DS 14: Ion irradiation effects

Time: Tuesday 11:45–12:45 Location: H 0111

DS 14.1 Tue 11:45 H 0111

In-Situ Investigation of Swift Heavy Ion Induced Dewetting in Edge- and Hole-Symmetry — •Knut Dautel, Redi Ferhati, Daniel Garmatter, Susanne Weidenfeld, and Wolfgang Bolse — Institut für Halbleiteroptik und Funktionelle Grenzflächen, Universität Stuttgart

Previous experiments have shown that swift heavy ion (SHI) irradiation of thin oxide films on Si-substrates results in dewetting patterns even at temperatures far below the coatings melting point [1]. It was found that an initially coherent and smooth film under SHI bombardment breaks up into circular holes which then grow in diameter until they coalesce and form a meander- or dot-like structure of the film material. In our present study we have extended the materials range by the metallic glass $Fe_{40}Ni_{40}B_{20}$, in addition to NiO and Fe_2O_3, and furthermore changed the initial geometry by coating only half of the substrate, with a sharp edge between the uncovered and the covered side. In this case different dewetting kinetics are expected because of the infinite lateral curvature radius of the backward moving edge as compared to the circular rim around holes (which also form in the coherent part of the film). The experiments were carried out with our in-situ SEM/EDX-setup at the UNILAC accelerator of the Helmholtz Center for Heavy Ion Research (GSI) as decribed in [2]. We will compare the dewetting rates for the above mentioned different symmetries and materials in order to shed light on the dewetting mechanisms and the driving forces. [1] T. Bolse, et al., Nucl. Instr. Meth. 245 (2006), [2] S. Amirthapandian et al., Rev. Sci. Instr. 81 (2010)

DS 14.2 Tue 12:00 H 0111

Ion implantation-induced defects in Oxide Dispersion Strengthened (ODS) steel probed by positron annihilation spectroscopy — •Wolfgang Anwand[1], Maik Butterling[1], Gerhard Brauer[1], Andreas Wagner[1], Astrid Richter[2], Reinhard Koegler[3], and C.-L. Chen[4] — [1]HZDR, Institut für Strahlenphysik — [2]Technische Hochschule Wildau — [3]HZDR, Institut für Ionenstrahlphysik und Materialforschung — [4]I-Shou University, Kaohsiung, Taiwan

ODS steel is a promising candidate for an application in fission and fusion power plants of a new generation because of its advantageous properties as stability and temperature resistance. A microscopic understanding of the physical reasons of the mechanical and thermal properties as well as the behaviour of the material under irradiation is an important pre-condition for such applications. The investigated ODS FeCrAl alloy *PM2000* has been produced in a powder metallurgical way. Neutron-induced damage at ODS steel was simulated by He+ and Fe2+ co-implantation with energies of 2.5 MeV and 400 keV, respectively, and different fluences. The implantation has been carried out with a dual ion beam which enables a simultaneous implantation of both ion types. Thereby the Fe2+ implantation was used for the creation of radiation defects, and He+ was implanted in order to reproduce He bubbles as they are expected to appear by neutron irradiation. The implantation-induced damage was investigated by depth dependent Doppler broadening measurements using a variable energy slow positron beam.

DS 14.3 Tue 12:15 H 0111

Ion beam induced stress formation and relaxation in semiconductors — Tobias Steinbach, •Aaron Reupert, and Werner Wesch — Institute of Solid State Physics, Friedrich Schiller University Jena

The irradiation of crystalline semiconductors leads to the formation of defects, which accumulate with increasing ion fluence until in many materials a continuous amorphous surface layer is formed. In general, this phase transition causes expansion of the materials due to density change, which consequently leads to the formation of stress. However only a few studies on ion beam induced stress phenomena have been made, even though stresses in microelectronic structures cause substrate bending, delamination and cracking as well as anomalous diffusion of dopands. To investigate the ion beam induced formation and relaxation of stress due to density change and plastic phenomena in semiconductors a new modified scanning laser reflection technique based on the concepts of Volkert[1]. was established at the FSU Jena. By means of this technique the bending of a freestanding sample away from the irradiated surface is defined by the compensation of forces and moments between the underlying substrate and the irradiated regions. We present a brief overview of the configuration and the general principle of this technique. Furthermore, first results from wafer curvature measurements made during amorphization are shown for the irradiation of germanium and silicon. The results will be discussed based on the effects of density change, radiation-enhanced plastic flow and plastic deformation. [1]C. Volkert, J. Appl. Phys. 70, 3521 (1991)

DS 14.4 Tue 12:30 H 0111

In-Situ Analysis of Nanostructures Induced by Slow Highly Charged Ions — •Richard A. Wilhelm, René Heller, and Stefan Facsko — Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

The sum of the binding energies of all missing electrons (potential energy) of highly charged ions can induce surface modifications on the nanometer scale. We present results of a set-up for slow highly charged ion irradiations and scanning probe microscopy studies under in-situ conditions. A Dresden-EBIT is used to provide ions of different species with charge states up to $q = 40$ (e.g. for Xe). An electrostatic deceleration lens system allows to vary the kinetic energies of the ions in the range of $10\text{eV}\cdot q$ up to $5\text{keV}\cdot q$. Furthermore, we studied surface nanostructures on various substrates by an Omicron ultra high vacuum (UHV) scanning probe microscope, which is directly connected to the ion source. The size and the shape of nanostructures created by the deposition of potential energy and analyzed in-situ under UHV conditions are discussed and compared to those observed by recent studies under ex-situ conditions.