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Modelling of Melt Damage of Tungsten Armour under Multiple Transients Expected in ITER and Validations against JET-ILW Experiments

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The ITER Organization has recently decided to install a full-tungsten (W) divertor from the start of operations. One of the key issues with such a strategy is the possibility of W melting and melt splashing during transients, which can lead to modifications of surface topology and which may lead to higher disruption frequency or compromise subsequent plasma operation. Although every effort will be made to avoid leading edges, ITER plasma stored energies are sufficient that transients can drive shallow melting on the top surfaces of components.

A new experiment has now been performed on JET-ILW in the ITER-Like Wall (ILW) environment, in which a deliberately misaligned W element (lamella) in the outer divertor has been used to perform controlled ELM transient melting experiments for the first time in a tokamak. This paper reports on the application of the 3D MEMOS code to modeling of these experiments. Input heat loads are obtained from experimental data, notably high resolution IR camera thermography. Importantly, the code indicates that that shielding by the evaporated tungsten prevents bulk melting between ELMs. Encouragingly, the simulations are also able to quantitatively reproduce the dimensions of the damaged area observed by high resolution photography after the first pulse in which melting was achieved.

MEMOS simulations on the consequences of multiple mitigated major disruptions (MD), mitigated vertical displacement events (VDE) and major disruptions expected in ITER on damage of tungsten castellated armour have been performed for several scenarios of impact conditions specified by IO.

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