Study of Plasma Behavior During Impurity Injection Experiments in D-module of GAMMA 10/PDX.

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GAMMA 10/PDX is the world's largest linear device which is 27 m long. In GAMMA 10/PDX, divertor simulation experiments have been started by using a divertor simulation experimental module (D-module) [1]. In the D-module, a V-shaped target made of tungsten has been installed. It has been aimed to investigate the physics of radiation cooling and detachment. A set of calorimeter and Langmuir probes has been installed on the target plate. In this experiment, the plasma parameters in D-module have been measured in the case of Ar and Xe injection. It has been found that the plasma parameters in D-module depend on the gas throughput and gas species. Reduction of electron temperature, heat and ion fluxes in the case of Xe injection is higher than those of Ar injection. Especially, ion flux is drastically reduced during Xe injection. The heat flux distribution on Y axis [2] has also been investigated. In this case, the heat flux distribution has a peak at Y=0 [cm] and heat flux decreases toward the Y direction. According to the increase of gas throughput, the heat flux distributions become uniform. Electron temperature reduces to about 2 eV and 3 eV by Xe and Ar injection, respectively. The increase of electron density firstly occurs due to impurity injection. Then decrease of electron density has been observed according to the increase of impurity injection. These results indicate that detached plasma is generated.

In order to investigate the energy loss processes and the plasma behaviors under the same conditions of the divertor simulation experiments in the GAMMA 10/PDX, a simplified code for the end-cell has been developed based on the same fluid model as the B2-code [3], which has been originally developed by Braams for the numerical simulation of tokamak SOL and divertor plasmas [4]. The effect of neutral hydrogen and Ar impurity injection on the plasma parameters has been investigated numerically. Reduction of electron and ion temperature has been observed with the increasing injected hydrogen neutral density. However, a remarkable reduction of electron temperature and heat flux has been observed during simultaneous injection of Ar and hydrogen neutral, which indicates the radiation cooling effect of Ar. For ions, it is found that the most effective processes are ionization, CX loss between hydrogen ion and neutral particles and, CX loss between Ar and ion. Therefore, other processes such as recombination for H^+ are very small. On the other hand, for electrons, the effective processes are the effect of ionization for H, radiation loss by inelastic collision with neutral particles. More detailed results will be presented at the meeting.

[1] Y. Nakashima et al., Trans. Fus. Sci. Technol. **68**, 28 (2015).
[2] M. Iwamoto et al., Plasma Fus. Res. **9**, 3402121 (2014).
[3] H. Takeda, et al., Contrib. Plasma Phys. **54**, 4-6, pp. 605-609 (2014).
[4] B.J. Braams, NET Rep. 68 EURFU/X-80/87/68, CEC, Brussels (1987).