

Spectroscopic Observation of WI to WXLVII Tungsten Emission Lines in Visible, VUV and EUV Wavelength Ranges in the Large Helical Device for ITER Edge Plasma Diagnostics

Content

Spectroscopic studies for emissions released from tungsten ions have been conducted in the Large Helical Device (LHD) for contribution to the tungsten transport study in tungsten divertor fusion devices and for expansion of the experimental database of tungsten line emissions [1-3]. Tungsten ions are distributed in the LHD plasma by injecting a pellet consisting of a small piece of tungsten metal wire enclosed by a carbon tube. The electron temperature of the LHD core plasmas with a tungsten pellet injection ranges from 0.5 keV to 3.5 keV, which is close to that of the edge plasmas in ITER around the last closed flux surface, including the scrape-off layer. Thus, observation of tungsten lines in LHD could improve the tungsten diagnostics in ITER edge plasmas. The current status of tungsten emission lines observed in LHD using visible, vacuum ultraviolet (VUV), and extreme ultraviolet (EUV) spectroscopy can be summarized as follows. The line emissions from the neutral atoms, WI, as well as the singly ionized ions, WII, were observed using visible spectroscopy in the wavelength range of 4000–4400 Å [2]. The visible spectroscopy has also observed magnetic dipole (M1) forbidden transition lines from WXXVII and WXXVIII in the wavelength range of 3300–3900 Å [4,5]. The line emissions from tungsten ions in low charge states, WIII–WVII, have been identified in the VUV range of 500–1500 Å [6]. Recently, several M1 lines of WXXX–WXL were successfully observed in the VUV wavelength range of 500–900 Å [7]. Additionally, in the EUV range of 5–500 Å, tungsten ions in low charge states, WV–WVIII, medium charge states, WXXV–WXXXIV in the structures of the unresolved transition array (UTA), as well as high charge states, WXLII–WXLVII, have been identified [8,9]. Measurements of emissions from WIX to WXXXIV are still insufficient, which is addressed as a future task.

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