DS 16 Ion beam solid interaction I

Time: Thursday 09:30–11:00 Room: GER 37

Invited Talk

DS 16.1 Thu 09:30 GER 37

Ion beam shaping of nanometals — •Arjen Vredenberg — Debye Institute, Utrecht University

Metal nanorods and nanowires have great potential in a wide range of fields, because of their tunable (by shape and size) optical and magnetic properties. We present a new and unique way of producing nanorods and -wires, embedded in a solid, that are aligned in the same direction. Starting from spherical Au nanocolloids in a silica film we will show that the colloids are shaped controllably into rods and -at later stages- wires by irradiation with an MeV heavy ion beam. The ion-beam induced anisotropy (from a spherical colloid to a rod) is caused by the highly anisotropic ion track: a long, few nm diameter cylinder of highly excited material. The colloids elongate and form rods with their long axis in the direction of the ion beam. The mechanism of this deformation is still under investigation, but we will discuss possible origins, involving anisotropy in mechanical or mass balance gradients.

DS 16.2 Thu 10:15 GER 37

Swift heavy ion irradiation of InP: Thermal spike analysis of ion track formation — •Andrey Kamarou, Werner Wesch, and Elke Wendler — Institut für Festkörperphysik, Universität Jena, Max-Wien-Platz 1, 07743 Jena

Irradiation of single-crystalline InP with swift heavy ions (SHI) in above-threshold electronic stopping regime causes formation of ion tracks for certain irradiation temperatures [1]. With increasing SHI fluence, more and more ion tracks are formed, until at high ion fluences a continuous amorphous layer is produced finally due to the multiple overlapping of the tracks.

Single-crystalline InP samples were irradiated either at liquid nitrogen temperature (LNT) or at room temperature (RT) with Kr, Xe, or Au ions with specific energies ranging within ca. 0.3 to 3.0 MeV/u. Afterwards the samples were investigated by means of the Rutherford backscattering spectrometry (RBS) and the transmission electron microscopy (TEM) in plan-view and cross-section geometries.

The obtained experimental data can be qualitatively and quantitatively explained using the thermal spike model. The results of the thermal spike calculations offer a self-consistent way to explain the influence of various irradiation conditions on the ion track formation and damage accumulation in InP and, therefore, can make a contribution to a better understanding of the underlying mechanisms.

[1] O. Herre, W. Wesch, E. Wendler, P.I. Gaiduk, F.F. Komarov, S. Klaumünzer, and P. Meier, Phys. Rev. B 58, 4832 (1998).

DS 16.3 Thu 10:30 GER 37

Swift Heavy Ion induced Modifications in Thin Halogenide Coatings — •Hartmut Paulus, Thunu Bolse, and Wolfgang Bolse — Institut für Strahlenphysik, Universität Stuttgart

Thin layers of several Halogenides have been deposited onto Silicon and Silicon Oxide substrates by thermal evaporation at different substrate temperatures. The samples were irradiated with swift heavy ions (SHI) of various energies and fluences at a temperature of about 80K. The irradiated as well as the remaining unirradiated parts of the samples were characterized by Rutherford backscattering spectrometry. In selected cases also scanning electron and atomic force microscopy as well as surface profilometry and X-ray diffraction were performed.

Low temperature (300K) deposition results in rough layers, which upon SHI irradiation significantly smoothen. The latter can be attributed to grain size reduction and compaction of the material. Substrate temperatures around 900K on the other hand result in already smooth layers. Higher fluences lead to significant intermixing of the coating with the Silicon Oxide substrate, while the interfaces (and surfaces) of the films deposited onto Si remain smooth. At very high fluences a reduction of the film thickness can be observed due to sputtering and in some cases circular holes of sub-micrometer dimensions form, which point at SHI induced dewetting phenomena similar to those recently reported for thin oxide films.

DS 16.4 Thu 10:45 GER 37

Ion-beam induced effects at 15 K in α-Al_2O_3 of different orientation — •W. Wesch[1], C.S. Schnohr[1], E. Wendler[1], K. Gaertner[1], and K. Ellmer[2] — [1]FSU Jena, Institut für Festkörperphysik — [2]HMI Berlin

In order to study the primary effects of ion-beam induced damage formation in sapphire, both implantation and subsequent damage analysis by Rutherford backscattering spectrometry (RBS) were performed at 15 K. We used Ar^+, K^+ or Na^+ ions to investigate the amorphisation of α-Al_2O_3 with either the c-axis (0001), the a-axis ($11\bar{2}0$) or the r-axis ($01\bar{1}2$) being perpendicular to the surface. Defect annealing was observed during the RBS measurements with 1.4 MeV He^+ ions. It can be understood in terms of the electronic energy loss of the He ions which may cause changes in the charge state of the defects thus enhancing their mobility. This results in actual damage recovery or the alignment of the defect structures. The He beam induced defect annealing is taken into account to obtain the undisturbed curves of damage accumulation. The analysis of these curves yields three stages of defect formation. In the first stage isolated point defects are formed. Recombination of point defects is observed when the collision cascades start to overlap. Above a critical concentration these point defects are altered into a second type of defects called clusters. With further increasing ion fluence these clusters exhibit a stimulated growth. A third stage occurs by a saturation of the clusters and their gradual transformation into amorphous material. For the various orientations investigated differences were found, which seem to be caused by a different visibility of the created defects.