Impurity behaviour during ICRH and NBI operation with ITER-like wall at JET


The impurity release during Ion Cyclotron Resonance Heating (ICRH) and Neutral Beam injection (NBI) operation was investigated in the JET tokamak. This contribution mainly focuses on documenting the Nickel (Ni) behaviour in the plasma and comparing the Ni levels with the new ITER-like wall consisting of tungsten (W) MKII-HD divertor and beryllium (Be) main wall and with the Carbon (C) wall. Spectroscopic measurements along the vessel midplane were obtained using the SPRED (survey poor resolution extended domain) spectrometer with the routinely used 450 gmm$^{-1}$ holographic grating. This registers the VUV spectra in the wavelength range 100–1100Å. With the former C plasma facing components, (PFCs) the VUV spectrum was dominated by different mid-Z metallic impurities like Nickel, Iron, Chromium and Copper. However with the new Be/W PFCs, the spectrum also contained intense W features. The determination of Ni impurity densities, based on the combination of absolutely calibrated VUV transition intensity measurements with the Universal Transport Code (UTC) simulations is described in details in [1].

It was found that the Ni concentration increases with the ICRH power and for the same NBI power level, ICRH-heated plasmas are characterized by higher Ni content. This applies to both H-mode discharges as well as L-mode discharges, where both divertor and limiter configurations were examined. Additionally in ICRH discharges, the influence of the plasma shape, the ICRH antenna phasing, and the minority cyclotron resonance position on the Ni content was investigated. The Ni content increased with plasma triangularity and decreased with increasing plasma density. For the same ICRH power and -π/2 phasing, the Ni concentration was higher than in the case of dipole phasing. The use of ICRH with the resonance on-axis resulted in higher Ni concentration in comparison to off-axis ICRH. The behavior of the Ni content in different plasma and heating scenarios was correlated with the bulk radiated power ($P_{rad,bulk}$). Higher $P_{rad,bulk}$ was measured when using ICRH compared to NBI. The contribution of Ni to $P_{rad,bulk}$ was evaluated and it was observed that although with the new Be/W metal wall the main radiation came from W, Ni was also contributing significantly to $P_{rad,bulk}$ up to a 20 % level. Typical Ni concentrations (expressed as the ratio of impurity density to electron density $n_i/n_e$) of order of $10^{-4}$ were found, similar to the Ni concentrations with the C wall.