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Editorial

2022 *Nuclear Fusion* prize acceptance speech

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Dear participants, dear *Nuclear Fusion* board members, dear chief editor, dear colleagues,

Let me first thank the JET team in the name of all co-authors for the help to carry out the experiments, the analysis, and the associated modelling described in our paper. The work was done under the combined flag of EUROfusion and UKAEA and I personally thank the JET operator, who more than once had to deal with my specific and sometimes challenging requests to the machine requirements in some of the mentioned experiments.

The studies presented in this contribution from 2019 were part of the wider planned exploitation strategy of the beryllium/tungsten material wall mix in JET in view of future ITER operation. These studies are addressing specifically plasma-wall interaction processes in lower single null configuration with a tungsten (W) divertor closest in dimension to the one in ITER. I would like to remind you, that at the start of the so-called ILW operation at JET in 2011, ITER had planned a material mix of graphite and tungsten for the plasma-facing components in the divertor. Experiments in JET with focus solely on the W divertor operation, which include the W erosion, W transport, and W screening, presented here, as well as the deliberated W melting experiment in 2013, vitally supported the ITER decision to start operation with full-W armor in the divertor.

Our paper from 2019 concluded the work related to experiments in Hydrogen and Deuterium prior to Tritium experiments in JET reported at the IAEA conference in 2023. The results cover a multi-year research as they include not only a set of tokamak experiments with *in-situ* diagnosis, in particular spectroscopy for the W gross erosion estimate and bolometry for the W radiation, but also extensive post-mortem analysis, in particular ion beam analysis for the W net erosion quantification, as well as associated interpretative plasma-wall interaction and transport modelling with the ERO code. I specifically thank my main co-authors Dr Matej Mayer (Max-Planck-Institute in Garching, Germany) and Dr Andreas Kirschner (Forschungszentrum Jülich, Germany) who carried out the main part of post-mortem analysis and plasma-wall interaction simulations, respectively.

The main physics results of the paper can be categorised as follows: (a) W sputtering processes for a large set of plasma parameters were assessed and the role of impurity-induced W sputtering and the sputtering threshold in a device with Be/W mix validated. (b) The intra- and inter-ELM erosion of W were investigated in detail and the dominant role of the intra-ELM phase in the W sputtering by impurities as well as fuel ions identified. (c) The importance of the inner divertor W source in the intra-ELM sputtering was revealed as no ELM- buffering occurred despite operating in the inter-ELM phase below the sputtering threshold for W. (d) The gross and net erosion of tungsten utilising more than 150 identical H-mode discharges in sequence under attached plasma conditions were quantified. (e) The important role of local W re-deposition with a redeposition factor of more than 92% was experimentally confirmed. (f) The very high W divertor screening in JET was quantified. Finally, the experimental results could be reproduced to a large extent by plasma-wall interaction modelling disentangling the contribution of the individual processes at the inner and outer divertor mentioned and validating thereby the ERO code for ITER predictions.

The JET results are fully in line with *in-situ* observations in ASDEX Upgrade operating with W divertor and a mix of impurities including boron, oxygen, nitrogen etc.

Additionally, they triggered additional research in EAST, WEST and DIII-D resulting in further improvements in the physics understandings of plasma-tungsten interaction in the divertor with other first wall materials and impurity mixtures as well as expansion to other magnetic configurations and plasma regimes.

Finally, let me thank—in the name of all co-authors—not only the *Nuclear Fusion* Board for their selection, but specifically the readers of *Nuclear Fusion* who acknowledged the work by reading and citing the article.

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