DS 12 Ionen-Festkörper-Wechselwirkung II

Zeit: Montag 10:45–12:45 Raum: TU H107

Hauptvortrag DS 12.1 Mo 10:45 TU H107

Solid matter under extreme conditions - Electronic excitations by swift highly charged ions — •Gregor Schiwietz — Hahn-Meitner-Institut Berlin, Abt. SF4, Glienicker Str. 100, 14109 Berlin

The kinetic energy of fast ions is transferred virtually only to the electrons of the medium. The individual energy-loss events occur within 10^{-17} s and typical energy transfers are between a few eV up to several keV. Thus, the energy deposition of a single swift heavy ion, as delivered, e.g., by the ISL cyclotron at the Hahn-Meitner-Institut, is comparable to the giant focussed multi-photon pulse that will be available at the future free-electron laser XFEL.

The talk will address ion-induced electronic excitations inside solids and subsequent atomic rearrangement processes that lead to materials modifications once a certain threshold excitation-density is exceeded. Surface-sensitive experiments under ultra-high vacuum conditions will be presented and snapshots of the short-time evolution are extracted from high-resolution Auger electron spectra for different materials.

DS 12.2 Mo 11:30 TU H107

Swift heavy ion irradiation of InP: Why a thin surface layer remains crystalline? — •Andrey Kamarou, Werner Wesch, and Elke Wendler — Institut für Festkörperphysik, Universität Jena, Max-Wien-Platz 1, 07743 Jena

Irradiation of single-crystalline InP with large fluences of swift heavy ions (SHI) causes formation of amorphous layers within the depth range of dominating electronic energy loss ε_e. However, unlike the bulk, thin surface layers (tens of nm) remain almost undamaged. In order to amorphise also those thin crystalline surface layers (TCSL), much higher SHI fluences are necessary. Hence, two suggestions can be made: (a) either the surface acts as a powerful sink for defects generated by SHI irradiation near the surface (i.e., they move towards the surface and annihilate there), or (b) SHI energy deposition is not constant within thin surface layers.

Our results show that the existence of TCSL can not be solely due to migration of defects to the surface, but should be ascribed to ε_e that increases with depth in the thin surface layers. Particularly, the last feature is characteristic to SHI having the initial charge lower than the equilibrium one for the bulk. Generally, one can state the dominating influence of SHI charge state; the influence of the surface itself is less significant, but can not be ruled out completely.

DS 12.3 Mo 11:45 TU H107

Ion-induced sputtering — •Bente Walz[1,2], Gregor Schiwietz[2], Melanie Roth[2] und Beate Schattat[2] — [1]Institut für Experimentelle und Angewandte Physik, Universität Regensburg, Universitätsstraße 31, 93053 Regensburg — [2]Hahn-Meitner-Institut Berlin, Glienickerstaße 100, 14109 Berlin

Treffen schnelle schwere Ionen auf ein Festkörpertarget kommt es aufgrund des hohen elektronischen Energieeintrags entlang ihrer Flugbahn zur Ausbildung von Ionenspuren. Aufgrund dessen werden von der Targetoberfläche sowohl geladene, als auch neutrale Teilchen emittiert. Informationen über die zeitliche Entwicklung der Ionenspur erhält man über eine energieaufgelöste Detektion der emittierten Teilchen. Zum Nachweis der emittierten Neutralteilchen wurde im Ionenstrahllabor am Hahn-Meitner-Institut in Berlin ein neuer Experimentierplatz aufgebaut. Es werden erste Testmessungen vorgestellt.

DS 12.4 Mo 12:00 TU H107

Self-organisation of thin NiO-films under swift heavy ion bombardment — •M. Kalafat[1], A. Feyh[1], W. Bolse[1], D. Etissa-Debissa[1], S. Klaumünzer[2], G. Schumacher[2], and G. Bilger[3] — [1]Institut für Strahlenphysik, Stuttgart — [2]Hahn-Meitner-Institut, Berlin — [3]Institut für Physikalische Elektronik, Stuttgart

NiO films with thicknesses from 5 to 260nm on SiO_2 have been irradiated with swift heavy ion (Mev/amu) at 80K under different tilt angles ($\geq 75°$) with respect to the beam direction.
At low fluences the initially smooth and coherent NiO-layer was found to crack periodically and transform into a periodic lamellae structure with increasing fluence. The lamella (as the cracks) are oriented perpendicular to the projection of the beam direction onto the surface. They have a height of up to 2μm and a width down to 0,1μm. Their distances varied between 1 and 5μm. The characteristics of the lamellae structure depend on the irradiation conditions (ion, energy, fluence, angle, temperature). Multiple irradiation from different directions results in complex structures on a sub-μm scale. Post-irradiation of already existing structures under large angles and permanent rotation of the sample allows to homogeneously shrink their dimensions. This way we were able to generate an almost regular, large area covering arrangement of pillars of <200nm in diameter and some μm height.

DS 12.5 Mo 12:15 TU H107

Trapping and transport of gold atoms in tracks of swift heavy ions — •C. Dais[1], W. Bolse[1], and J. K. N. Lindner[2] — [1]Institut für Strahlenphysik, Universität Stuttgart — [2]Institut für Physik, Universität Augsburg

We have investigated the modification of single- and multi-markerlayers of Au in NiO on Si-substrate due to irradiation with swift heavy ions. The samples were analysed with RBS, TEM and AFM. A redistribution of the Au-atoms into cylindrical tracks parallel to the beam direction was found. For Kr-irradiation the Au filled tracks have a length of 20-30nm and are symmetrically distributed around the initial marker plane. For Au and Xe ions these tracks reach the surface where the Au segregates into spherical nano-particles. In case of Au irradiated multilayers continous Au nanowires of about 6nm in diameter and a length of up to 180nm are formed.
Trapping and transport of Au was found to depend on the marker-thickness, marker-position, irradiation angle and irradiation temperature. The marker-thickness is of particular importance: the lower the thickness the slower is the Au transport. We present a model which explains the phenomenon by a combination of trapping in and transport along the hot ion track. Trapping of the Au-atoms occurs due to recrystalisation of the ion track, while the transport is induced by the high pressure build up in the melt phase.

DS 12.6 Mo 12:30 TU H107

High-energy Au implantation of GaAs at 16 K — •E. Wendler, R. Lauck, and W. Wesch — Institut für Festkörperphysik, Friedrich-Schiller-Universität Jena, Max-Wien-Platz 1, 07743 Jena

In GaAs implanted with high-energy ions (10 MeV range) and analysed at room temperature, the defect concentration close to the surface was found to be lower than expected from theoretical simulations. Thermal or ionisation-induced annealing of defects was considered to be the cause for that. In the present paper GaAs was irradiated with 10 MeV or 17.5 MeV Au ions at 16 K and subsequently measured at the same temperature. Under these conditions ion-beam induced processes can be studied whilst thermal effects are widely excluded. It is found that the measured defect concentration scales with the number of displacements per lattice atom (representing the nuclear energy deposition) independent of the ion energy and of the depth. This result demonstrates that, for the chosen ion energies, the electronic energy deposition itself does not influence the damage production in GaAs. The explanation for the previously observed effects is a preferred annealing of lightly damaged areas during warming the samples to room temperature for measurement.