§10. EUV Spectroscopy of Highly Charged Tungsten Ions with Electron Beam Ion Traps

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Tungsten will be used for the material of divertor plates in ITER because of higher threshold energies for sputtering by light ion bombardment, the highest melting point in the chemical elements, and less tritium retention than that in carbon based materials. However, since extremely high particle- and heat-fluxes of intermittent edge plasma transports (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 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]. Although intensive and systematic studies are in progress at several institutes, there is still a serious lack of data. In particular, the data of moderate charge state tungsten ions (W^{10-30+}) are quite limited.

For the systematic spectroscopic studies of tungsten ions, we have constructed two compact electron beam ion traps, called CoBIT [4]. The electron energy range of CoBIT is 0.1 - 2.5 keV, and the accessible charge states for tungsten are about 10 - 40. In this paper, we present extreme ultraviolet (EUV) spectra obtained with the electron energy range 0.49 - 1.5 keV. A grazing-incidence flat-field grating spectrometer especially designed for CoBIT was used for EUV emission in the 10 - 300 Å range [5]. A laminar-type diffraction grating (1200 gr/mm or 2400 gr/mm depending on wavelength) is used to focus the radiation on the surface of a back illuminated CCD (PIXIS-XO:400B). Figure 1 shows the typical EUV spectra of highly charged tungsten ions. The observation wavelength ranges are from 15 to 45 and 40 to 60 A, respectively. To identify the observed lines, we have calculated the spectra using a collisional-radiative (CR) model [6]. From the comparison, the observed lines have been identified as the 5f-4d, 5p-4d, 5g-4f, and 4f-4d transitions of W^{27-30+} as indicated in the figure.

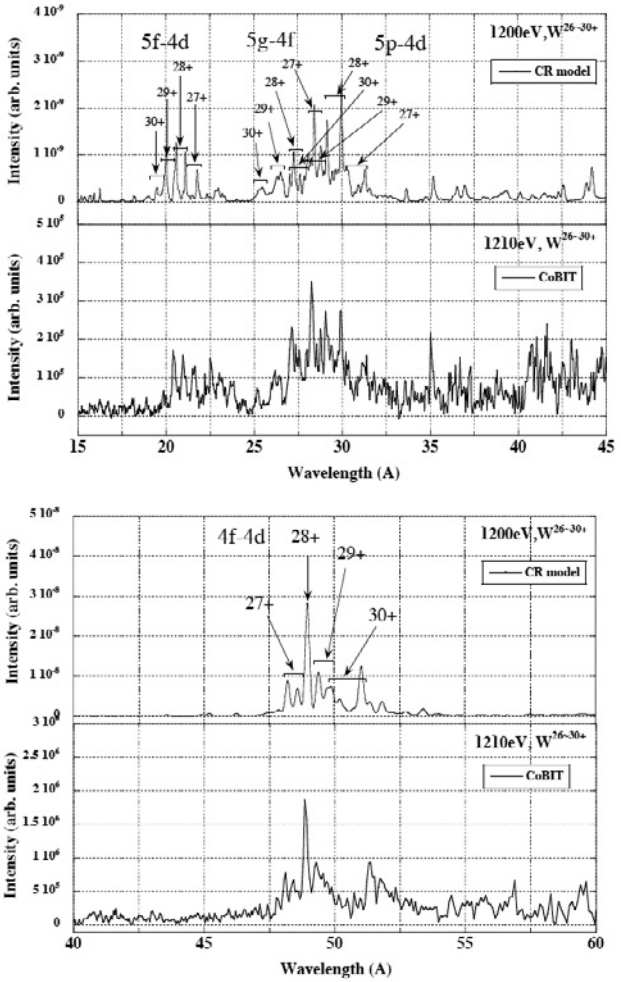

Fig. 1. EUV spectra of highly charged tungsten ions. The upper panels are calculated CR-model spectra and the lower panels are experimental spectra.

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