VUV spectroscopy measurements on WEST first plasmas

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The WEST machine aims at testing actively cooled full W monoblock Plasma Facing Units under long plasma discharge, with thermal loads of the same magnitude as those expected for ITER. For the first operation phase, copper plasma facing components were directly tungsten coated and carbonaceous components were coated with a molybdenum sublayer covered by a tungsten layer. Ten seconds stable L-mode X-point plasma discharges were routinely performed, including up to 2.5 MW LHCD. During the first plasmas, some runaway electron control issues were the cause of plasma contamination by wall material. The VUV spectroscopy measurements characterising this contamination are reported in this paper.

WEST as well as Tore Supra, is equipped with two VUV spectrometers providing plasma impurity measurements. To perform tungsten spectroscopy measurements, various spectral ranges were selected. The spectral feature around 5 nm wavelength has been observed and allowed to show that the tungsten content increased on a pulse-to-pulse basis correlated with the LHCD power ramp-up. It showed also that in the same phase of the campaign, the core electron temperature was increased from 300 eV to more than 2 keV (as confirmed by the ECE electron temperature measurements). Operational limitations due to the tungsten content increase were also observed in some occasions and induced a modification of the plasma control strategy. Higher tungsten ionization stages (W^{38+}-W^{45+}) have been observed in the 11.5-15.5 nm wavelength range consistently with AUG observations [1]

In the same time, in view of a more effective impurity monitoring, a thorough line identification of the VUV spectra has been performed: Copper and Molybdenum line brightnesses have been identified and studied by comparing them with the sources deduced from the visible spectroscopy diagnostics. Copper is correlated with the LH power while Molybdenum is due to runaway electron damages on tungsten coated plasma facing components. The latter cause might explain also why carbon, which was completely absent from the spectra at the beginning, appeared later in the campaign.

[1] T. Pütterich et al. 2008 Plasma Phys. Control. Fusion 50 085016