Investigation of ion energy distribution functions in EUV-induced plasmas by ion mass spectrometry

INVESTIGATION OF ION ENERGY DISTRIBUTION FUNCTIONS IN EUV-INDUCED PLASMAS BY ION MASS SPECTROMETRY

Tijn H.M. van de Ven[1], Pim Reefman[1], Edgar A. Osorio[2], Vadim Y. Banine[1,2] and Job Beckers[1]

[1] *Eindhoven University of Technology, P.O. Box 513, 5600 MB Eindhoven, The Netherlands*
[2] *ASML, De Run 6501, 5504DR Veldhoven, The Netherlands*

The creation of plasma by direct photo ionization by extreme ultraviolet radiation (EUV, 13.5 nm) is a common phenomenon in extraterrestrial planetary nebulae. However, this process has been difficult to reproduce in a laboratory because of the scarceness of EUV radiation sources. With the development of next-generation lithography tools, using EUV radiation to create smaller features on computer chips, EUV induced plasmas are now created in the low pressure background gas in lithography tools. Industries have realized that these plasmas are of significant importance with respect to machine lifetime.

EUV induced plasmas affect exposed surfaces due to impacting ions. In this research an ion mass spectrometer, capable of measuring mass resolved energy spectra, is used to investigate the ion fluxes and ion energy distribution functions (IEDF) of EUV-induced plasmas. A xenon pinch discharge produces EUV radiation, which is focused into a measuring vessel with a low pressure hydrogen environment. In this vessel photo ionization creates free electrons with energies up to 76 eV, which further ionize the background gas by electron impact ionization.

Ions are sampled through a 50 µm orifice in the spectrometer's front plate. The influence of pressure and EUV power on the IEDF of the EUV-induces plasma are investigated. The results show the fast transformation of H_2^+ to H_3^+ by collisions with the background gas as a decrease in H_2^+ / H_3^+-ratio with pressure and distance to the EUV beam.