DS 11: Thin Film Characterisation: Structure Analysis and Composition (XRD, TEM, XPS, SIMS, RBS, ...) IV

Time: Monday 15:45–17:00 Location: GER 38

DS 11.1 Mon 15:45 GER 38

Modeling of the relaxation kinetics of Phosphorus doped metastable tensile strained Si:C alloys — •Felix Ulomek[1], Ina Ostermay[2], Thorsten Kammler[2], and Volker Mohles[1] — [1]Institut für Metallkunde und Metallphysik, RWTH Aachen — [2]GLOBALFOUNDRIES Dresden Module One LLC & Co. KG, Wilschdorfer Landstraße 101, 01109 Dresden

In order to enhance the performance of CMOS transistors, embedded epitaxial layers of Si:C are of interest. In the present work, Si:C layers with Carbon contents up to 1.9 at-% and in-situ Phosphorus doping up to 4E20 At/cm3 have been investigated. Due to the low solubility of Carbon in Silicon (0.0004 at.-% at the melting point), all layers considered in this work are metastable and tend to relax. Since it is crucial to the application to retain the strain of those layers, the responsible mechanisms must be understood. The relaxation during thermal treatment was studied by high resolution x-ray diffraction and was found to behave differently, depending on Carbon content and Phosphorus doping concentration. We model the macroscopic relaxation behavior by statistical simulations and extrapolate the behaviors for different relaxation conditions. The resulting activation energies, which are fit parameters in this model, are compared to values of atomistic simulations.

DS 11.2 Mon 16:00 GER 38

XPS depth profiling on polymers using Ar, C_{60}, Coronene and Gas Cluster Ion Beam. — •Andrey Lyapin[1], Stefan Reichlmaier[1], John S. Hammond[2], John F. Moulder[2], Takuya Miyayama[3], Noriaki Sanada[3], Mineharu Suzuki[3], and Atsushi Takahara[4] — [1]Physical Electronics GmbH, 85737 Ismaning, Germany — [2]Physical Electronics USA, 18725 Lake Drive East, Chanhassen, MN. 55317 USA — [3]ULVAC-PHI, Inc., 370 Enzo, Chigasaki, Kanagawa, 253-8522 Japan — [4]Kyushu University, Motooka, Nishi-ku, Fukuoka 8190395 Japan

The use of cluster ion sputtering for depth profiling of polymers, organics, and biomaterials has opened an entirely new field of application for surface analytical methods and shown potential to analyze chemical bonding and molecular structures during sputtering into a sample surface. In this talk we present a comparison of the use of XPS depth profiling of thin polymer films with Ar, C_{60}, Coronene and Ar Gas Cluster Ion Beam (GCIB) sputter sources. The GCIB sputter source produces an $Ar_{2500}{}^{+}$ ion beam with user definable incident beam energy. Optimized conditions for the incident ion beam energy of the GCIB will be presented to provide minimal chemical state damage during the depth profiling. Results will also be presented showing that the GCIB source can be used to remove damaged layers from modified surfaces.

DS 11.3 Mon 16:15 GER 38

Structure of FePt thin films with copper addition — •Herbert Schletter, Christoph Brombacher, Manfred Albrecht, and Michael Hietschold — Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz

The continuous increase in storage density of magnetic hard disk drives creates a need for new concepts and new materials in this field. One approach is the use of highly anisotropic materials which allow for further reduction of bit sizes. One of these materials is the $L1_0$ phase of FePt. However, a thermal treatment of the material (either during or after the deposition) is necessary to (i) transform the material from cubic A1 to tetragonal $L1_0$ phase and (ii) create a (001)-textured film, for which the magnetic anisotropy axis is perpendicular to the film plane.

In our experiments, different amounts of Cu (up to 21 at.%) were added to 5 nm thick FePt layers to support the phase transformation as well as the texture evolution during rapid thermal annealing (RTA) [1]. The structure of these layers was investigated by means of TEM and electron diffraction combined with multislice simulations. It was found, that pure FePt layers consist of a mixture of untextured A1-FePt and (001)-textured $L1_0$-FePt after RTA to 600 °C for 30 s. In this case, the A1-phase is encountered in significantly smaller grains ($\approx$ 10 nm) than the $L1_0$-phase ($\approx$ 50 nm). However, the addition of ≥ 9 at.% Cu leads to pure $L1_0$-FePt:Cu films with the desired (001)-texture when applying the same annealing parameters.

[1] D. Makarov et al., Appl. Phys. Lett. 96, 062501 (2010)

DS 11.4 Mon 16:30 GER 38

Depth resolved Doppler broadening spectroscopy in thin metallic films — •Markus Reiner[1,2], Philip Pikart[1,2], and Christoph Hugenschmidt[1,2] — [1]ZWE FRM 2, Garching, Germany — [2]Technische Universität München, Physikdepartment E 21, Garching, Germany

Within this contribution the examination of thin metallic films by (C)DB ((coincident) Doppler broadening) measurements at different temperatures is presented. Systems with a gold or copper layer with a thickness between 20 and 500 nm were produced by evaporation deposition on silicon substrates. Doppler broadening and positronium fraction were examined in order to investigate annealing processes. In addition, theses samples as well as gold-copper-silicon systems were studied by depth resolved CDB measurements with the goal to obtain information about temperature dependent diffusion processes at the interface.

These measurements were performed by use of the highly intensive positron beam NEPOMUC. Depth resolved DB measurements are used for the determination of the positron diffusion length which is highly sensitive to defect concentration. At high temperatures the thermic desorption of positronium can be detected and additionally considered to determine the diffusion length. Depth resolved CDB measurements allow the detection of the chemical surrounding of defects in layered structures. Recently a new heatable sample holder has been set up in order to achieve a sample temperature up to 1000 K.

DS 11.5 Mon 16:45 GER 38

Neutron Reflectometry and GISANS studies of Thin Films at Refsans — •Jean-François Moulin[1], Martin Haese-Seiller[1], Reinhard Kampmann[1,2], Matthias Pomm[1], and Andreas Schreyer[2] — [1]Helmoltz Zentrum Geesthacht, Institute of Materials Research, Instrument REFSANS Lichtenbergstr. 1 85747 Garching (Germany) — [2]Helmoltz Zentrum Geesthacht Institut für Werkstoffforschung Abteilung WPN,Max-Planck-Straße 1 21502 Geesthacht (Deutschland)

Neutron reflectometry (NR) and grazing incidence small angle neutron scattering (GISANS) are two complementary techniques which enable to study the structure of thin films in a non destructive/non invasive manner. Given the sensitivity of neutron scattering to the isotopic composition of the system under investigation, contrast enhancement can be used to acces information that would otherwise remain masked e.g to conventional X-Ray methods.

The characteristics and operation modes of the neutron reflectomer REFSANS (which is operated at the FRM2 reactor near Munich) will be presented stressing how this versatile instrument can help elucidating the structure of different classes of materials. On one hand, examples of out of plane structure resolution via NR experiments performed on polymers, biological systems and metallic multilayers will be presented. On the other hand, the TOF-GISANS method will be introduced and it will be shown how it enables to resolve the lateral structure of thin films. Here too, examples from different fields of material physics will be shown.