§19. Study of Neutral Hydrogen and Impurity Behavior in Heliotron J Plasmas

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The optimization of the advanced helical configuration is one of the chief aims of the Heliotron J experiment. Three configurations which have different bumpiness component ε_b have been intensively investigated in the last experimental campaign. One is the high bumpiness configuration($\varepsilon_b = 0.15$), another is the medium bumpiness(standard, $\varepsilon_b = 0.06$), and the other is the low bumpiness($\varepsilon_b = 0.01$). A grazing incidence flat field survey VUV spectrometer has been employed to study the behavior of highly ionized impurities by the analysis of the VUV spectra obtained in such magnetic configurations with the different heating discharges (ECH, NBI, and ECH+ICRF). The wavelength region of the VUV spectrometer is 5~40 nm and the minimum time resolution is 5 msec.

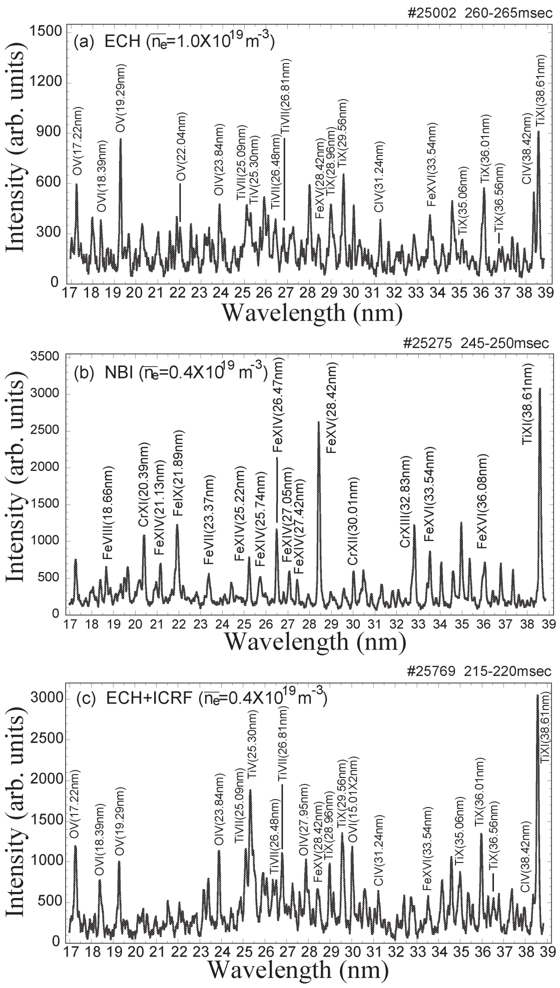

Fig. 1: Comparison of typical VUV spectra in different heating method (a)ECH, (b)NBI and (c)ECH+ICRF plasmas in standard configration ($\varepsilon_b = 0.06$).

Figure 1 shows the typical VUV spectra obtained in (a)ECH, (b)NBI and (c)ECH+ICRF plasmas in the standard configuration. As can be seen in Figure 1, there are some distinctive feature of the spectra according to the heating method. In ECH plasmas, the oxygen lines are intensively observed and OV lines are the most intense among them. In NBI plasmas, the emissions of the metallic species such as Fe, Ti and Cr have been identified. Especially, many Fe lines in the different ionization stages have been observed. In ECH+ICRF plasmas, VUV emissions have been increased during ICRF injection and many low ionized Ti lines have been observed.

Figure 2 shows the power dependences of (a)FeXV(28.42 nm) line intensity in NBI plasmas and (b)TiXI(38.61 nm) line intensity in ECH+ICRF plasmas. The closed circles, the open triangles and the closed diamonds correspond to the high bumpiness, the standard and the low bumpiness cases, respectively. As shown in Fig. 2(a), the FeXV line intensity increases with the NBI power (200 kW~600 kW) regardless of the bumpiness component. The TiXI line intensity also increases with ICRF power (100 kW~400 kW) as shown in Fig. 2(b). In each case, the increasing rate of the line intensity tends to be higher in the higher bumpiness configuration. There can be some causes to affect the line intensities of the impurity emissions, such as the impurity generation processes, the screening effect by the edge plasma and the transport processes in the core plasmas. These processes are thought to be changed according to the different bumpiness conditions. Further investigations are needed to determine which process affects the enhancement of the emission in the higher bumpiness configuration.

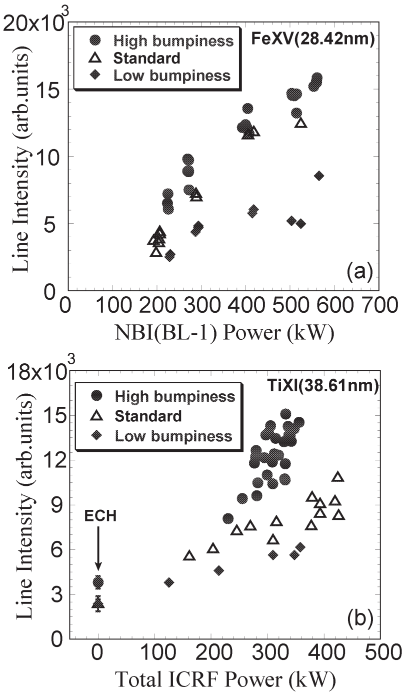

Fig. 2: Power dependence of (a)FeXV(28.42nm) in NBI plasma and (b)TiXI(38.61nm) in ECH+ICRF plasmas.