# DS 17: Layer Properties: Electrical, Optical and Mechanical Properties I

Time: Wednesday 9:30–11:00 Location: GER 37

DS 17.1 Wed 9:30 GER 37

**Physical and electrochemical properties of anodic oxides on combinatorial valve metal libraries. An application of the Scanning Droplet Cell** — •Andrei Ionut Mardare[1], Alan Savan[2], Alfred Ludwig[2], Andreas Dirk Wieck[2], and Achim Walter Hassel[1] — [1]Max-Planck-Institut für Eisenforschung, Düsseldorf, Germany — [2]Ruhr-Universität, Bochum, Germany

Usually, the electrochemical properties of valve metal alloys and their anodic oxidation are investigated in a small component concentration range limited by the number of available samples. A combinatorial approach has the advantage of offering a very broad compositional distribution of the alloys using a minimum number of samples. A vapor phase co-deposition technique, (co-sputtering), is successfully used for deposition of thin film binary and ternary composition spreads from various valve metals. The basic properties of the newly created alloys are mapped using SEM and XRD as a function of their composition. An automated version of a scanning droplet cell (SDC), with a tip diameter of 0.2mm, is used for local growth of anodic oxides on the surface of the combinatorial valve metal libraries. Using a step-wise increase of the oxide thickness combined with electrochemical impedance spectroscopy (EIS) allow the in-situ measurement of the oxide capacitance and electrical resistance. These lead further to the calculation of the permittivities and electrical resistivities of the anodic oxides and the computer-controlled SDC allows a mapping of these properties as a function of the parent metal concentrations.

DS 17.2 Wed 9:45 GER 37

**Annealing experiments of Sb doped $SnO_2$ thin films** — •Janika Boltz, Dominik Köhl, and Matthias Wuttig — 1.Physikalisches Institut 1A, RWTH Aachen University, Aachen, Germany

Sb-doped $SnO_2$ films posses a high optical transparency and good electrical conduction, which makes them attractive for TCO applications. In order to deposit suitable films on large area substrates we have explored the properties of Sb-doped $SnO_2$ thin films that have been prepared by reactive dc magnetron sputtering from a metallic target. Films with reasonable quality can only be produced in a narrow process window. Therefore the films were subsequently annealed at 350 °C in an Ar atmosphere. Samples were optically and electrically characterised employing spectroscopic methods (transmission, reflectance and ellipsometry) and 4-point probe resistivity measurements. In order to investigate the structure and stoichiometry of the sputtered films X-ray diffraction and RBS (Rutherford Backscattering) measurements have been performed. At the transition to highly transparent films the specific resistivity drops to a minimum of $5{\cdot}10^2\Omega{\cdot}$cm and the films transform to crystalline $SnO_2$. By subsequent annealing the transmission and specific resistivity of Sb-doped $SnO_2$ films are improved and a wider process window is observed.

DS 17.3 Wed 10:00 GER 37

**Influence of substrate temperature and oxygen partial pressure on the electrical properties of Al-doped ZnO grown by reactive pulsed magnetron sputtering** — •Steffen Cornelius, Mykola Vinnichenko, Anatoly Rogozin, Natalia Shevchenko, Andreas Kolitsch, and Wolfhard Möller — Institut für Ionenstrahlphysik und Materialforschung, Forschungszentrum Dresden-Rossendorf e.V., Bautzner Landstraße 128, 01328 Dresden, Deutschland

The study is focused on improvement of the free electron mobility in Al-doped ZnO films grown by reactive pulsed magnetron sputtering. At optimum growth conditions low-absorbing films are obtained with a Hall mobility of 46 $cm^2V^{-1}s^{-1}$, a free electron density of $6.0{\cdot}10^{20}$ $cm^{-3}$, and an electrical resistivity of $2.26{\cdot}10^{-4}$ Ωcm. The relation between the mobility and free electron density for different growth conditions is discussed in terms of ionized impurity scattering, impurity clustering, and grain boundary limited transport.

DS 17.4 Wed 10:15 GER 37

**Deposition, characterization and biological application of ZnO double-layers** — •Angela Vlad[1], Sergii Yakunin[1], Erich Kolmhofer[2], Vikotoriia Kolotovska[3], Leila Muresan[4], Alois Sonnleitner[3], Dieter Bäuerle[1], and Johannes Pedarnig[1] — [1]Institute of Applied Physics, Johannes Kepler University, A-4040 Linz, Austria — [2]DICE GmbH & Co KG, Freistädter Straße 400, A-4040 Linz, Austria — [3]Center for Biomedical Nanotechnology, Upper Austrian Research GmbH, A-4020 Linz, Austria — [4]Department of Knowledge-Based Mathematical Systems, Johannes Kepler University, A-4040 Linz, Austria

Double-layers of Lithium doped ZnO (LZO) and Aluminum doped ZnO (AZO) are grown on r-cut sapphire (r-$Al_2O_3$) crystal substrates by pulsed-laser deposition. The epitaxial double-layers are a - axis lattice oriented to the substrate. The LZO / AZO / r-$Al_2O_3$ samples have high optical transmission in the visible range and a band-gap energy of $E_g = 3.23$ eV according to the absorption edge of ZnO. The AZO bottom layers are electrically conductive (resistivity at room temperature $\rho = 10^{-3}$ Ω cm) and LZO top layers are highly resistive ($\rho = 10^5$ Ω cm). Acoustic shear mode resonances in r-$Al_2O_3$ are excited by employing electric fields to the piezoelectric LZO layer (frequency interval 1.5 - 3 GHz). For biological applications, madine darby canine kidney cells are cultivated on Platinum coated LZO / AZO / r-$Al_2O_3$ samples. Osmotic pressure applied to the cells increases or reduces the cell volume depending on the osmolarity of the medium.

DS 17.5 Wed 10:30 GER 37

**Ultrathin SiO films on Si(111) studied by infrared spectroscopy - Probing the Si/SiO interface** — •Markus Klevenz, Steffen Wetzel, and Annemarie Pucci — Kirchhoff-Institut für Physik der Universität Heidelberg; INF 227; 69120 Heidelberg

The growth of an ultrathin SiO film on clean Si(111) was studied *in situ* by infrared spectroscopy. The film was produced by thermal evaporation from a Knudsen cell with a final average film thickness of 12 Å. A large shift of the SiO main vibrational frequency from about 880 $cm^{-1}$ for very low thicknesses to the bulk value of SiO about $984{\pm}6$ $cm^{-1}$ for thicknesses larger than 10 Å was observed. Possible reasons for this strong shift will be discussed.

DS 17.6 Wed 10:45 GER 37

**Conductivity of nanocrystalline chromium from infrared spectra** — •Robert Lovrincic and Annemarie Pucci — Kirchhoff-Institut für Physik der Universität Heidelberg

During the growth of Cr on diamond C(100) a structural phase transition from a disordered phase to the crystalline bulk phase is observed. The nature of the phase transition is clarified by analysing thickness dependent infrared transmittance spectra with a Drude-Smith type dielectric function. In particular, there is an evident memory effect in the electronic collisions below a critical thickness of 2.5 nm and a clear Drude-type behaviour above that thickness. The thickness of that phase transition well agrees with the predicted maximum diameter value for stable fcc Cr nanoclusters. It is hence concluded that a phase transition from fcc nanoclusters to the bulk bcc phase is the origin of the observed spectral behaviour.

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