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Ion Cyclotron Resonance Heating for Tungsten Control in JET H-mode Scenarios

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Development of high performance plasma scenarios in high Z metal plasma-facing environment is hampered by an unfavourable distribution of these particles across the plasma core, known as 'core accumulation'. Tungsten core profiles have been analysed in different JET scenarios (Ip=2.5-4.0MA, Ptot=18-30MW) with ICRH (0-6MW, H minority heating) from the soft X-ray diagnostic.
At a plasma current of 2.5MA, the peaking of the tungsten radiation can be strongly reduced when ICRH power in excess of 4MW is added to 15MW of NBI power. At low gas rate (˜5×10ˆ21el./s), more than 6MW of ICRH power would be necessary to obtain flat W radiation profiles but the anisotropy of the W radiation profile is already strongly reduced with 4MW. When the plasma current is raised, low tungsten peaking in quasi stationary conditions (i.e. modulated between 1 and typically 3 with the sawtooth frequency) can still be obtained but with higher gas rate (typically, for 3.5MA, 4×10ˆ22el./s with strike point close to the pumping duct). In hybrid scenarios (Ip=2.5MA), strong peaking of the tungsten occurs 1.5-2s after the start of the high power phase with with slightly off-axis ICRH heating (Rres-Rmag˜0.10m, PICRH=3-5MW).
MHD activity plays a key role in tungsten transport and core W radiation is modulated with the sawtooth cycle. When at low plasma current (Ip=2.5MA), the tungsten peaking increases and saturates until the sawtooth crash, at higher Ip, the tungsten peaking generally starts decreasing well before the sawtooth crash. This is well correlated with fishbone activity generated by the fast ion pressure.
Modelling of the temperature screening provided by the fast minority ions indicates that this screening is weak at low H concentration and experimental results suggests that even at high concentration (nH/ne˜15%) this is not a major player for tungsten control.

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