Interaction Between Ion Beam And Recombining Hydrogen Plasma In Radio-Frequency Discharge Divertor Simulating Device

A. Okamoto, H. Takahashi, T. Takahashi and S. Kitajima
Department of Quantum Science and Energy Engineering, Tohoku University, 6-6-01-2 Aobayama, Sendai, 980-8579 Japan

Energetic ions flowing into the divertor region of magnetic confinement devices interact with low temperature recombining plasma. The plasma density and temperature are then concerned to be changed, which might results in reduction of recombination rate in the detached plasma. To study the compatibility of the volumetric recombining processes with energetic ions, a beam injection experiment has been conducted using a linear device [1]. High density plasma was produced by helicon discharge with helium gas [2]. The recombining spectra were observed when helium gas was puffed into a helium plasma [3]. While the interaction in hydrogen plasma system is significant in the divertor region, simulating experiments of that interaction were little attempted. In this presentation, experimental results using hydrogen gas are reported.

Experiments are performed in the DT-ALPHA device, the length of which is 2 m. Hydrogen plasma is produced by 13.56 MHz radio-frequency field under the magnetic field that almost matches with the lower hybrid resonance. Langmuir probe measurement shows that the electron density $n_e > 10^{17}$ m^{-3} in the production region. The plasma is transported toward a recombining test region along the magnetic field, where the plasma is radially confined by the magnetic field ($B_z \sim 0.2$ T). Response of a hydrogen plasma to a proton beam is investigated using a one-dimensional model. In addition to the ionization by ion impact, which is considered in the previous model [4], the charge exchange (CX) process is considered. Difference in spatial dependence is observed between CX and ionization. While the spatial distribution of perturbed electron density is a monotonic function for the ionization, a local maximum is appeared in that for CX.

The work was partly supported by JSPS KAKENHI Grant Number 26420848.

[1] A. Okamoto, et. al., *Plasma and Fusion Research* **7**, 2401018 (2012)
[2] A. Okamoto, et. al., *Journal of Plasma and Fusion Research SERIES* **9**, 428 (2010)
[3] H. Takahashi, et. al., *Fusion Science and Technology* **63**, 1T, 404 (2013)
[4] A. Okamoto, et. al., *JPS Conference Proceedings* **1**, 015010 (2014)