DS 36: Thin Film Characterisation: Structure Analyse and Composition (XRD, TEM, XPS, SIMS, RBS, ...) I

Time: Thursday 9:30–11:00 Location: H8

DS 36.1 Thu 9:30 H8

GD OES analysis of thin film samples with application of pulsed discharge. — •Varvara Efimova[1], Volker Hoffmann[1], and Jürgen Eckert[1,2] — [1]IFW Dresden, Institut für Komplexe Materialen, Helmholtzstraße 20, 01069 Dresden, Germany — [2]TU Dresden, Institut für Werkstoffwissenschaft, D-01062, Dresden, Germany

The application of a pulsed power supply of glow discharge (GD) in optical emission spectrometry (OES) has a number of advantages in comparison with the continuous one [1]. Because of the slower sputtering and less heating of the sample, pulsed discharge is preferable for the analysis of thin layers and heat-sensitive samples.

However, the use of pulsed GD (PGD) in commercial spectrometers has still some limitations. Firstly, the influence of PGD parameters on the analytical performance is not yet enough investigated. Secondly, it is difficult to quantify the profiles measured with PGD, because the existing quantification model is established for the continuous discharge.

In the present work the methodic of the optimization of PGD parameters has been developed. According to the studies carried out, the measurement of depth profiles of thermally fragile and thin layered samples with pulsed radio frequency GD OES has been optimized. To some of the measured depth profiles a quantification procedure has been applied. The results of the quantification have shown that the existing quantification model is valid also for the pulsed discharge, if the measurement is performed under the same conditions as the calibration.

[1] W.W. Harrison, J. Anal. At. Spectrom., 13, 1051 (1998).

DS 36.2 Thu 9:45 H8

Structural investigations of the grain growth induced by focused-ion-beam irradiation in thin magnetic films — •Olga Roshchupkina, Jörg Grenzer, Monika Fritzsche, and Jürgen Fassbender — Institute of Ion Beam Physics and Materials Research, Forschungszentrum Dresden-Rossendorf, P. O. Box 51 01 19, 01314 Dresden, Germany

Focused ion beam (FIB) techniques are one way to modify locally the properties of magnetic thin films. In previous works it was demonstrated that focused-ion-beam irradiation causes a considerable grain growth in magnetic thin films under certain conditions and therefore a change of their magnetic properties [1]. Although the grain growth can be already qualified by simple REM images a crystallographic tool is needed for a qualitative analysis. We used the advantage of non-destructive X-ray diffraction to study the grain growth.
A magnetic thin film of $50nm$ thick permalloy film ($Fe_{0.2}Ni_{0.8}$) sputtered on Si was used for the investigations. We have analyzed two simple parameters such as the grain size and the microstrain depending on the ion dose and beam current. Due to the very small structures created by focused-ion-beam techniques (usually less then $0.4x0.4mm^2$ size) an optimized X-ray laboratory setup with a focused X-ray beam of $200\mu m$ was used.

[1] C.M. Park and J.A. Bain, J. Appl. Phys. 91, 6830(2002).

DS 36.3 Thu 10:00 H8

Surface characterization after subaperture Reactive Ion Beam Etching — •André Miessler, Thomas Arnold, and Bernd Rauschenbach — Leibniz-Institut für Oberflächenmodifizierung (IOM), Permoserstrasse 15, D-04318Leipzig, Germany

In usual ion beam etching processes using inert gas (Ar, Xe, Kr...) the material removal is determined by physical sputtering effects on the surface. The admixture of suitable gases ($CF_4 + O_2$) into the glow discharge of the ion beam source leads to the generation of reactive particles, which are accelerated towards the substrate where they enhance the sputtering process by formation of volatile chemical reaction products.

During the last two decades research in Reactive Ion Beam Etching (RIBE) has been done using a broad beam ion source which allows the treatment of smaller samples (diameter sample < diameter beam). Our goal was to apply a sub-aperture Kaufman-type ion source in combination with an applicative movement of the sample with respect to the source, which enables us to etch areas larger than the typical lateral dimensions of the ion beam. Concerning this matter, the etching behavior in the beam periphery plays a decisive role and has to be investigated. We use interferometry to characterize the final surface topography and XPS measurements to analyze the chemical composition of the samples after RIBE.

DS 36.4 Thu 10:15 H8

RBS and resonant scattering analysis of thin oxidic films prepared by sputtering — •Dieter Mergel[1], Hans-Werner Becker[2], and Detlef Rogalla[2] — [1]Universität Duisburg-Essen, FB Physik, 47048 Duisburg — [2]Ruhr-Universität Bochum, Dynamitron Tandem Labor des RUBION, 44780 Bochum

The oxygen content in various oxidic thin films has been determined from alpha scattering spectra based upon gauging with a rutile and a $SrTiO_3$ crystal. Both RBS and scattering with the 3.04 MeV resonance (for O) were applied and compared to each other.

Main findings are:
- Gradient in O-content of TiO_2 prepared by reactive magnetron sputtering at 300°C at various oxygen partial pressures.
- Oxygen surplus in ITO films prepared by rf-diode sputtering.
- Variation in the oxygen content of nominal Cr_2MnO_4 prepared by magnetron sputtering at 350°C to 650°C.

DS 36.5 Thu 10:30 H8

A New High-Resolution Scanning Electron Microscope for the in-situ investigation of ion beam modifications of solid surfaces — •Wolfgang Bolse[1], Sankarakumar Amirthapnadian[1,2], and Florian Schuchart[1] — [1]Institut für Halbleiteroptik und Funkitonelle Grenzflächen, Universität Stuttgart — [2]on leave from: IGCAR, Kalpakkam, India

A High Resolution Scanning Electron Microscope (HRSEM), which allows for in-situ investigation of swift heavy ion (SHI) induced modifications of solid surfaces with nm resolution, has been installed at the M-branch of the UNILAC ion accelerator at GSI in Darmstadt. The HRSEM is a standard SUPRA-40 SEM by CARL ZEISS SMT with an annular in-lens secondary electron detector, an Everhart-Thornley scintillation detector and a retractable 4-quadrant Si-diode with a hole in the center. Two ports of the microscope chamber have been modified such that it could be integrated into the UNILAC beam line and the ion beam can pass through the focal zone of the upright electron lens. In addition to the standard eucentric stage, a special stage was designed which allows to continuously vary the tilt angle of the sample from normal incidence of the electron beam to normal incidence of the ion beam, as well as for continuous azimuthal rotation of the sample. In this report we will introduce the setup and discuss why in-situ investigation of structure formation under SHI bombardment outmatches conventional ex-situ experiments. We will demonstrate the potential of the instrument by presenting the results of our first in-situ experiments on SHI induced dewetting of thin oxide films.

DS 36.6 Thu 10:45 H8

Structure of Co/Pt multilayers on gold particle arrays — •Herbert Schletter[1], Carsten Schulze[1], Denys Makarov[1], Alan Craven[2], Sam McFadzean[2], Manfred Albrecht[1], and Michael Hietschold[1] — [1]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz — [2]Department of Physics and Astronomy, University of Glasgow, Glasgow G12 8QQ, Scotland, UK

Nanostructuring of thin films is used in a variety of applications and attracts scientific as well as technological interest. One way to realize such structuring is by using particle arrays as templates onto which the films are deposited [1]. In the present study, gold particles with diameters of 20 nm to 60 nm are used to implement this concept. A 17 nm thick Co/Pt multilayer film with out-of-plane magnetic anisotropy was deposited onto these particles. Besides magnetic characterisation, a detailed structural investigation is essential for the understanding of magnetic properties. In this regard, SEM was used to analyze the particle assembly as well as the surface morphology of the film. Further details about the magnetic films were gathered with cross sectional TEM and EELS Spectrum Imaging. It was found, that for 60 nm and 40 nm particles, the magnetic layer forms a closed film which follows the morphology of the particle arrangement. In contrast to that, on 20 nm particles the roughness of the magnetic film is of the same size as the height variations induced by the particles. These findings allowed conclusions about magnetic coupling behaviour and served to clarify differences found in the magnetization reversal process.

[1] M. Albrecht et al., Nature Materials 4 (2005) 203.