



Contribution ID: 21

Type: Oral

In-Situ SEM-Investigation of SHI induced Modification of Surfaces and Thin Films

Thursday, 21 May 2015 12:30 (20 minutes)

We are running a High Resolution Scanning Electron Microscope in the beam line of the UNILAC ion accelerator at the GSI Helmholtz Centre for Heavy Ion Research in Darmstadt, Germany, which has recently been extended also with an EDX-system and two micro-manipulators. This instrument allows us to in-situ investigate the structural and compositional development of individual objects and structures in the um- and nm-range under swift heavy ion bombardment, from the very first ion impact up to high fluences of the order of several $10^{15} / \text{cm}^2$. The sample under investigation is irradiated in small fluence steps and in between SEM-images (and EDX-scans) of one and the same surface area are taken. The irradiation can be carried out at any incidence angle between 0 and 90 degree and also under stepwise or continuous azimuthal rotation of the sample. The micro-manipulator system allows us to perform additional analysis like electrical and mechanical characterization as well as substrate-free EDX at sub-um objects. We are now also able to irradiate almost free standing sub-um structures (pasted on a nanoscale tip or held in micro-tweezers). In this report an overview over this unique instrument and its capabilities and advantages will be given, illustrated by the results of our recent in-situ studies on ion induced modification of thin films (dewetting and self-organisation) and on shaping of sub-um objects with swift heavy ions (by taking advantage of ion sputtering, ion hammering and ion induced visco-elastic flow).

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Session Classification: Session 11

Track Classification: 05 - Insulators