**Ion and neutral particle diagnostics in Radio Frequency discharges in the upgraded TOMAS device**

D. López-Rodríguez1,2, K. Crombé1,2, A. Goriaev1, J. Buermans1,2, Yu. Kovtun3,

L. Dittrich4, P. Petersson4, S. Moon4, T. Wauters5

*1 Laboratory for Plasma Physics, LPP-ERM/KMS, Brussels, Belgium*

*2 Department of Applied Physics, Ghent University, Ghent, Belgium*

*3 Institute of Plasma Physics, NSC KIPT, Kharkov, Ukraine*

*4 Fusion Plasma Physics, KTH Royal Institute of Technology, Stockholm, Sweden*

*5 ITER Organization, St. Paul-lez-Durance, France*

The upgraded TOroidal MAgnetized System (TOMAS) is a device used to complement studies of wall conditioning techniques for superconducting devices like W7-X and ITER [1]. The magnetic field of TOMAS is toroidal and has a maximum intensity of 0.125 T on axis. The flexible system allows the use of both microwaves and radio frequency (RF) waves for plasma production. An ion cyclotron radio frequency (ICRF) system made of a single strap antenna generates the RF discharges, it operates with an adjustable frequency in the range of 10–50 MHz and can couple up to 6 kW of power to the plasma [1].

The study and optimization of the ion and neutral fluxes and energy distributions in RF discharges is necessary to properly describe the conditions used during sample analysis experiments, performed using a sample load lock system built for material samples exposure. The aim of the research is to study the ion cyclotron wall conditioning (ICWC) technique, foreseen for magnetic confinement devices like ITER [2].

The characterisation of RF plasmas is performed using several diagnostics present at TOMAS: a Time-of-Flight Neutral Particle Analyzer (ToF-NPA), employed to measure neutral particles fluxes and the low energy (10–725 eV) neutrals distribution [3]; a Retarding Field Energy Analyser (RFA) integrated into the sample load lock system, used to measure local ion fluxes and their energy distribution (10–1000 eV) [4]; and a set of movable Langmuir probes, utilized to determinine plasma quantities like the electron temperature and density at different positions inside the vessel [5]. For this research, the measurements of plasma parameters, ion and neutral fluxes and their energy distributions are performed for hydrogen plasmas as a function of different values of pressure during the discharges, frequency of the RF waves launched into the plasma, and intensity of the magnetic field.

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