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# A Numerical and Experimental Study of Ion Impingement from RF Discharge on the Mirror Surface in Strong Magnetic Field

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Optical elements of Thomson scattering diagnostic system in ITER tokamak will require cleaning techniques against the Be-W contaminations. Ion bombardment from radio frequency (rf) discharge is promised to be the most efficient technique for remove of deposited metal films. We present a numerical study of ion transport in collisional rf sheath in presence of strong magnetic field using PIC simulation. Calculated ion flux and energy distribution functions are compared with experimental measurements for different noble gases, discharge frequencies (40 – 100 MHz), inclination angles of magnetic field lines (0 – 90 degrees) and magnetic field strength.

## 1. Introduction

Thomson scattering of electromagnetic radiation is one the main methods to measure fusion plasma parameters. Based on this phenomenon, optical diagnostic system uses mirrors installed in the vacuum vessel of tokamak reactor. During the ITER tokamak operation, sputtered Be and W elements will be deposited on the mirror surface changing reflectance and measured spectra. Therefore, optical diagnostic system in ITER will require the implementation of mirror cleaning system. Ion bombardment from capacitively coupled plasma (CCP) is considered to be the most promising method to remove contaminations from the mirror surface [1].

Development and optimization of plasma cleaning process requires measuring of ion flux density, ion angular and energy distribution function (IEDF). The study becomes more complicated in presence of strong external magnetic field (~ few T) inclined to the mirror surface.

## 2. Modeling and experimental results

Self-consistent PIC simulations of ion movement through the collisional oscillating CCP sheath were performed for noble gases (He, Ar and Ne) in presence of strong magnetic field (~ 0.9 T). Both elastic and charge exchange collisions were taken into account. Magnetic field was considered to be spatially uniform. Experimentally measured ion flux density and potential drop across the sheath were used as input parameters for PIC simulation.

Experimental measurements of IEDF were performed using retarding field energy analyzer for different discharge frequencies 40 – 100 MHz at fixed discharge power. Maximal magnetic field strength was 0.9 T.

As the result, we have numerically calculated ion energy and angular distribution functions, plasma sheath thickness and sputtering coefficients for different noble gases, discharge frequency 40 – 100 MHz, inclination angle 0 – 90 degrees and magnetic field strength up to 0.9 T. Simulation results have been compared with experimental measurements of IEDF and .

## 3. References

[1] A.G. Razdobarin et al, Nucl. Fusion. **55** (2015) 093022 (11pp).