

Improvement of Xe Plasma FIB Resolution and its Integration with Electron and Photon Beams

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Combined plasma Xe ion source FIB (focused ion beam) with SEM (scanning electron microscope) was introduced three years ago¹. It proved to be an important tool for ultra-fast milling, especially for semiconductor industry. Besides 50-times higher milling rate compared to traditional Ga ion FIB, it eliminates the conductive contamination of integrated circuits and it is useful for processing of compounds such as SiGe, (In)GaAs and (In, Al)GaN. We demonstrated its utilization also for other fields, for example preparation of large TEM lamella² or the first large-scale FIB tomography³.

Here we will present the latest advances of Xe plasma FIB leading to improvement of lateral resolution more than two times. This allows to expand Xe ion beam applications into the area of traditional Ga FIB applications. The SEM part of the combined FIB-SEM instrument is upgraded using recently developed immersion electron optics yielding ultra-high resolution imaging at low beam energies. The detection system comprising 8 electron detectors will be described including the backscattered electron detector for the complete range of energies 0.2-30 keV. Special piezo manipulator called rocking stage is designed to minimize curtaining effects.

The TOF-SIMS analyser recently integrated to FIB-SEM also benefits from Xe primary ions by better detection limit compared to Ga ions. Results will be discussed. Raman analysis in FIB-SEM⁴ is also enabled here thus providing ultra-high resolution electron beam, ultra-fast milling Xe ion beam and finally photon beam in one instrument.

¹ T. Hrnčíř, F. Lopour, M. Zdražil, A. Delobbe, O. Salord, P. Sudraud, ISTFA: Conference Proceedings from 38th Int. Symp. for Testing and Failure Analysis (2012) 26.

² A. Delobbe, O. Salord, T. Hrnčíř, P. Sudraud, F. Lopour, *Microsc. and Microanal.* 20, (2014) 298.

³ T. Hrnčíř, L. Hladík, J. Jiruše, F. Lopour, *Microsc. and Microanal.* 19 Suppl 2, (2013) 860.

⁴ J. Jiruše, M. Haničinec, M. Havelka, O. Hollricher, W. Ibach, P. Spizig, *J. Vac. Sci. Technol.* B32, (2014) 06FC03.