§11. EUV Spectrum of Highly Charged Tungsten Ions in LHD

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Tungsten is planned to use as material for the divertor plates in ITER because of higher sputtering threshold energy for light ion bombardment, the highest melting point among all the elements, and less tritium retention compared with carbon-based materials. Since in ITER extremely high particle- and heat-fluxes are predicted based on the intermittent edge plasma transport, *e.g.,* edge-localized-mode, it causes a serious damage to such components. Tungsten is therefore considered to be one of the most abundant impurities in the ITER plasma. However, impurity tungsten enters the high-temperature plasma and is ionized to highly charged ions, and then highly charged ions emit very strong photons of EUV and/or X-ray. This emitted photon has very important information on plasma diagnostics; information on electron and ion temperature, electron density, impurity ion abundance and impurity transportation. The impurity tungsten exists in not only core region of high-temperature plasma but also in the plasma area of relatively low temperature of the divertor vicinity. The energy range of the plasma that there are impurity highly charged tungsten ions in the fusion reactor such as the ITER becomes extensive from several tens eV to several tens keV. The charge states of highly charged tungsten ions existing in such plasma are approximately from several tens to 60~70, and it is the present conditions that those emission spectra are very complicated and those spectral data are very poor. Emission lines of highly charged tungsten ions thus play an important role in the spectroscopic diagnostics of the ITER plasma, and consequently the spectroscopic data of tungsten ions have been studied at several facilities[1)-3)].

For the first time, we succeeded in observation of unidentified emission lines which are expected from theoretical calculations from W^{26+} around 100Å. We observed the emission lines of the 4f-5s transition by impurity pellet injection in LHD. These LHD spectra are shown in Figure 1. The wavelength of emission lines was slightly shifted comparing with the theoretical calculations because the wavelength of spectrometer has not been calibrated. Strong peak was observed at 101Å and other emission lines were also observed at both ends of this strong peak. These lines are emission lines of W^{26+} $4f5s \rightarrow 4f^2$ by electron excitation.

Some emission lines of highly charged tungsten ions have been identified in this experiment. Furthermore it was confirmed as a single emission line in fusion plasma. These single emission lines of highly charged tungsten ions become very important lines in spectroscopic diagnostics of plasma. In future, we will promote detailed studies for the spectroscopic diagnostics of plasma, such as electron energy dependence and electron density dependence of these.

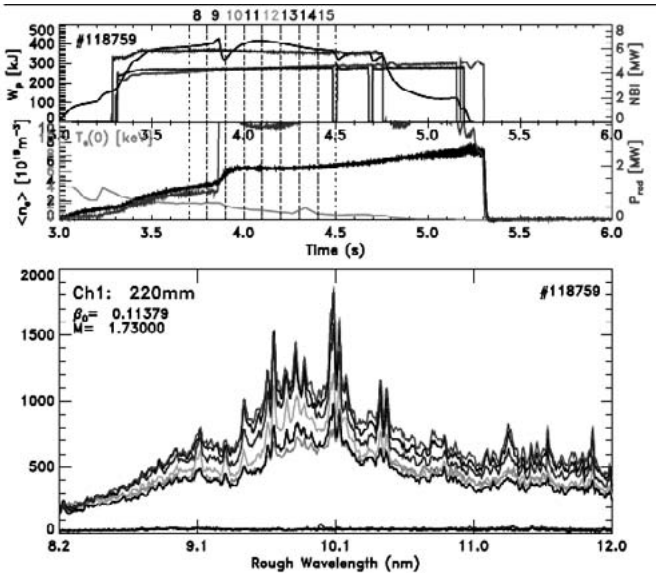

Fig. 1. EUV spectra after impurity tungsten pellet injection in LHD

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2) M.B. Chowdhuri, S. Morita, M. Goto, H. Nishimura, K. Nagai and S. Fujioka, Plasma and Fusion Research Vol.2, S1060 (2007)
3) J. CJ. Clementson, P. Beiersdorfer, E.W. Magee, H.S.McLean and R.D. Wood, J. Phys. B **43** 144009 (2010)