OR2008

Characterization and optimization of a neutral atomic hydrogen source developed for the study of the specific chemical etching of highly oriented pyrolitic graphite.

Thomas Bieber[1], Ludovic de Poucques[1], Jean-Luc Vasseur[1], Robert Hugon[1], Mohammed Belmahi[1], Jamal Bougdira[1]

[1]Institut Jean Lamour, UMR CNRS 7198, Vandoeuvre-lès-Nancy, France

thomas.bieber@lpmi.uhp-nancy.fr

Successful future fusion devices require longer confinement time for their fusion plasma. However, the plasma under such durations will erode chemically and physically the wall materials. Better understanding of wall erosion processes is one of the challenging issues looked for ITER fusion research program. In this perspective, we work on plasma-surface interactions. The aim of this work is to use a helicon reactor to create an atomic hydrogen (H) source in order to study the chemical erosion of carbon surfaces.
The plasma reactor is composed of a Pyrex tube as a source chamber and a stainless steel diffusion chamber. The plasma is generated by a Boswell type antenna placed around the tube. The input 13.56 MHz RF power ranges up to 1000 W. Static low magnetic fields (up to 200 G) are generated by two sets of copper coils, placed around the source and diffusion chambers.
To characterize the Ar/H_2 plasma, we use several plasma diagnostics. For Ar^+ density measurements, we use an OPO (Optical Parametric Oscillator) laser tuned around 668.429 nm to probe its $3d^4$ metastable state and the laser induced fluorescence (LIF) signal is collected at 442.6 nm. The same LIF measurements are done on the $3d^2$ metastable state of Ar^+, using the OPO laser tuned around 611.492 nm (LIF signal at 461 nm). The LIF experiments are completed by RF compensated Langmuir probe measurements to obtain the electronic characteristics of the diffusion plasma. To measure the relative quantity of H in the ground state, Two photons Absorption LIF is performed with a dye laser centred at 205 nm and the signal is measured at 656 nm.
In this contribution, we show that the optimal pressure to obtain the highest H density in the diffusion chamber is around 30 mTorr and 800W (competition between production and diffusion of H towards the substrate), Ar (at least 50%) is necessary in the gas mixture to obtain a dense and stable plasma, and the magnetic field in the diffusion chamber must be maximum to confine the charged particles.

Keywords
ITER
LIF
atomic hydrogen-carbon interaction