A STUDY OF WI-WVII LINE EMISSIONS FROM LOW-IONIZED TUNGSTEN IONS IN LARGE HELICAL DEVICE

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Behavior of tungsten ions in fusion plasmas has attracted attention because tungsten is regarded as a leading candidate material for the plasma facing components in ITER and future fusion reactors. Considering tungsten impurity transport in ITER, the following three transport processes need to be evaluated: (1) release of neutral tungsten atoms from the divertor plates; (2) transport of tungsten ions at lower ionization stages in the edge plasmas; and (3) accumulation of tungsten ions at higher ionization stages in the core plasmas. However, tungsten ions in lower ionization stages have not been measured sufficiently even though it is necessary for accurate evaluation of tungsten influx and comprehensive understanding of the tungsten impurity transport. Therefore, we conducted spectroscopy diagnostics to measure spectra of emissions released from tungsten ions in Large Helical Device (LHD) with superconducting magnetic coils for the steady state operation of current-free plasma discharges.

The tungsten is externally introduced in the LHD plasma by injecting a coaxial tungsten impurity pellet. Visible spectroscopy has been applied to observe line emissions from neutral and singly ionized tungsten represented by a bright WI line at 4008.75 Å. VUV spectroscopy using a high-resolution 3 m normal incidence spectrometer has been applied to measure VUV lines from tungsten ions at lower ionization stages [1]. Many tungsten lines of WIV-WVII are successfully observed just after the tungsten pellet injection as the first observation of line emissions from low-ionized tungsten ions in magnetically-confined fusion plasma experiments. It is found that five WVI lines at 605.93 Å, 639.68 Å, 677.72 Å, 1168.15 Å and 1467.96 Å have the highest intensity and are entirely isolated from other intrinsic impurity lines [2]. The result strongly suggests that those lines will be useful for the spectroscopic study in ITER and other tungsten divertor devices.

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References

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[2] T. Oishi, S. Morita, X. L. Huang et al, Physica Scripta 91, 025602. (2016)