§12. Effect of the Directional Contact of Cooled Gas with Plasma in TPD-I Device

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It is important to reduce the heat load of the divertor plate for the next generation fusion devices, such as ITER. The idea of gas target divertor is based on the redistribution of heat load at a surface due to the radiation and due to the elastic and inelastic collisions with neutral particles[1]. The gas target divertors is one of the most attractive method which may solve the divertor heat load. Such a concept has been realized by using the linear plasma divertor experiments, such as TPD-I and PISCES-A and so on[2][3].

In present paper, a wide range of experimental condition can be changed in TPD-I to simulate a divertor plasma interacting with a neutral gas target and to evaluate the relevant atomic physics and plasma transport processes. A water-cooled target, like a divertor, is placed at the end of plasma in TPD-I. The cooled gas (helium or argon) contacts a helium plasma in the closed neutrizer tube at the angle of θ=90°(**G1**) and θ=45°(**G2**), except for an experiment of no directional contact (**G3**) of cooled gas with plasma(Fig. 1). The pressure in the plasma test region is usually kept less than 10^{-5} Torr by differential pumping and can be controlled from 10^{-5} to 10^{-3} Torr by feeding a cooled gas into the plasma test region. Typical experimental conditions are as follows: the discharge current is 10A, the electron density is ~2×10^{17} m^{-3}, the electron temperature is ~6 eV, the axial magnetic field strength is about 0.3T.

Figure 2 show the electron density n_e and the electron temperature T_e as a function of the He contact gas glow Q_{He}. In the case of no directional contact of cooled gas, n_e increases and T_e gradually decreses with increasing Q_{He}; the detached plasma is not appeared. On the other hand, when the cooled gas contacts the perpendicularly (θ=90°), a stable detached plasma is found to be produced. In this case, a reduction of plasma heat flux at the target plate is certified with a decrease in electron temperature (~2 eV) and density (~10^{16} m^{-3}).

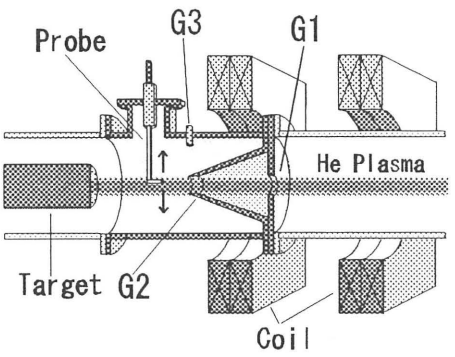

Fig. 1. Schematic diagram of directional contact of cooled gas system in TPD-I device.

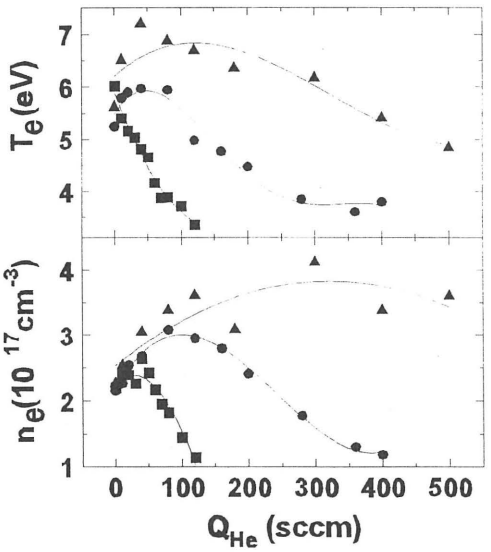

Fig. 2. The electron denstiy and the electron temperature as function of the contact gas flow: G1(■), G2(●), G3(▲).

References

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