

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 MÄNDL¹, and BERND RAUSCHENBACH¹ — ¹Leibniz Institute of Surface Modification, Leipzig, Germany — ²Translational 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 GEHRKE¹, ANNE-KATRIN NIX¹, JOHANN KRAUSER², CHRISTINA TRAUTMANN³, ALOIS WEIDINGER⁴, JÜRGEN BRUNS⁵, FRANK WÜNSCH⁴, and HANS HOFSSÄSS¹ — ¹Georg-August Universität, Göttingen, Deutschland — ²Hochschule Harz, Wernigerode, Deutschland — ³Gesellschaft für Schwerionenforschung, Darmstadt, Deutschland — ⁴Helmholtz-Zentrum Berlin für Materialien und Energie, Berlin, Deutschland — ⁵Technische 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 KROTH¹, JÖRG WIESMANN¹, FRANK HERTLEIN¹, CARSTEN MICHAELSEN¹, and MICHAEL STÖRMER² — ¹Incoatex GmbH, Max-Planck-Strasse 2, 21502 Geesthacht — ²GKSS 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 an-

gle: 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 HOFSTETTER¹, ANDREW AQUILA², MARTIN SCHULZE³, MARKUS FIESS³, ELEFTHERIOS GOULIEMAKIS³, JOERG SCHUSTER¹, MARTIN HUTH⁴, FERENC KRAUSZ³, and ULF KLEINEBERG¹ — ¹LMU Physik — ²CXRO — ³MPQ — ⁴LMU 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=10⁻¹⁸s)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 [Gouliemakis 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, LaB₄CMo, LaB₄C, MoB₄C), 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

interesting for applications, e. g., as core material for microinductors and for magnetoelastic sensors/actuators. For the use in such devices, tailoring of the magnetic film properties (e. g. saturation magnetization M_S , coercitive field H_C , anisotropy field H_K) is necessary.

In this study, multilayer films consisting of FeCo as the magnetic constituent and TiN as diffusion barrier are developed. The films are grown by sequential magnetron sputter deposition using a FeCo and a TiN target in an Ar atmosphere with an additional N_2 flow between 0 and 5% of the total gas flow. The films are annealed *ex-situ* in a static magnetic field. The static and dynamic macroscopic magnetic properties of the films are determined by means of a vibrating sample magnetometer and a strip-line permeameter connected to a vector network analyzer, respectively. The microstructure and constitution of the films are examined by XRD, XRR, TEM and AES depth profiling.

It is shown that films with a coercitive field below 0.2 mT and a sufficient high frequency response can be produced by defining appropriate growth and film annealing conditions. Furthermore, the correlation between the nanoscale coating architecture, the films' microstructure and its macroscopic magnetic properties is presented.

DS 31.5 Thu 17:15 GER 37

Development of higher m supermirrors — ●VALICU ROXANA and BORCHERT GUNTHER — FRM II

Supermirrors are important components of neutron guides used for performing neutron scattering experiments for from the reactor core to the instruments, where the background is low enough to permit measurements of even weak signals. We will present the methods used at our facility to produce supermirrors, the trials that we have made to increase the performances of supermirrors and the results obtained from the neutron reflectivity measurements. Using the Hayter and Mook algorithm we have simulated sequences with increasing number of Ni

and Ti layers and we have achieved a neutron reflectivity of around 84% for m equal to 3. The next step in improving our facility was to try the reactive sputtering process (by using N and air as sputter gas together with Ar) in order to achieve the deposition of more layers and therefore of higher m-values. X-ray and neutron reflectivity measurements as well as X-ray diffraction and profilometry for the stress analysis were performed in order to determine the proper parameters for the sputtering of Ni. As a consequence we have produced supermirrors with higher m values that were not able to achieve without the reactive sputtering of Ni. Neutron reflectivity measurements for the produced supermirrors show promising results.

DS 31.6 Thu 17:30 GER 37

Nanostructured magnetic FeCo/TiN thin film composites — ●HAYO BRUNKEN, ALAN SAVAN, and ALFRED LUDWIG — Institute of Materials, Faculty of Mechanical Engineering, Ruhr-University Bochum, 44780 Bochum, Germany

In this study, magnetic thin film composites consisting of a nanostructured wear-resistance-coating and a nanogranular ferromagnetic component are presented. The magnetic thin film composites were prepared from a precursor multilayer thin film (FeCo/Ti) using magnetron sputtering. The multilayer precursor structure was deposited as a continuous composition spread on Si/SiO₂ substrates and transformed into a multiphase microstructure by thermal activation (typically 850°C, 1 h) in a reactive atmosphere (N₂). The characterization of the annealed thin films' microstructure using X-ray diffraction indicated a FeCo (100) phase and the formation of a TiN (111) phase. Furthermore, it was found that the films show a coercivity below 2 mT and a high saturation magnetization. Funding by the DFG via the priority program 1299 is gratefully acknowledged.

DS 32: Invited Johnson

Time: Thursday 9:30–10:15

Location: GER 38

Invited Talk

DS 32.1 Thu 9:30 GER 38

Optimizing Electronic Properties of Misfit Layered Compounds — ●DAVID JOHNSON¹, COLBY HEIDEMAN², QIYIN LIN³, and CLAY MORTENSEN⁴ — ¹University of Oregon, Eugene, Oregon, USA — ²University of Oregon, Eugene, Oregon, USA — ³University of Oregon, Eugene, Oregon, USA — ⁴University of Oregon, Eugene, Oregon, USA

Misfit layered compounds are naturally occurring nanostructured solids that have been reported to have low thermal conductivities on the order of 0.8 Wm⁻¹K⁻¹ and unoptimized figures of merit ZT as large as 0.3. We have recently reported thermal conductivity in [(PbSe)_{1.00}m[MoSe₂]_n and [(PbSe)_{0.99}m[WSe₂]_n misfit compounds

as low as 0.06 Wm⁻¹K⁻¹. Here we describe annealing treatments of these misfit compounds in fixed chalcogen partial vapour pressures and demonstrate that samples equilibrate with the dominant source of vapour, resulting in controlled carrier concentrations. The thermal stability of these materials allows annealing times and temperatures in excess of 24 hours and 500° C to be used without destroying the layered structure. We present data showing the convergence of electrical properties for isostructural samples on annealing. In addition to control of carrier concentrations, the annealing treatments dramatically improve the carrier mobility. We report electrical resistivity, Seebeck coefficients and carrier concentrations as a function of annealing conditions.

DS 33: Thermoelectric Thin Films and Nanostructures I

Time: Thursday 10:30–12:00

Location: GER 38

Topical Talk

DS 33.1 Thu 10:30 GER 38

Preparation and Charakterisierung von thermoelektrischen Nanodrähten — ●FRIEDEMANN VÖLKLEIN¹, REINHARD NEUMANN², SVEN MÜLLER², OLIVER PICHT², HEIKO REITH¹ und MATTHIAS SCHMITT¹ — ¹Institut für Mikrotechnologien, FH Wiesbaden, Am Brückweg 26, D-65428 Rüsselsheim, Germa — ²GSI Helmholtzzentrum für Schwerionenforschung GmbH, Planckstraße 1, D-64291 Darmstadt, Germany

Thermoelektrische Nanodrähte werden bei GSI Darmstadt durch Ionenspur-Technologie und elektrochemische Abscheidung hergestellt. Die thermoelektrischen Eigenschaften von Bismuth- und V/VI-Verbindungshalbleiter-Nanodrähten als Funktion der Kristallstruktur, der Zusammensetzung und der Draht-Abmessungen werden untersucht, um Modelle des Ladungs- und Wärmetransports in niederdimensionalen thermoelektrischen Materialien zu entwickeln. Microchips zur Messung der elektrischen und thermischen Leitfähigkeit und des Seebeck- Koeffizienten von einzelnen Nanodrähten wurden entwickelt und erfolgreich getestet. Diese Messungen gestatten die Bestimmung der thermoelektrischen Effektivität ZT und damit die Prüfung theo-

retischer Voraussagen hinsichtlich einer Steigerung von ZT in niederdimensionalen Thermoelektrika als Folge von Quantum-Size Effekten bzw. verstärkter Phononen-Streuung.

DS 33.2 Thu 11:00 GER 38

Thermoelectric transport in periodic 1D stacks of InAs/GaAs quantum dots — ●VLADIMIR M. FOMIN^{1,2,3} and PETER KRATZER¹ — ¹Fachbereich Physik and Center for Nanointegration (CeNIDE), Universität Duisburg-Essen, Germany — ²TFVS, Departement Fysica, Universiteit Antwerpen, Belgium — ³PMS, Department of Theoretical Physics, State University of Moldova, Chişinău, Moldova

Superlattices (SLs) of InAs/GaAs quantum dots (QDs) are presently of interest for possible thermoelectric applications. Due to the quantum confinement of electrons and phonons, such SLs are expected to provide an improved figure-of-merit. The present work is aimed at the investigation of a periodic 1D stack of InAs quantum disks in GaAs. Electron minibands for a 3D SL of InAs/GaAs QDs are calculated using the tight-binding approach. The essential features of the obtained minibands, e.g. the distribution of the probability density in