MI 5: Ion Beam Methods

Chair: Enrico Langer (TU Dresden)

Time: Wednesday 9:30–10:45 Location: MER 02

MI 5.1 Wed 9:30 MER 02

Materials Analysis with Electron Beam Ion Sources — J. König[1], L. Bischoff[3], U. Kentsch[2], M. Kreller[1], W. Pilz[3], E. Ritter[1], M. Schmidt[1], A. Silze[1], and •G. Zschornack[2] — [1]DREEBIT GmbH, Dresden, Germany — [2]Technische Universität Dresden, Dresden, Germany — [3]Helmholtz-Zentrum Dresden-Rossendorf, Dresden, Germany

Electron beam ion sources (EBIS) are able to create a spectrum from low to highly charged ions from gaseous, liquid, or solid primary materials. The high density electron beam in an ultra-high vacuum environment inside of these sources ionizes the material under very well controllable operation parameters. Thus, an ion beam with a sharp energy distribution to be set between some 100 eV and several 10 keV is formed. This allows for a precise analysis of the material components with a relative sensitivity for abundances down to 10^{-4} and a relative mass resolution on the order of 10^{-3}, accurate enough to distinguish between isotopes or molecular ions with small mass differences. In this presentation, we give an overview of materials analysis techniques using easy-to-handle tabletop-sized electron beam ion sources of the Dresden EBIS type. Mass spectrometry measurements with ion sources in combination with bending magnets or ExB filters for mass-to-charge ratio analysis are presented. Furthermore, in comparison to analysis methods where sample material is introduced directly into the source, results from secondary ion mass spectrometry with standard as well as focused ion beam (FIB) EBIS setups are shown. Finally, applications for the presented methods will be discussed.

MI 5.2 Wed 10:00 MER 02

Helium and Neon Ion Microscopy. Extending the frontiers of nanotechnology — •Peter Gnauck, Lars-Oliver Kautschor, and Mohan Ananth — Carl Zeiss Microscopy, Oberkochen, Germany

The Helium Ion Microscope has been described as an impact technology offering new insights into the structure and function of nanomaterials. Combining a high brightness Gas Field Ion Source (GFIS) with unique sample interaction dynamics, the helium ion microscope provides images offering unique contrast and complementary information to existing charged particle imaging instruments such as the SEM and TEM. Formed by a single atom at the emitter tip, the helium probe can be focused to below 0.25nm offering the highest recorded resolution for secondary electron images. The small interaction volume between the helium beam and the sample also results in images with stunning surface detail . Besides imaging, the helium ion beam can be used for fabricating nanostructures at the sub-10nm length scale. The helium ion beam has been used for deposition and etching in conjunction with appropriate chemistries. Helium induced deposition results in higher quality deposits than with Ga-FIB or EBID (Electron Beam Induced Deposition). Finally, the helium ion beam can be used for direct sputtering of different materials. Patterning of graphene has resulted in 5nm wide nanoribbons and 3.5nm holes in silicon nitride membranes have been demonstrated. This work has culminated in the development of an ion microscope with a gas field ion source that can operate with both He and Ne.

MI 5.3 Wed 10:30 MER 02

Depth Profiling of OLED Materials by Cluster Ion Beams. — •Andrey Lyapin[1], John S. Hammond[2], Sankar N. Raman[2], Scott R. Bryan[2], Nicholas C. Erickson[3], and Russell J. Holmes[3] — [1]Physical Electronics GmbH, Fraunhoferstr. 4, D-85737, Ismaning, Germany — [2]Physical Electronics, 18725 Lake Drive East, Chanhassen, MN, 55317, USA — [3]University of Minnesota, Minneapolis, MN, 55455, USA

The improvements in the efficiencies for OLED structures have recently focused on the incorporation of more effective organic materials and the development of novel structures for arranging these organic materials. Multi-layer devices, graded composition devices and novel electrical contact layers to the organic materials are all being rapidly developed. The need for analytical techniques to elucidate the organic thin film structures as a function of device fabrication and lifetime studies is becoming extremely important. The past few years have witnessed a paradigm shift in the use of cluster ion beams for the sputter depth profiling of organic materials in conjunction with the surface analysis techniques. Today the use of low-energy monatomic ion beams such as Ar^{+} for depth profiling of a wide range of organic materials, including multi-layer organic thin films and organic light emitting diodes (OLEDs) has been replaced with cluster ions such as $C_{60}{}^{+}$ and Ar gas cluster ion beams (GCIB). The presentation will illustrated the capability to provide quantitative compositional depth profiling of OLEDs from the XPS depth profile analysis of graded composition multilayer OLED films.