§12. EUV Spectrum of Highly Charged Tungsten Ions by Electron Beam Ion Trap

Sakaue, H.A., Kato, D., Murakami, I.,
Nakamura, N. (The Univ. of Electro-Commu.)

Tungsten will be used 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. However, since extremely high particle- and heat-fluxes of the intermittent edge plasma transport (e.g. edge-localized-mode) in ITER would cause serious damages to such components, tungsten is 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.

On the other hand, an electron beam ion trap is a useful device for the systematic spectroscopic studies of highly charged tungsten ions. We have constructed a compact electron beam ion trap, called CoBIT1)-3), and observed extreme ultraviolet (EUV) spectra of highly charged tungsten ions.

We observed an unidentified emission lines which are expected from theoretical calculations from W^{26+} around 100Å at CoBIT. As electron energy of CoBIT is increased across the ionization energy (*Ip(25+)*=786.3eV) of W^{25+}, new emission lines were appeared in the spectrum. These emission lines are identified as emission lines from W^{26+}. In Figure 1 (a) and (b), EUV spectra of CoBIT are shown. As subtracting the spectrum of electron energy *Ee*=770eV from the spectrum of electron energy *Ee*=800eV, emission lines only from W^{26+} appears. Because the electron energy is increased to 800eV beyond the ionization energy of W^{25+} (*Ip*=786.3eV), W^{26+} ions were generated in the trap. Then, new emission lines from W^{26+} appear in the spectrum. In Figure 2, we show the spectrum of W^{26+} obtained by subtracting spectrum of *Ee*=770eV from spectrum of *Ee*=800eV. Strong peak was observed at 102Å and other emission lines were also observed at both ends of this strong peak. These lines are emission lines of W^{26+} 4f5s → 4f^2 by electron excitation. In future, we will promote detailed studies for the spectroscopic diagnostics of plasma, such as electron energy dependence and electron density dependence of these.

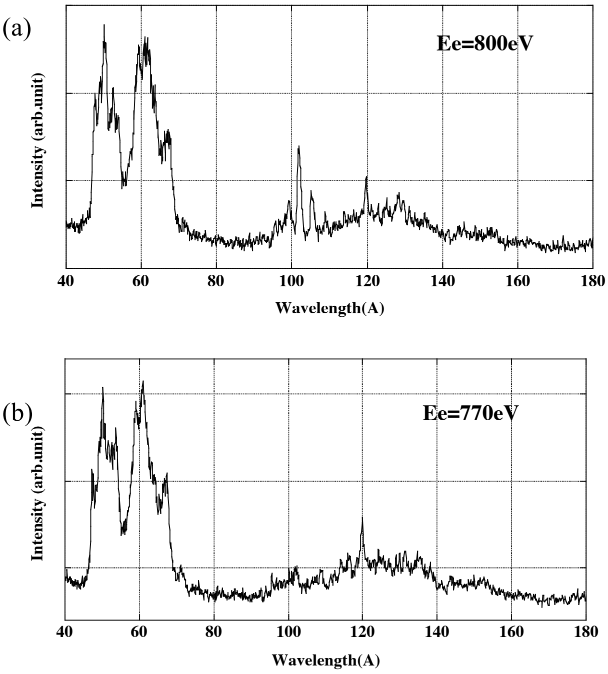

Fig. 1. EUV spectra of CoBIT. Electron energy of spectra (a) and (b) are 800eV and 770eV, respectively.

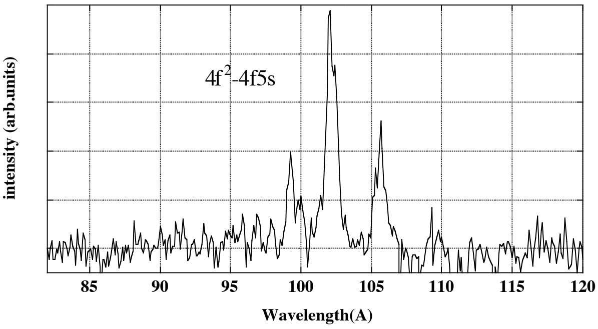

Fig. 2. Subtracted W^{26+} EUV spectrum of CoBIT.

1) Nakamura, N. *et al*.: *Rev. Sci. Instrum*. **79** (2008) 063104
2) Sakaue, H. A. *et al*.: J. Phys.:Conf. Ser. **163** (2009) 012020
3) Sakaue, H. A. *et al*.: *AIP Conf. Proc*. (2012) 143891