MI 7: Ion Beam Methods

Chair: Enrico Langer

Time: Wednesday 11:00–12:15 Location: H5

MI 7.1 Wed 11:00 H5

The He Ion Microscope: Extending the frontiers of nanoscale research — •Peter Gnauck — Carl Zeiss Microscopy, Oberkochen, Germany

The need for more precise image information of samples coming from fields such as materials analysis, semiconductor processing, and life sciences have pushed the boundaries of charged particle microscopy. A new microscope has been developed that uses a beam of helium ions which is focused and scanned across the sample. In principle, and in its applications, it is similar to a traditional scanning electron microscope (SEM). However, the source technology, the sample interaction, and the contrast mechanisms are distinctly different. The helium ion source offers high brightness and a small energy spread, and hence allows the beam to be focused into very small probe sizes. As the helium ion microscope uses heavier Helium ions instead of electrons the helium ion microscope overcomes the diffraction effect that limits the resolution of a classical SEM. As the beam interacts with the sample, the beam penetrates relatively deeply before it diverges and hence there is a narrow sample interaction region near the surface. This results in an unmatched surface sensitive imaging capability. The helium beam generates secondary electrons, scattered helium atoms (ions and neutrals), and other detectable particles from which images can be generated or analysis can be performed. Due to the different beam * sample interaction of the He ions compared to electrons the HIM provides unmatched surface sensitivity even at high voltages.

MI 7.2 Wed 11:30 H5

Broadening of a helium beam in hydrogen silsesquioxane — •Paul Alkemade[1], Anja van Langen-Suurling[1], Emile van Veldhoven[2], and Diederik Maas[2] — [1]Kavli Institute of Nanoscience, Delft University of Technology, Delft, The Netherlands — [2]TNO Nano-instrumentation, TNO, Delft, The Netherlands

The realization of a practical helium gas field-ionization source made helium ion microscopy possible as an imaging and nanofabrication technique with high spatial resolution. Three key elements enable the high resolution: 1) the sub-nanometer probe size; 2) the fact that the emission of secondary electrons and backscattered ions is highly localized; and 3) the weak scattering of helium ions in matter.

With help of experiments and simulations we investigate how scattering of the penetrating ions causes broadening of the beam and thus loss of resolution. The helium beam energy is 30 keV and the material used is hydrogen silsesquioxane, a radiation sensitive material.

The results suggest that the most common simulation model (SRIM) underestimates the broadening of the penetrating helium beam. We will discuss causes of the observed discrepancy.

MI 7.3 Wed 11:45 H5

Ultra-high 2D and 3D imaging SIMS with cluster ions - approaching the physical limits — •Sven Kayser, Felix Kollmer, Wolfgang Paul, Martin Krehl, and Ewald Niehuis — ION-TOF GmbH, Münster, Germany

Time-of-flight secondary ion mass spectrometry (TOF-SIMS) is a very sensitive surface analytical technique. It provides detailed elemental and molecular information about surfaces, thin layers, interfaces, and full three-dimensional analysis of the sample. One major improvement especially for the analysis of organic materials on a small scale was the introduction of cluster ion beams to the field. During the last years bismuth clusters have become the standard primary ion species for all imaging applications providing a lateral resolution of down to 80 nm. Recent developments of the emitter technology and the ion optics allow pushing the performance further towards the physical limits of the technique reaching a lateral resolution of down to 20 nm.

At the same time new sputter ion sources were developed using large argon clusters for dual beam depth profiling of organic materials. With the new sources the preservation of molecular information under high-dose sputtering conditions has become possible. This has enabled TOF-SIMS to do depth profiling and 3D analysis of organic materials.

In this contribution we will present the latest results in high-resolution TOF-SIMS imaging with bismuth primary ion clusters. We will also discuss examples from the field of organic electronics using the combination of bismuth and large argon clusters for analysis.

MI 7.4 Wed 12:00 H5

A position sensitive germanium detector for the measurement of angular deviation of positron-electron annihilation radiation — •Benjamin Löwe[1], Markus Reiner[2], Werner Egger[1], Christoph Hugenschmidt[2], and Günther Dollinger[1] — [1]Universität der Bundeswehr, LRT2, Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany — [2]FRM II, Technische Universität München, Lichtenbergstraße 1, 85747 Garching, Germany

To improve electron momentum sensitivity in Coincidence Doppler Broadening Spectroscopy (CDBS) measurements it is envisaged to measure the angular correlation of annihilation radiation along with the energy of both annihilation photons. For this purpose two position sensitive 36-fold pixelated, planar germanium detectors will be utilized. The position sensitivity of one of those detectors has been tested with a collimated gamma source. A data acquisition system consisting of 37 sampling analogue-to-digital converters with PC based on-line/off-line processing has been installed. A position sensitivity of 1.6 mm has been be achieved.