EBIS-Based HCI Micro-Beams

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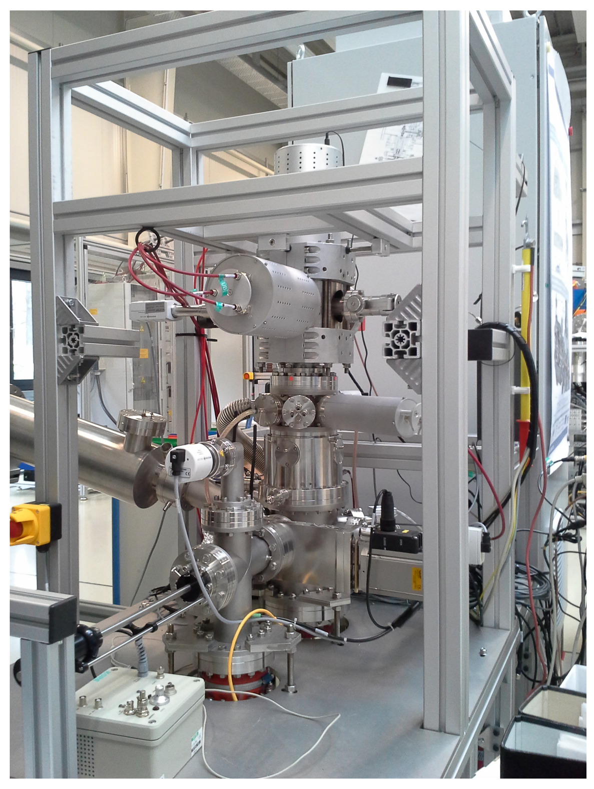
Dresden EBIS-M ion source

The EBIS-M is a room-temperature ion source based on the design of the Dresden EBIS-type. It is utilising bakeable magnet rings to generate an axial magnetic field with a strength of ca. 500 mT, but is primarily characterised by a specially designed third drift tube segment which is attached to the electron collector.

The recipient housing the remaining drift tube is flanged on top, plugging the central and extraction-side drift tube into each other. The advantages lie in the fixed on-axis alignment between the two electrodes involved in extraction: the third drift tube and the electron repeller. The maximum achievable drift tube potential and therefore the maximum kinetic energy for single charged ions is set at 20 kV, while the electron repeller which also acts as an einzel lens, can utilise up to 30 kV.



Current Setup and Features

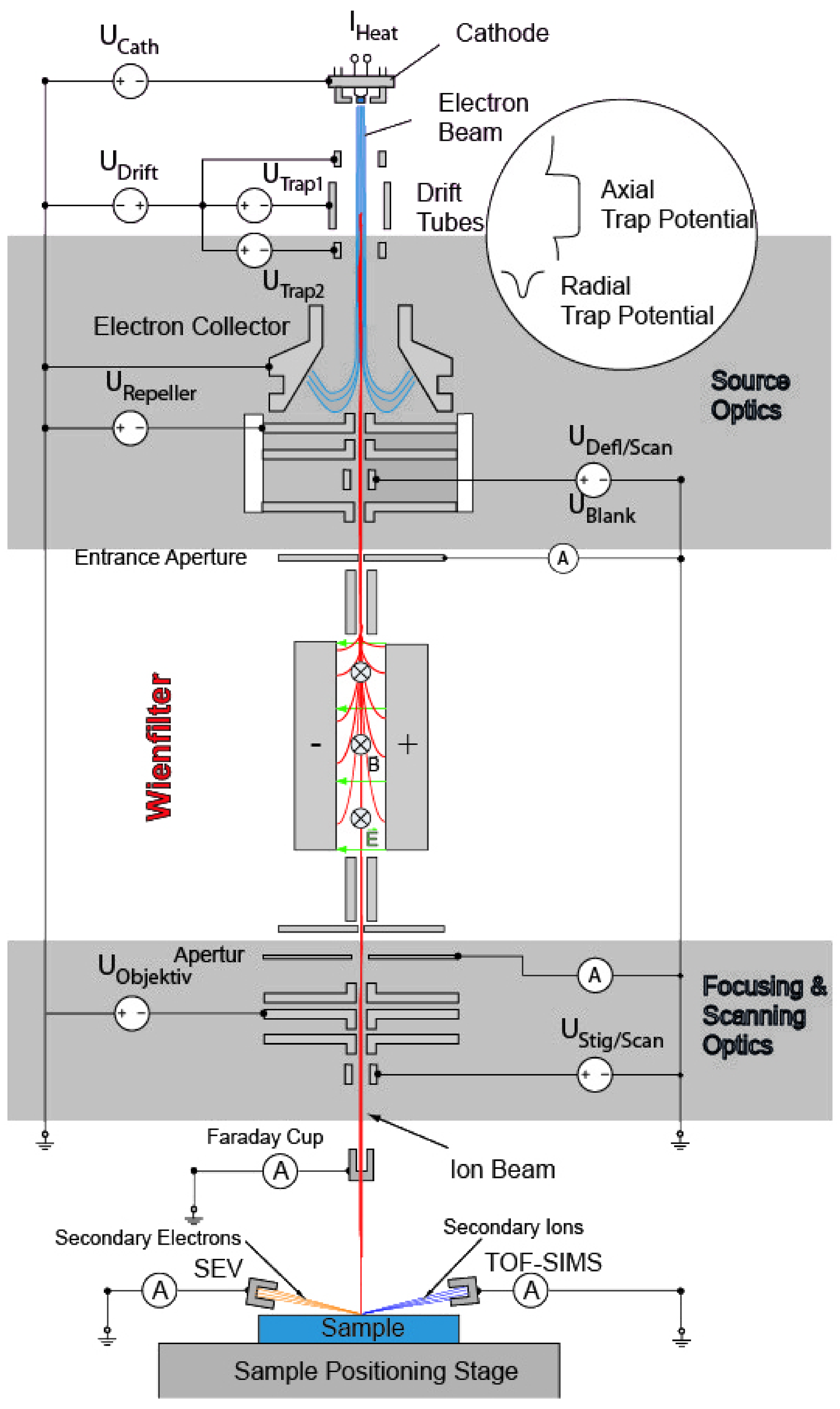
Used components
- Dresden EBIS-M ion source
- Wien filter
- ion-optical column
- 4-axis stage with target mount
- Faraday cup
- electron multiplier
- secondary ion mass spectrometer

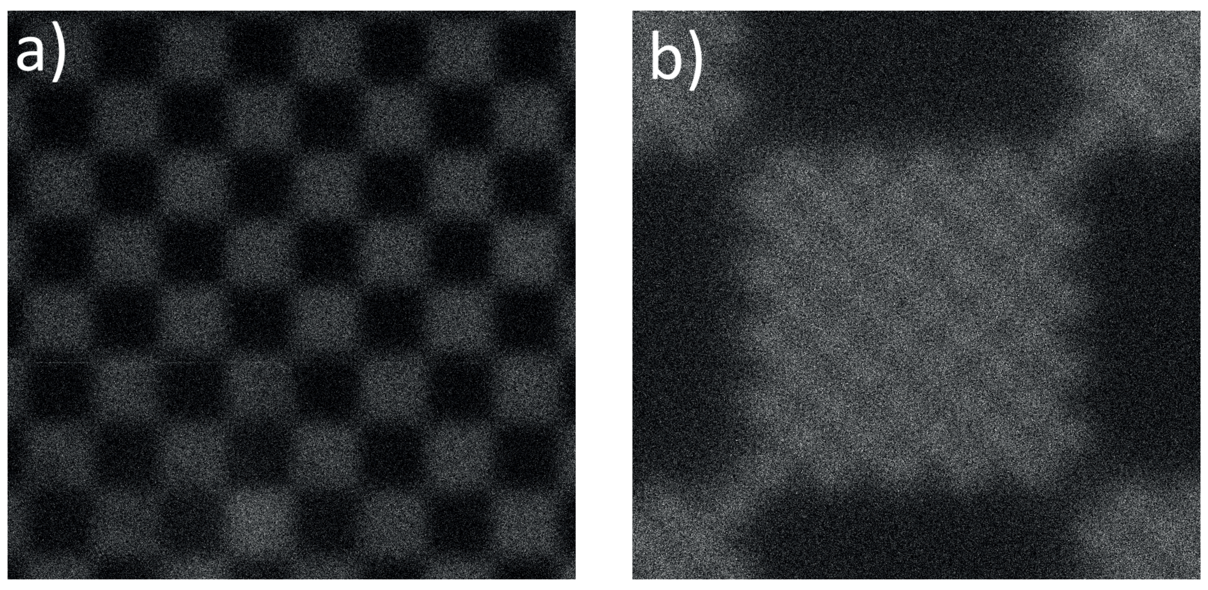
Available beam width and ion current

Final Aperture with 1mm diameter:
- <1 mm beamwidth, >500 pA
- 40 µm beamwidth, >300 pA current
- 30 µm beamwidth, ~100 pA current

Final aperture with 100 µm diameter:
- minimum beam width of <20 µm (so far)

Available charge states
- He, Ne, and Ar fully ionised
- up to Kr^{35+}
- up to Xe^{46+}





a) EM image of a chessboard-like gold pattern on silicon, made with a beam of Helium ions with a diameter of 30 µm. The visible squares measure 100 µm x 100 µm and have a substructure not resolvable with the used parameters. **b)** EM close-up image of the chessboard-like pattern. The visible substructure measures 10 µm x 10 µm, thus hinting a beam width below 20 µm.

Pending measurements
- investigation of minimum beam width (expectation: sub-micrometer range)
- charge state separation via time-of-flight
- ToF-SIMS measurements
- single ion implantation

Applications

- creation of chemical maps by combining electron multiplier imaging and the ToF-SIMS technique (see graphic to the right)
- photolithography-free structuring (ion-beam-induced etching, nanomasks, nano-column epitaxy)
- intensive local sputtering of micro-regions
- ion implantation of selected ion species, including HCIs
- investigation of single ion surface interactions

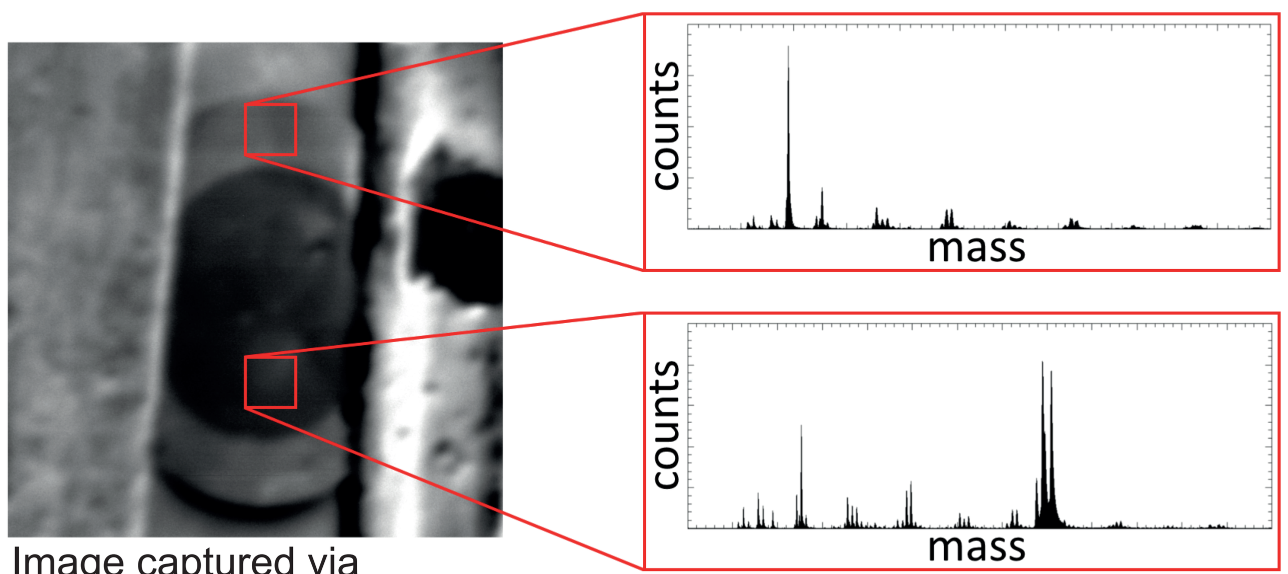


Image captured via electron multiplier

ToF-SIMS spectra

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