O 24: Poster: Ion Beam Interaction with Surfaces and Interfaces

Time: Monday 18:00–20:00 Location: P2/EG

O 24.1 Mon 18:00 P2/EG

Defect Engineering of Graphene using Ultra-low energy Ion Implantation — •Felix Junge[1], Manuel Auge[1], Zviadi Zarkua[2], Lino M.C. Pereira[2], and Hans Hofsäss[1] — [1]II. Physikalisches Institut, Georg-August-Universität Göttingen — [2]Quantum Solid State Physics, KU Leuven

Doping and defect engineering of graphene and TMD's to change the electrical properties is highly desirable. To achieve this, we use a unique mass-selected ion beam deposition system, which makes it possible to work in an energy range of $10 < E < 600\,\text{eV}$ for implantation and thus to implant into a 2D-lattice. We use electrostatical masking to control the region which get irradiated. Graphene was doped with Boron and subsequently examined by means of Kelvin probe measurements (SKPM). Furthermore, Helium was implanted into graphene using an electrostatic gradient for decceleration of the ions, to implant the sample with different energies at the same time, which was then analysed with Raman spectroscopy. With these experiments we can see the change of the surface potential of the graphene between a doped and undoped surface region on the one hand and the increasing defect density with increasing implantation energy on the other hand. These results are compared by IMINTDYN (a SDTrimSP based Monte Carlo program for ion implantations) simulations.

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O 24.2 Mon 18:00 P2/EG

Sputtering of structured tungsten model surfaces — •Martina Fellinger[1], Christopher Hahn[1], Christian Cupak[1], Gabriele Alberti[2], David Dellasega[2,3], Matteo Passoni[2,3], Matteo Pedroni[3], Andrea Uccello[3], Espedito Vassallo[3], and Friedrich Aumayr[1] — [1]TU Wien, Institute of Applied Physics, Vienna, Austria — [2]Politecnico di Milano, Department of Energy, Milan, Italy — [3]Istituto per la Scienza e Tecnologia dei Plasmi, Consiglio Nazionale delle Ricerche, Milan, Italy

Erosion of first wall materials in nuclear fusion devices limits the lifetime of plasma-facing materials. In the search for materials with low sputtering yields we have investigated not only the sputtering properties of randomly rough [1] but also of oriented and nano-structured tungsten surfaces. Since oriented tungsten nano-columns have shown a favourable reduction in sputtering yield [2], we have now started also to investigate nano-pyramids. These were obtained depositing a tungsten coating on top of chemically etched silicon substrates. The pyramidal surfaces were then exposed to ion irradiation and the subsequent sputtering process was investigated in situ by using a quartz crystal microbalance measurement setup [3]. We will present the experimental results and compare them to state of the art simulations.

[1] C. Cupak et al., Appl Surf Sci 570 (2021)
[2] A. Lopez-Cazalilla et al., Phys Rev Mat 6 (2022)
[3] B. M. Berger et al., Nucl Instrum Methods Phys Res B 406 (2017)

O 24.3 Mon 18:00 P2/EG

In situ GISAXS observation of ion-induced nanoscale pattern formation on crystalline Ge(001) in the reverse epitaxy regime — •Denise Erb[1], Peco Myint[2,3], Kenneth Evans-Lutherodt[4], Karl Ludwig[4,5], and Stefan Facsko[1] — [1]Institute of Ion Beam Physics and Materials Research, Helmholtz-Zentrum Dresden-Rossendorf, Germany — [2]Division of Materials Science and Engineering, Boston University, USA — [3]X-ray Science Division, Argonne National Laboratory, USA — [4]National Synchrotron Light Source II, Brookhaven National Laboratory, USA — [5]Department of Physics, Boston University, USA

The ion-induced nanoscale pattern formation on a crystalline Ge(001) surface is observed in situ by means of grazing incidence small angle x-ray scattering (GISAXS). Analysis of the GISAXS intensity maps yields the temporal development of geometric parameters characterizing the changing pattern morphology. In comparison with theoretical predictions and with simulations of the patterning process based on a continuum equation we find good agreement for the temporal evolution of the polar facet angle, characteristic length, and surface roughness in the nonlinear regime. To achieve this agreement, we included an additional term in the continuum equation which adjusts the pattern anisotropy.

O 24.4 Mon 18:00 P2/EG

Non-ambient Raman spectroscopy combined with ion bombardment — •André Maas, Lucia Skopinski, Stephan Sleziona, Marika Schleberger, and Lars Breuer — Universität Duisburg-Essen, Fakultät für Physik and CENIDE, Germany

Spectroscopic and electronic characterization of materials under non-ambient condition is an ongoing challenge. Irradiation-induced defects under ambient conditions are usually saturated with adsorbates. The direct analysis of the effects caused by unsaturated defects on the crystal structure and its electronic and optoelectronic properties is however essential to gain a deeper understanding of defect generation, defect saturation and the corresponding relaxations of the lattice due to adsorbates.

A novel experimental setup is presented that allows ion bombardment with two different ion sources and subsequent characterization of samples by a mobile Raman spectrometer in ultra high vacuum. The interaction of highly charged ions (Xe^{17+} - Xe^{40+} at around $E_{kin} = 200$ keV) from an electron beam ion source (EBIS) can be studied at the University of Duisburg-Essen. A second experimental setup utilizes the swift heavy ions (up to 14.8 MeV/u for $^{238}U^{92+}$) from the CRYRING@ESR at the GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt for defect generation.

Another experiment uses a custom-built cell that allows for electrical and optical characterization of samples under high vacuum and at low temperatures ($\simeq$ 77 K).

O 24.5 Mon 18:00 P2/EG

Ion induced defects in two-dimensional tungsten diselenide boron nitride heterostructure — •Leon Daniel, Stephan Sleziona, Lucia Skopinski, Anke Hierzenberger, Jennifer Schmeink, and Marika Schleberger — Universität Duisburg-Essen, Germany

Monolayer transition metal dichalcogenides (TMDCs) like tungsten diselenide (WSe_2) are highly interesting materials for optoelectronic and valleytronic applications. We used Xe^{q+} ions with E_{kin}=180 keV to deliberately introduce defects into the WSe_2 lattice and compared its optoelectronic properties before and after irradiation with photoluminescence spectroscopy. Encapsulation in hexagonal boron nitride (hBN) isolates the WSe_2 from environmental influences like adsorbates and detrimental interactions with the widely used Si/SiO_2 substrates. We find differences in the photoluminescence response for encapsulated and non-encapsulated WSe_2, which can be explained by the encapsulation preventing saturation of the created vacancies by adsorbates. In particular, there are various localized excitonic states in our different sample systems, and we explain this observation with differing ion interactions with encapsulated and non-encapsulated WSe_2. Furthermore, we observe overall highly increased exciton lifetimes after the irradiation, likely caused by the longer lifetime of the localized excitons.