Institute of
Applied Physics
Friedrich-Schiller-Universität Jena

Characterizing the Linear Accelerator 4GABIS

Background:

We are currently improving a unique four-grid accelerator broad ion source (4GABIS) for the acceleration of a selection of gas species from a plasma source with energies up to 30 keV. Currently, 4GABIS is not completely characterized in terms of e.g. profile shape and ion flux for many of the available acceleration parameters.

Objective:

The first objective of the characterization is to measure the shape of the broad beam of ions generated from the plasma. This encompasses an investigation regarding differences of the profile shapes related to ion species, acceleration energy and plasma parameters. Furthermore, we want to investigate the possibilities for a tuning of the profile by changing the voltage applied to the acceleration grids. The resulting profile shapes are to be measured directly with a mobile Faraday-cup placed on a linear axis, and indirectly by observing e.g. sputtering effects related to the irradiation in the targets.

The second objective is a characterization of ion flux for different acceleration energies of the available ion species. This is a non-trivial task, as the comparatively high pressure necessary for the operation of the plasma causes a neutralization of accelerated ions before they hit the Faraday-cup or target. These neutral atoms cannot be measured via the current measurement any longer, but affect the target similarly to ions nonetheless. To achieve the goal of ion flux measurements with a deviation of below 5 %, the extent of ion neutralization needs to be measured for all investigated combinations of ions and acceleration energy.

Tasks:

- Extensive operation of our accelerator 4GABIS
- Combining existing models for charge transfer to experimental results
- Interferometry to measure the remaining thickness of sputtered targets
- (Optional) Ellipsometry to measure changes of the refractive indices due to ion irradiation

Contact:

Johannes Kaufmann
Microstructure Technology, Institute of Applied Physics
Albert-Einstein-Str. 15, 07745 Jena
Tel.: 03641 947838, johannes.michael.kaufmann@uni-jena.de

Literature:

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S. Bromley et al. (2019), *Symmetric Charge Exchange for Intermediate Velocity Noble Gas Projectiles*, https://dx.doi.org/10.1088/1361-6455/ab42d1