Spectral modeling of tungsten transport based on a compact advanced extreme ultraviolet spectrometer system for KSTAR and WEST plasmas

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In this presentation, a newly developed spectral model of tungsten transport is reported. In KSTAR, a compact advanced extreme ultraviolet (EUV) spectrometer system (CAES) was installed to measure tungsten spectra in EUV range where W^{27+} to W^{45+} charge states lie. Spatially-resolved tungsten spectra were successfully acquired with 2.7 cm and 67 ms of spatial and time resolutions. Poloidal asymmetry of the tungsten radiation was also observed by the infrared video bolometer (IRVB) and the X-ray pinhole camera based on a GEM detector. In order to interpret the measured result, a time- and space-resolved spectral model has been developed. This model calculates the intensity of many spectral lines and features of tungsten in the given electron temperature and density profiles as well as their brightness, considering the geometry of the tokamak and the viewing lines of the spectrometer. Atomic Data and Analysis Structure (ADAS) was utilized to obtain ionization and recombination rates for the ionization equilibrium calculation. In order to find the global tungsten density profile in the plasma, the continuity equation including diffusion and convection, radiation power loss relation, and the force balance equation with a centrifugal force effect were individually considered. Flexible Atomic Code (FAC) was used to calculate the photon emission coefficient (PEC) of W^{10+} to W^{48+} allowing to determine the time- and space-dependent brightness. The modeling result of spatially-integrated quasi-continuum emission of tungsten in 2 – 7 nm wavelength showed a good agreement with the measured data from the tungsten powder injection experiment in KSTAR. A similar study will also be performed in WEST plasmas with tungsten as an intrinsic impurity.