easy producible sensors for organic chemical vapor detection are of increasing interest for various applications. We have produced quasi two dimensional systems of noble metal (Au, Ag) clusters embedded in different polymer films (PMMA, PS, Nylon6). The polymer films were prepared via spin-coating in various thicknesses from 100 to 500 nm on different substrates. The clusters with the density near the percolation threshold were synthesized by the deposition of metal in high vacuum on the polymer surface. The threshold was determined by in-situ measurements of the electrical resistance. The size and density of the clusters were specified by TEM measurements. The time dependent resistance measurements showed that responses of the sensor-nanocomposite to different organic vapors depends on the composite conductivity, the polymer thickness and the vapor pressure. In addition the shift of the plasmon resonance due to the absorbance of the solvent vapor was observed by using UV-Visible spectroscopy.

DS 1.6 Mon 10:45 GER 37

Optical properties of ultra-thin metal films at and below the percolation threshold — •Tobby Brandt, Bruno Gompf, Natalia Drichko, and Martin Dressel — 1. Physikalisches Institut der Universität Stuttgart

While the optical properties of thicker metal films are well understood, little has been done at and below the metal-to-insulator transition (percolation threshold), especially in the infrared region.

We present temperature dependent FTIR reflection measurements in the range 500 to 6000 cm^{-1} on ultra-thin gold films grown on vicinal Si (111)(7x7) surfaces. The films with thicknesses between 9 nm and 0.4 nm were characterized in situ under UHV conditions between 300 K and 5 K.

The thicker films show normal Drude behaviour with an increasing reflectivity toward lower frequencies. At about 2 nm the metal-to-insulator transition is observed. Here the films show a nearly frequency and temperature independent optical conductivity. Below 2 nm a dielectric anomaly was observed with an inverted temperature characteristic. The data are analysed within the framework of the model given by D. Bedeaux and V. Vlieger [1], which has the advantage compared to effective medium theories, that it takes explicitly the interaction with the interface into account.

[1] D. Bedeaux and J. Vlieger ; "Optical Properties of Surfaces"; Imperial Collage Press, 2001