§15. Impurity Transportation in High Density Plasma Produced by TPD-II

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i) Introduction

A reduction of reversed gas flow toward main plasma in a gas divertor is required to achieve both a low thermal load on a divertor plate and high magnetic confinement in the main plasma. In the divertor system proposed by us, a high vacuum region is set between the divertor region and the monitoring region1,2). In this paper, impurity transportation of the divertor materials in the plasma was investigated using TPD-II (Test Plasma generated by Direct Current).

ii) Experimental apparatus

Experimental setup is shown in Fig.1. The helium plasma produced in a plasma source travels through a monitoring chamber, contacts with a metal divertor or gas divertor, and finally relaxes to neutral gasses. Chemical species of impurity deposited on the silicon substrate placed on the diverter region were analyzed by XPS. Spatial distribution and chemical species in the plasma was measured by using emission spectroscopy for the plasma. Neutral atoms and molecules within the monitoring region were monitored by quadruple mass spectroscopy.

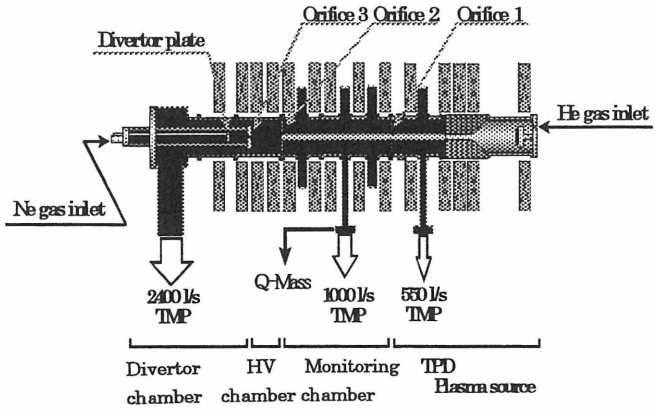

Fig. 1. Schematic diagram of TPD-II

iii) Experimental results

Divertor materials were detected on the substrate in the diverter region placed at both 10 cm in front of divertor plate and a few cm behind. Spatial distributions of atoms and molecules were measured from 0 to 200cm in front of divertor plate made of molybdenum. Spectral line (229.5nm) of molybdenum were observed, and the intensities of the spectra were observed strongly for the point far from the divertor plate. In the case of the divertor plate made of carbon, similar results were obtained. Some of the neutral particles sputtered or evaporated by plasma come into plasma flow and become ionized. Another particles were either deposited on the chamber surface near the divertor plate or exhausted as a waste matter from the chamber.

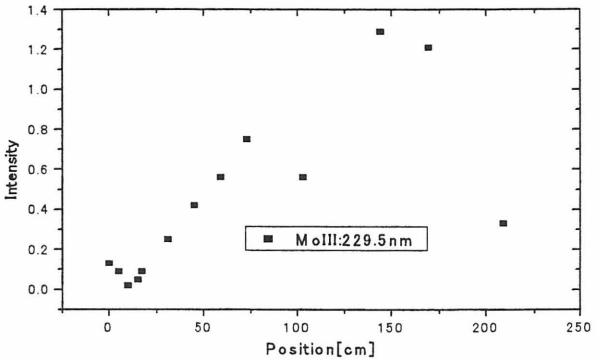

Fig.2. Spatial distribution of MoI(229.5nm) line.

Neon gas was introduced from a hole on the divertor plate through the mass flow controller. Gas injection was carried out within 100 ms. The time before the gas start emission of NeI 352.0 nm (Fig.3) were measured. The time increased as distance become further from the divertor plate. The time decreased as the discharge current increased. It is thought that neutral neon was rapidly excited by contacting with the high density plasma.

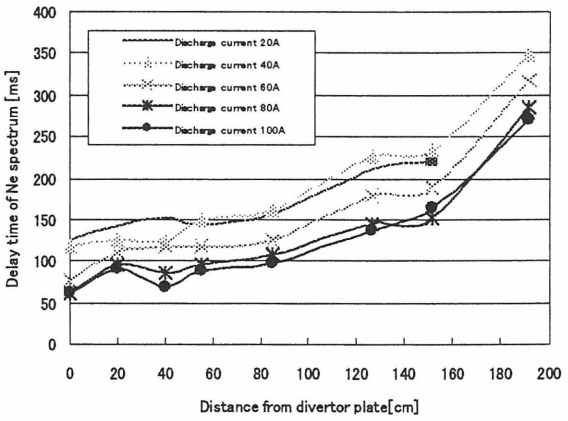

Fig.3. The delay time of NeI spectra vs. distance from the divertor plate for variable discharge current (20～100A).

References

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