Role of ion magnetisation on the self-bias / floating potential in low-temperature plasma within a magnetic field up to 0.5T

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Radio-frequency (RF) plasma discharges are widely used in laboratories, especially for plasma etching in the semiconductor industry. However, similar etching processes are foreseen to be used to remove contaminants on the first mirrors in optical diagnostics for the next generation of fusion devices to recover their initial optical efficiency [1]. This mirror cleaning operation is expected to be performed under magnetic fields up to 3.5 T [2]. Such discharges are commonly driven with an electrode DC isolated from the ground via a blocking capacitor, which charges up negatively, leading to the formation of a self-bias on the electrode surface. The self-bias voltage has an influence on the energy distribution of the ions on the surfaces as it contributes to the voltage drop into the sheath, especially in magnetic fields [3]. Knowing electrode self-bias (V_{bias}) and plasma potential (V_p) allows for controlling the ion energy distribution on the electrode surface.

The experimental characterisations of the influence of ion magnetisation on the electrode self-bias potential and floating potential in a magnetic field were performed using a rotatable planar electrostatic probe to measure V_p and floating potential (V_f) in the quasi-neutral plasma region. The ion current densities perpendicularly and parallelly to the magnetic field were compared and gave an experimental criterion on ion magnetisation. In this contribution, the influence of ion magnetisation on electrode self-bias and probe floating potential in argon, neon and helium plasma in a magnetic field up to 0.5T for various pressures and RF frequencies are discussed.

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