troscopy. Emphasis has been placed on pure Ag and combined Ag/Au nanoparticles.

DS 29.6 Thu 12:30 GER 37

Metal Nanostructures bound to Dielectric Substrates for Plasmonic Applications — •Marisa Mäder, Susanne Perlt, Markus Lippmann, Jürgen Gerlach, Thomas Höche, and Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung e.V., Permoserstraße 15, 04109 Leipzig, Germany

Metal nanospheres, especially when arranged in a predefined way, facilitate surface plasmon related applications [1]. In this paper, a method called Diffraction Mask Projection Laser Ablation (DiMPLA) [2] is used to create such nanostructres. The straightforward method uses an Excimer laser pulse (KrF, 248 nm, 25 ns) whose intensity is laterally modified by a phase mask and subsequently demagnified (15x, 36x, 50x) by a reflective objective. Exposure of a thin metal film on a dielectric substrate leads to the formation of metal nanostructures. Dependent on the phase mask that is applied in the setup, the arrangement of nanospheres on the sample can be controlled as desired. It is even possible to create non-regular pattern arrangements. Dependencies of the nanospheres on different parameters and some first steps into plasmonic applications are presented in this paper.

[1] W. M. Saj, Optics Express 13, 2005, 4818
[2] M. Maeder et al., Phys. Stat. Sol. (RRL) 2, 2008, 34

DS 30: Application of Thin Films I

Time: Thursday 14:15–16:00 Location: GER 37

DS 30.1 Thu 14:15 GER 37

Extraction of nitride trap density distribution in SONOS (silicon-oxide-nitride-oxide-silicon) structures based on an advanced thermal emission model — •Kerstin Bernert[1], Jonas Schönlebe[2], Christiane Oestreich[2], and Thomas Mikolajick[2] — [1]Forschungszentrum Dresden-Rossendorf, Bautzner Landstraße 128, 01328 Dresden — [2]Institut für Elektronik- und Sensormaterialien, Technische Universität Bergakademie Freiberg, 09599 Freiberg

As a result of continued scaling and the emphasis on low power and low voltage operation, silicon-oxide-nitride-oxide-silicon (SONOS) nonvolatile memory has received more attention recently. In this talk we investigate the charge decay characteristics of SONOS devices at elevated temperatures. Based on the thermal emission model as the dominant charge loss mechanism, the trap density energy distribution is determined. Furthermore, we present an advanced model which includes the influence of subsequent tunneling through the bottom oxide after thermal excitation in the conduction band of the nitride.

DS 30.2 Thu 14:30 GER 37

Liquid Injection Atomic layer deposition of metallic Ru and RuO_2 thin films for electrode applications — •Susanne Hoffmann-Eifert, Seong Keun Kim, and Rainer Waser — Forschungszentrum Jülich, IFF-IEM and JARA-FIT, 52425 Jülich, Germany

In this project we studied the liquid injection atomic layer (LI-ALD) deposition of metallic Ru and RuO_2 thin films for application as electrode layers. The new capacitors will be built up from ultra thin films of higher-k materials like $SrTiO_3$ or (Ba, Sr)TiO_3 in order to decrease the equivalent oxide thickness. In order to have a conducting metallic or oxide electrode available for 3D integrated capacitor structures, we investigated the ALD growth process for Ru/RuO_2 thin films in detail. In this study, RuO_2 films were deposited using traveling wave type ALD reactor. Tris(2,2,6,6-tetra-methyl-3,5-heptanedionato)ruthenium(III)(Ru(TMHD)3) dissolved in ethylcyclohexane was used as a metal source. The Ru-solution was pulse injected and evaporated in a vaporizer at a temperature of 200 °C. The growth behavior of the ALD Ru/RuO_2 films was studied as a function of the substrate temperature and the type of oxidant. The films were characterized with respect to their structural, morphological and resistance properties. Special interest is layed on the effect of the solvent on the oxidation state of the conducting Ru based thin films. A model is suggested which explains the different growth behavior of Ru/RuO_2 films in "bubbler-type"and LI-ALD-type processes.

DS 30.3 Thu 14:45 GER 37

Liquid Injection Atomic Layer Deposition of Lead Zirconate Titanate Thin Films for Three Dimensional Ferroelectric Capacitor Structures — •Susanne Hoffmann-Eifert[1], Takayuki Watanabe[1], Cheol Seong Hwang[2], and Rainer Waser[1] — [1]Forschungszentrum Jülich, IFF-IEM and JARA-FIT, 52425 Jülich, Germany — [2]Dept. of Materials Science and Engineering, Seoul National University, Seoul, Korea

In order to combine the functionality of ferroelectric oxides with semiconductor memory devices, thin films with a thickness in the range of about 10 nm have to be integrated onto 3D stack structures with lateral diameter of about 100 nm and a height in the micrometer regime. The thin films have to be homogeneous in thickness and in composition. A fully conformal deposition onto extreme 3D structures can only be achieved by means of an atomic layer deposition (ALD) process. Here, we present an approach by which uniform coverage of multi-component oxide films over complex structures can be achieved in both, the cation composition and the film thickness. Quaternary PZT films were deposited using a combination of liquid injection ALD steps of binary PbO, ZrO_x, and TiO_x films. $Pb(TMHD)_2$, $Ti(OiPr)_4$, and $Zr(DIBM)_2$, dissolved in ethylcyclohexane, and H_2O were used as source materials. PZT films were grown on Pt or Ir-covered Si substrates at 240°C. A further annealing step after deposition was performed to crystallize the material. ALD-PZT films were grown onto 3D structures with homogeneous thickness and cation composition, even after crystallization.

DS 30.4 Thu 15:00 GER 37

Effect of the interface roughness on the performance of nanoparticulate zinc oxide field-effect transistors — •Koshi Okamura, Norman Mechau, Donna Nikolova, and Horst Hahn — Forschungszentrum Karlsruhe, Institute of Nanotechnology, Karlsruhe, Germany

Field-effect transistors (FETs) based on nanocrystalline inorganic materials have been attracting interests as a candidate for printable electronics. Nanocrystalline FETs take the advantage of compatibility with low-temperature and high throughput processes. However, the critical parameter of nanocrystalline FETs is the interface roughness between the nanocrystalline semiconductor and the insulator, where the channel of the FET is formed. Therefore, the correlation between the interface roughness and the performance of nanoparticulate ZnO FETs is systematically investigated. ZnO nanoparticles were dispersed in 2-methoxyethanol with stabilizer at a fixed concentration and processed by ultrasonic treatments. The agglomerate sizes were changed by the duration time, so that the resulting films had different degree of roughness at the interface. The FETs in the bottom-gate configuration were fabricated from suspensions, consisting of a Si substrate, a SiO_2 layer, a spin-coated nanoparticulate ZnO layer and Al source and drain electrodes. The FET with the lowest average roughness of 47.4 nm showed the best mobility of $8.4{\cdot}10^{-3}cm^2/Vs$. In contrast, the FET with the highest roughness of 70.6 nm showed two orders of magnitude lower mobility of $8.7{\cdot}10^{-5}cm^2/Vs$. These results indicate the strong correlation between the interface roughness and the FET performance.

DS 30.5 Thu 15:15 GER 37

Influence of Stabilizers in ZnO nanodispersions on the FET device performance — •Simon Bubel, Donna Nikolova, Norman Mechau, and Horst Hahn — Institute of Nanotechnology, Forschungszentrum Karlsruhe, 76021 Karlsruhe, Germany

In order to build printable inorganic electronic devices, semiconducting suspensions which can be processed at low temperatures and low-cost manufacturing techniques are needed. Stabilized suspensions made of zinc oxide nanoparticles were used to fabricate field-effect transistors (FETs) by spin coating. The performance of the devices is strongly affected by the nature and concentration of the compounds added to stabilize the nanodispersions. An increase of the field-effect mobility by more than one order of magnitude is observed by increasing the stabilizer concentration from 3 to 13 wt %. A further increase of the concentration above 13 wt % results in a decrease of the field-effect

mobility. This behaviour can be explained by changes in the morphology, the particle-particle junction, and the passivation of surface defect sites.

DS 30.6 Thu 15:30 GER 37

Anomalous Nitrogen Diffusivity During Plasma Nitriding of CoCr Alloys at High Temperatures — •Johanna Lutz[1,2], Stephan Mändl[1], and Bernd Rauschenbach[1] — [1]Leibniz Institute of Surface Modification, Leipzig, Germany — [2]Translational Centre for Regenerative Medicine, University of Leipzig, Germany

Plasma immersion ion implantation is an important method to tailor and to increase the physical and chemical properties of numerous materials. In this presentation, the diffusion of nitrogen and the phase formation is investigated for face-centred-cubic CoCr alloys in the temperature range from 230 - 580 °C. Plasma immersion ion implantation was carried out using 10 kV pulse voltage and a process pressure of 0.5 Pa. X-ray diffraction patterns show two different phase structures depending on the temperature: a lattice expansion at temperatures lower than 450 °C while the decomposition of the base material into CrN precipitates and another Co-rich phase is observed at the upper end of the temperature range. A two-step nitriding process at different temperatures shows clearly that at a previous implantation at a temperature of 560 °C, no nitrogen diffusion is observed for a subsequent nitriding at any temperature. For preimplantation at 450 °C, normal diffusivities are observed during the latter process. This clearly indicates that the phase decomposition at elevated temperatures leads to a radical change in the nitrogen diffusivity.

DS 30.7 Thu 15:45 GER 37

Self-Aligned Field Emission Device Prepared by Swift Heavy Ion Irradiation. — •Han-Gregor Gehrke[1], Anne-Katrin Nix[1], Johann Krauser[2], Christina Trautmann[3], Alois Weidinger[4], Jürgen Bruns[5], Frank Wünsch[4], and Hans Hofsäss[1] — [1]Georg-August Universität, Göttingen, Deutschland — [2]Hochschule Harz, Wernigerode, Deutschland — [3]Gesellschaft für Schwerionenforschung, Darmstadt, Deutschland — [4]Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Deutschland — [5]Technische Universität, Berlin, Deutschland

Swift heavy ion irradiation of tetrahedral amorphous carbon (ta-C) results in conductive ion tracks with a diameter of about 8 nm. The goal of our work is the fabrication of self-aligned field emission devices. The ion tracks embedded in the insulating ta-C film form nanosized field emitters. The gate structure is produced by a thin insulating SiN_X and a chromium layer on top of the carbon film. Finally, a spin coated polycarbonate layer is placed on top of the sample. The irradiation of the layer package leads to latent tracks in the polycarbonate above each conducting track in the ta-C. Therefore, after opening the polycarbonate mask with chemical wet etching, the pores are well aligned with the ion track underneath. Finally, the chromium and the SiN_X can be opened by sputtering or plasma etching to create the complete structure. The advantage of this approach is stability of the layer package; no free standing nanowires can be damaged. We present first results of experiments with the described self-aligned field emission structure.

DS 31: Application of Thin Films II

Time: Thursday 16:15–17:45 Location: GER 37

DS 31.1 Thu 16:15 GER 37

Development of multilayer optics for modern X-ray analytics — •Steffen Kroth[1], Jörg Wiesmann[1], Frank Hertlein[1], Carsten Michaelsen[1], and Michael Störmer[2] — [1]Incoatec GmbH, Max-Planck-Strasse 2, 21502 Geesthacht — [2]GKSS Forschungszentrum, Max-Planck-Strasse 1, 21502 Geesthacht

In this contribution, we give an overview on the state-of-the-art beam-shaping multilayer and total reflection optics for XRD in the lab and for synchrotron beamlines. Nowadays a large variety of 1D and 2D optics are available with optimized properties for the customer's applications. We explain the manufacturing process of multilayer and total reflection optics, summarize the different type of optics and give some examples of typical applications. The optics for lab-instrumentation consist of bent substrates with shape tolerances below 100nm, upon which multilayers are deposited with single layer thicknesses in the nm-range and up to several hundreds of layer pairs. Most multilayers were designed with lateral thickness gradients within 1% deviation of the ideal shape. This means that a deposition precision in the picometer range is needed. We use magnetron sputtering for deposition, optical profilometry in order to characterize the shape and X-ray reflectometry to characterize the multilayers. The microstructure is investigated by TEM. The beam parameters like monochromaticity, flux, brilliance and divergence demonstrate the quality of the multilayer optics for different lab applications.

DS 31.2 Thu 16:30 GER 37

Effect of FEL induced ionization on X-ray reflectivity of multilayers — •Dmitriy Ksenzov, Souren Grigorian, and Ullrich Pietsch — University of Siegen, Siegen, Germany

The VUV-FEL in Hamburg (FLASH) emits short-pulse radiation with wavelengths from 6 to 30 nm and a pulse length of 10-50 fs. The FLASH wavelength allows x-ray diffraction experiments at periodical multilayer's structures acting as 1D crystal. The probe of depth selective interaction of the high-intense x-ray short pulse with these objects can be used to obtain information about possible electronic excitation and various recombination processes inside multilayers. As known from recent experiments at FLASH, the later ones are most likely using highly intense FEL radiation.

The ML reflectivity is analyzed for case of that the optical parameters are changing as function of the depth of the penetrating incident pulse into the multilayer. The response is studied for the model system La/B4C using two experimental conditions both at fixed incidence angle: 1) the energy of the incident pulses, E, coincides with the energy of the 1st order multilayer Bragg peak, E_B, of the reflection curve, and 2) the energy of incident pulse differs by a small dE from E_B. The ML response to a given sub-pulse differs for both conditions. However, there is a clear fingerprint of ionization for both conditions for the case that E is close to the K-absorption edge of B-atoms. Our results support respective efforts to measure the optical parameters of solids under high-intense FEL radiation.

DS 31.3 Thu 16:45 GER 37

Broadband multilayer soft X-ray mirrors for attosecond pulse formation at photon energies above 100 eV — •Michael Hofstetter[1], Andrew Aquila[2], Martin Schulze[3], Markus Fiess[3], Eleftherios Goulielmakis[3], Joerg Schuster[1], Martin Huth[4], Ferenc Krausz[3], and Ulf Kleineberg[1] — [1]LMU Physik — [2]CXRO — [3]MPQ — [4]LMU Chemie

We report on the development, fabrication and application of multilayer mirrors as broadband soft-X-ray optical components for the formation of attosecond (1 asec=10^{-18}s)pulses from high harmonic radiation. Until recently, attosecond physics was merely confined to the photon energy range below 100 eV due to the properties of Mo/Si multilayer and single isolated pulses of 80 asec pulse duration have been achieved [Goulielmakis et.al.]. For many applications, e.g. in the characterization of the photoemission dynamics from solid surfaces or the characterization of ultrafast surface plasmon dynamics in metallic nanostructures by attosecond pump-probe spectroscopy, higher photon energies are desirable to address deeper bound electronic core states or to increase the kinetic energy of the emitted photoelectrons [Cavalieri et.al., Stockman et.al.]. Here, we introduce new aperiodic broad bandwidth multilayer systems based on lanthanum (e.g. LaMo, LaB_4CMo, LaB_4C, MoB_4C),for the 100-190 eV photon energy range. Multilayer properties like interface roughness, interlayer formation and reflectivity are discussed. Finally, first applications for spectral filtering of the HHG comb above 100 eV are presented.

DS 31.4 Thu 17:00 GER 37

Influence of nitrogen flow on structure and magnetic properties of magnetron-sputtered FeCo/TiN multilayer films — •Christian Klever and Klaus Seemann — Forschungszentrum Karlsruhe, Institute of Materials Research I, D-76344 Eggenstein-Leopoldshafen, Germany

Soft magnetic thin films with appropriate high frequency properties are