Energy resolved mass spectrometry in EUV-induced plasmas

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ENERGY RESOLVED MASS SPECTROMETRY IN EUV-INDUCED PLASMAS

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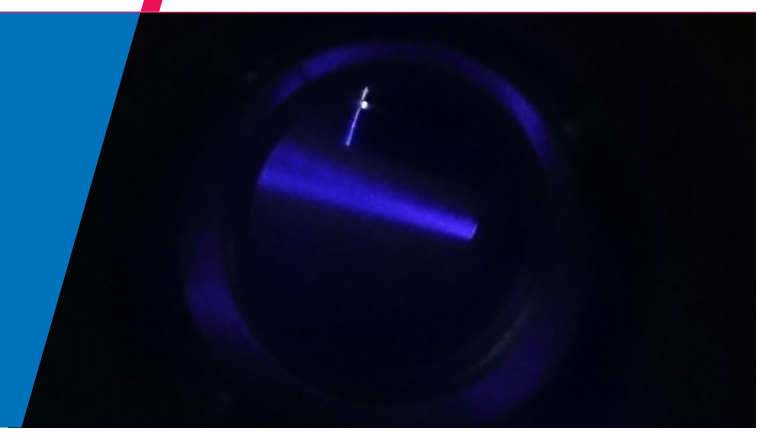
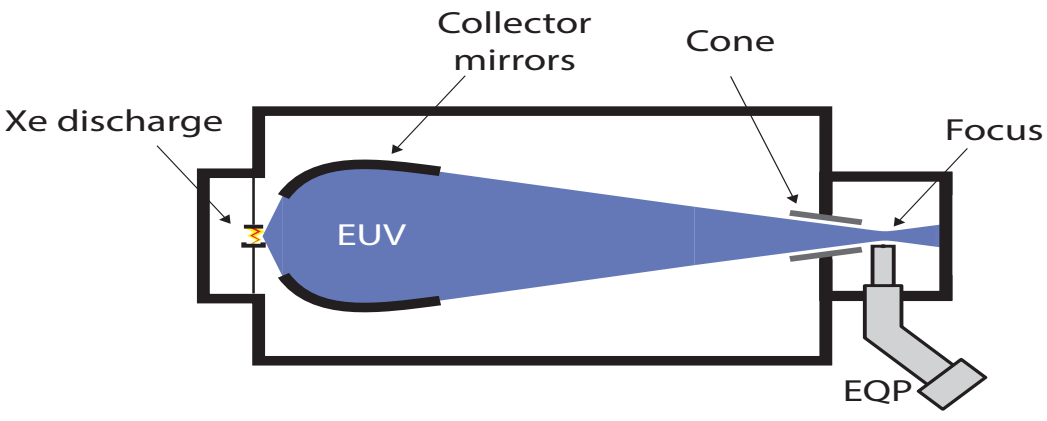
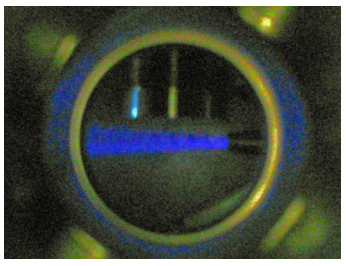


In this research Extreme Ultraviolet (EUV) light with a wavelength of 13.5 nm is used to induce a plasma in low pressure background gas. Comprehending these plasmas is important for industrial applications such as EUV lithography. To improve the understanding of ions in the plasma an electrostatic quadrupole plasma analyser is used to investigate the plasma composition and the ion energies.

PLASMA RESEARCH SETUP

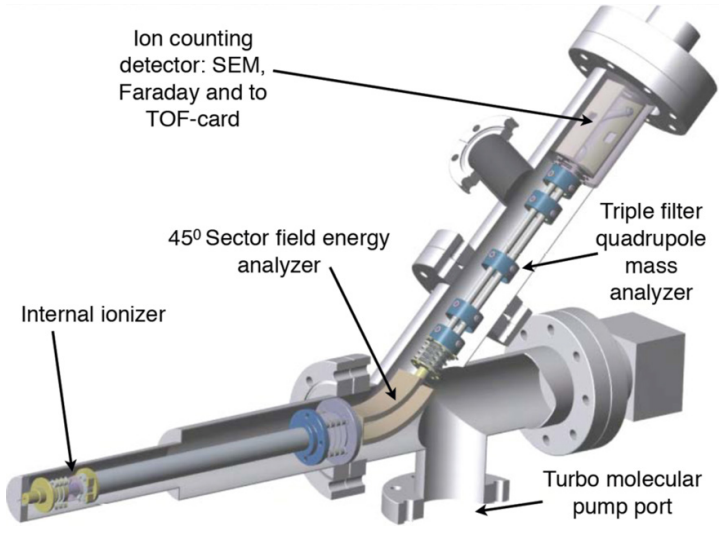
- EUV generated by a pulsed Xe pinch discharge
- Collector mirrors focus EUV radiation
- Measurements done at Focus where the EUV intensity is highest





EUV pulse frequency:	500Hz
Pulse width:	100 ns
Electron density:	10^{16} m^{-3}
Ionization degree:	0.01%

ELECTROSTATIC QUADRUPOLE PLASMA ANALYZER (EQP)



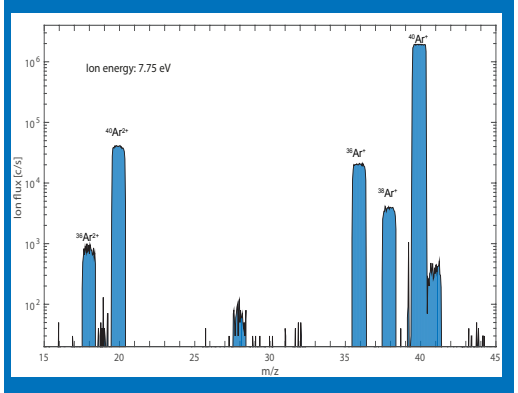
Hiden Analytic LTD., Warrington, England, http://www.hidenanalytical.com/

- Simultaneous measurement of ion mass and energy
- Time resolved with resolution up to 50 ns
- Large dynamic range (1 - 10^9 c/s) due to SEM and Faraday cup

FIRST RESULTS

The first measurements show the potential of the EQP. Some leads for interesting experiments where found.

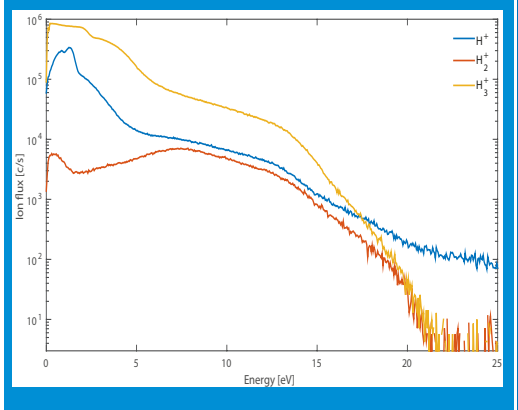
ION MASS



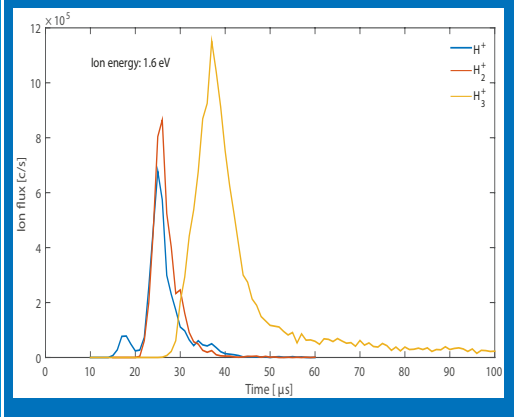
A mass scan of the ions in an argon plasma shows single en double charged ions. Also the argon isotopes are measured. The natural abundances are 0.34% for ^{36}Ar and 0.063% for ^{38}Ar.

ION ENERGY

The ion flux in a hydrogen plasma is measured as function of energy for H^+, H_2^+, H_3^+. The measurements show a high energy tail of H^+ which extends beyond the measurement range.



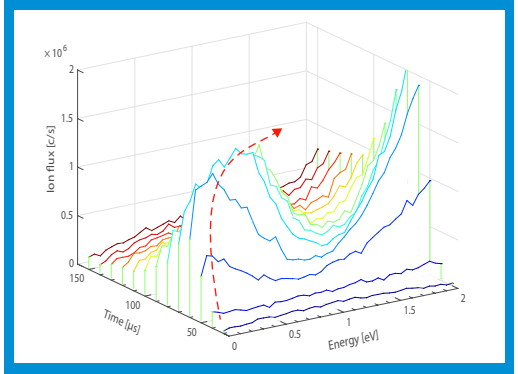
TIME RESOLVED ION FLUX



The ion flux in a hydrogen plasma is measured as function of time. H_3^+ reaches the detector at a later time than H^+ and H_2^+ which is (partly) explained by difference in flight time in the EQP due to the mass difference.

TIME RESOLVED ION ENERGY

The development of the low energy part of the Ar^+ energy distribution is measured as function of time with a resolution of 10 µs. As the IEDF develops the peak of the low energy bump shifts to higher energies.



EPG ASML