A BULK TUNGSTEN TILE FOR JET: DERIVATION OF POWER-HANDLING PERFORMANCE AND VALIDATION OF THE THERMAL MODEL IN THE MARION FACILITY

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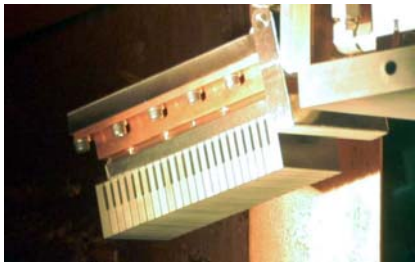
In the frame of the ITER-like Wall (ILW) for the JET tokamak [1], a divertor row made of bulk tungsten material has been developed for the position where the outer strike point is located in most of the foreseen plasma configurations [2]. In the absence of active cooling, this represents a formidable challenge when one considers the temperature reached by tungsten ($T_{W,surf}$ >2000°C) and the vertical gradient $\partial T/\partial z = 5 \times 10^4$ K/m. As the development is drawing to an end and most components are in production, exposure of actual 1:1 prototypes to an ion beam with a power density around 7 MW/m^2 on the plasma-facing surface brings valuable information. It does not only help in validating the thermal model that was steadily developed along with the tungsten tile, but also delivers experimental values to the expected performance under tokamak plasma conditions.

The Global Thermal Model (GTM) predicts temperatures for all components under uniform loading [3]. It was recently extended to cover the cases where the deposition profiles are peaked as expected at the strike point. Additional improvements include detailing of the clamping assemblies. The highest estimated tungsten temperatures support *a posteriori* the limit imposed on the energy that can be deposited on the tile within a plasma pulse and the different steps proposed for operation: $T_{W,surf}$ = 1200°C, 1600°C, 2200°C [4].



Prototype stack of solid tungsten lamellae in the MARION facility before exposure (stack length: 165 mm)

The dedicated experiments validate the thermal model to a large extent. Advantage is taken of the flexibility of the MARION facility in Jülich to expose a prototype tungsten stack under shallow angles of incidence (~6°) to a powerful beam of ions and neutrals (>70 MW/m^2 on axis); this required the installation of a newly designed scraper [5]. Information is derived on the tolerable energy deposition (around 60 MJ/m^2 for the given stack) and thus on the power handling performance of the tungsten assembly. The first campaigns have provided temperature values for last design improvements and validation of the GTM by means of pyrometers, IR cameras and embedded thermocouples. This is data to confront with material limits but also a valuable input to future operating instructions.

[1] G.F. Matthews et al., Phys. Scr. **T138** (2009) 014030 (4pp.)
[2] Ph. Mertens et al., Fus. Eng. Des. **84** (2009) 1289-1293
[3] S. Grigoriev et al., Fus. Eng. Des. **84** (2009) 853-858
[4] V. Riccardo et al., Phys.Scr. **T138** (2009) 014033(5pp.) and Ph. Mertens et al., Phys.Scr. **T138** (2009) 014032(5pp.)
[5] D. Nicolai et al., submitted to this conference