Fine-Focused Beams of Highly Charged Ions

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The DRESDEN EBIS/T platform technology comprises compact room-temperature operated Electron Beam Ion Sources and Traps (EBIS/T) as well as a new liquid-helium-free superconducting EBIS. These sources of highly charged ions (HCI) are suitable for a wide range of applications.[1]

In this contribution we introduce a FIB solution for sub-micrometer beams of noble gas ions and various species of ions of different elements ranging from high to low charge states. The assembly presented combines a DRESDEN EBIS with a FIB column. The additional integration of a crossed-field ion beam separator (Wien filter) downstream source enables to separate the ions according to their mass-to-charge ratio. Since the final ion energy depends on the ion charge state as well as on the mass a broad range of projectile energies can be realized, i.e. via the selection of the kinetic projectile energy different ion ranges as well as implantation depths can be realized. Furthermore, the available intrinsic potential energy stored in the ions due to the ionization process can be adjusted by the user by selecting the charge state of the ions. These properties are suitable for potential free sputtering, nanostructuring and nanodot production.

A proof-of-concept setup was designed and commissioned consisting of EBIS 2, FIB column, a target chamber for manipulating and analyzing target samples and Secondary Electron Multiplier (SEM) & Time-of-Flight Secondary Ion Mass Spectrometer (TOF-SIMS) for surface and compound analysis (see Figure 1). First experiments have been carried out and are presented. The measured SE images (Figure 2) show test meshes with different mesh sizes using xenon projectiles. The preliminary images were taken with a non charge state separated ion beam limiting the ultimate resolution to some microns since the ion beam consists of a broad distribution of many ion charge states (Xe^{1+} to Xe^{44+}).

The work is supported by the EFRE fund of the EU and by the Freistaat Sachsen (Projects 12321/2000 and 12184/2000).

[1] For more information see http://www.dreebit.com

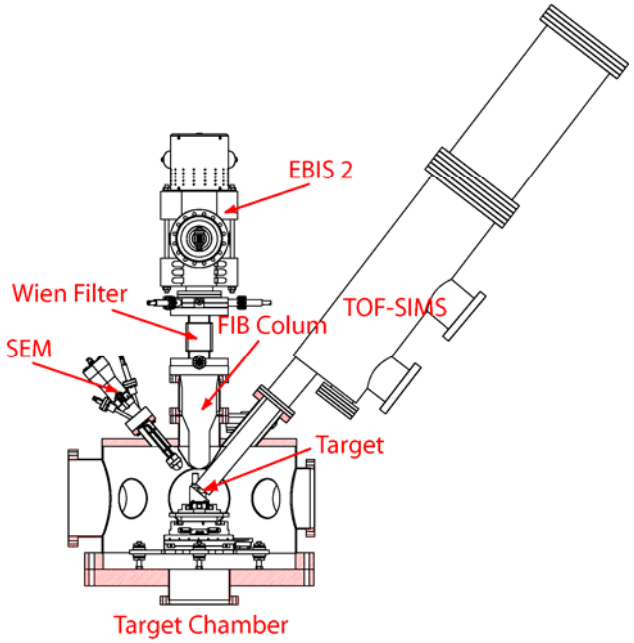

Figure 1: Scheme of the proof-of-concept setup.

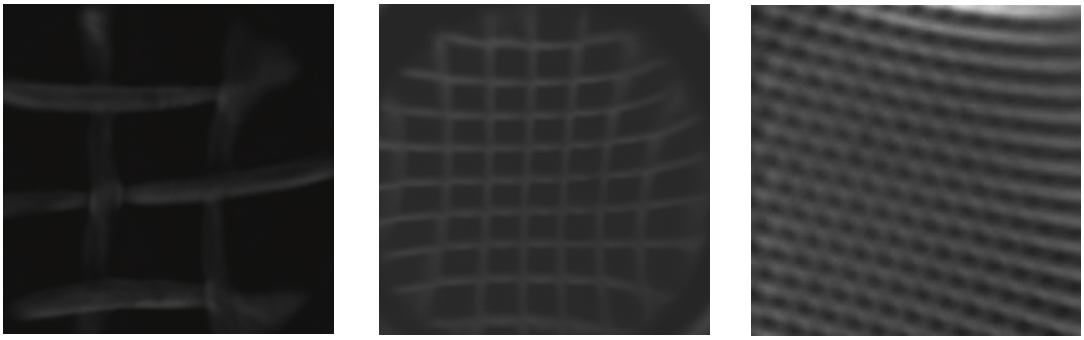

Figure 2: The world first SEM images of test meshes with a non charge state separated xenon ion beam. From left to the right: 140 µm mesh size, 60 µm mesh size, 10 µm mesh size.