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Impact of W on Scenario Simulations for ITER

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AUG and JET, the largest present devices with high-Z PFC components, have identified requirements for stable H-mode operation, i.e. to keep heavy impurity concentrations sufficiently low, to avoid central accumulation, radiative collapses and disruptions. Limitations in the operational space which can be accessed in H-mode have been identified, e.g. (i) the need of operating at sufficiently high levels of gas puff, impeding access to low density regimes at low gas puff levels; (ii) central electron heating and/or frequent sawteeth may be needed to avoid W core accumulation.
This paper starts with a short review of experimental results on erosion sources, edge (pedestal) transport, and core W transport. Then implications for ITER are discussed, concentrating on the effect of core W accumulation on the discharge evolution.
In different ways the critical W concentration in ITER was assessed i.e. the maximal tolerable level without significantly perturbing the evolution of li, or the q and Te profiles.
First, impurity transport (both neoclassical and anomalous) was modelled with the ZIMPUR code, in combination with ASTRA for the description of the bulk plasma parameters evolution with a scaling based transport model. The calculated critical W concentration is ~7 10-5 for the inductive scenario, and a factor 2-3 lower for the hybrid and steady state scenarios.
Second, the current ramp-up phase in JET, AUG and ITER was modelled with the CRONOS suite of codes for different W concentrations. For ITER the expected plasma parameters for the baseline ITER ramp-up were used; for JET and AUG the experimental data (Te, ne, Zeff) were taken. The Bohm-gyroBohm model for thermal transport was used, and nW/ne profiles were assumed either flat or of the same (peaked) shape as measured in JET. The effects of flat and peaded W profiles are very different. The modelling results are in excellent agreement with experimental findings.
As maximum tolerable W concentrations have now been calculated for different ITER scenarios, future work can concentrate on further quantify these limitations, using current understanding of neo-classical and anomalous W transport.

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