# Characterization of a broad reactive ion beam for the processing of optical relevant materials

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In recent years, the production of ultra-precision functional surfaces has gained more and more importance. Examples are the planarization and structuring for applications in, e.g. layer thickness trimming of frequency tuning of bulk acoustic wave or surface acoustic wave filters[1], the manufacturing of optical elements in semiconductor lithography systems[2] and the shape correction of telescope mirrors[3]. While the ion beam performance with inert gases has already been investigated in detail[4,5] , research on the use of reactive gases, which are essential for increasing the etching performance is still sparse. The usage of reactive species is accompanied by many complex reactions inside the ion source, along the ion pathway and on the substrate. Understanding these effects is crucial for meeting the continuously increasing requirements on precise surfaces.
For the characterization of a commercially available broad-beam ion source, a Faraday-cup array consisting of 256 single Faraday-probes for the measurement of the current density distribution and an energy-selective mass spectrometer for the measurement of the ion energy distribution functions and the mass distributions in the ion beam, i.e. the occurrence of different ion species, were used. The RF-excited broad-beam ion source was operated with an excitation-frequency of 13.56 MHz and with a gas mixture of $CHF_3$ and $O_2$. The current density distribution, ion energy distribution functions and mass distributions were recorded for different applied RF-powers.

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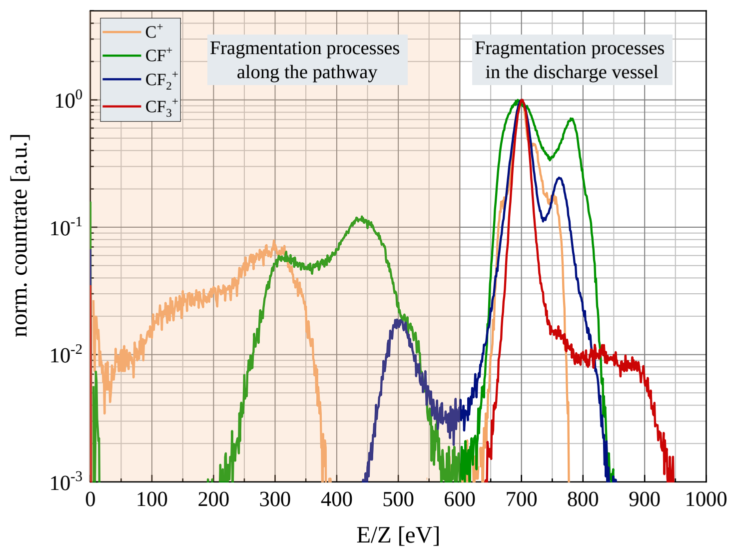


Figure 1: Energy scans for different ion species for an operation of the ion beam source with a mixture of $CHF_3$ and $O_2$ that shows peaks related to ion production in the plasma vessel and fragmentation processes outside the ion beam source.

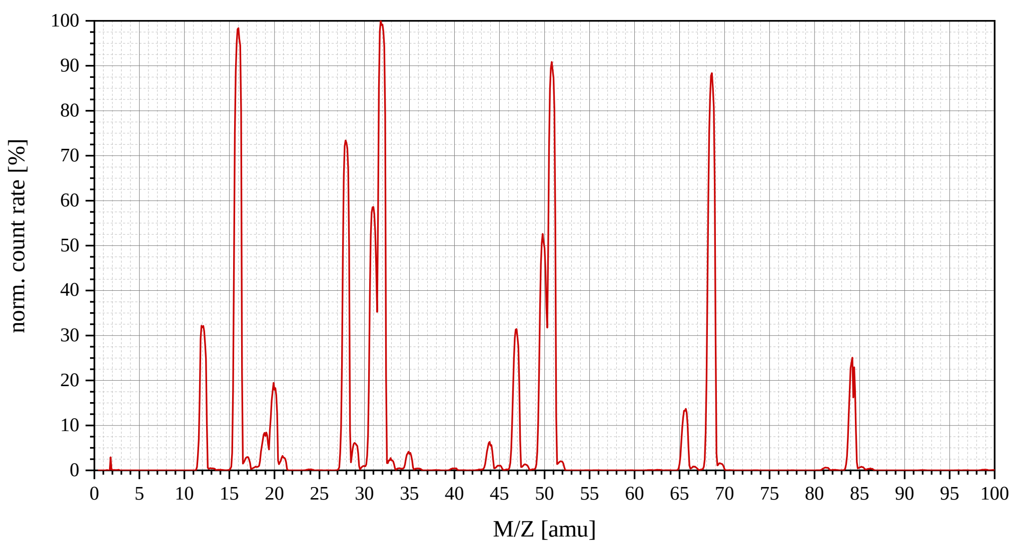


Figure 2: Mass scan at a fixed ion energy shows the different ion species present in the ion beam when the ion beam source is operated with a mixture of $CHF_3$ and $O_2$.