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Tungsten density and influx evaluations based on the latest atomic data in EAST tokamak plasma

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Upper and lower graphite divertors in EAST tokamak were replaced by tungsten divertors in 2014 and 2021, respectively, to improve plasma performance in long pulse discharges and accumulate knowledges on the tungsten divertor operation. Studies on the tungsten behavior in edge and core plasmas are then crucially important for improving the plasma performance. For the purpose four fast-time-response [1-2] and four space-resolved [3-4] extreme ultraviolet (EUV) spectrometers have been installed on EAST to observe line emissions from tungsten ions and their radial intensity profiles in wide wavelength range of 5-520Å.
Photon emission coefficient (PEC) data for W43+ at 61.334 and 126.29Å and W45+ at 62.336 and 126.998Å have been used to estimate the density profile of W43+ and W45+ions in the core plasma [3,5]. Tungsten unresolved transition arrays (W-UTA) emitted in long wavelength ranges of 168-225Å, 225-268Å and 278-332Å are analyzed for the study of tungsten behaviors in the edge plasma. As a result, three lines of 186.28 Å, 190.48 Å and 192.02 Å with relatively strong intensities were identified as line emissions from W8+ ions by comparing the time behavior of line emissions from W6+ at 216.219 and 261.387 Å [6,7] and W7+ at 200.367 Å and 200.483 Å [8] [1-4], which are well known as the EUV line emission from low-ionized tungsten ions. The number of ionization events per photon (or inverse photon efficiency), S/XB, for line emissions from low-ionized ions are strongly required to evaluate the tungsten influx rate at plasma edge. A visible spectrometer aimed at spatial profile measurement covering the whole poloidal cross section has been newly installed on EAST tokamak for investigation of atomic tungsten and the M1 transition from tungsten ions, which are observed for W26+-W28+ ions in LHD [9] and W8+-W12+ ions in EBIT [10]. Analyses of full radial density profiles of highly ionized ions tungsten ions and influx rate of low-ionized tungsten ions are attempted based on the PEC and S/XB data.

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