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ITR/P5-07: Developments Toward Fully Metallic Actively Cooled Plasma Facing Components for ITER divertor

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On the road toward fusion energy, a significant threshold to step over is giving up the use of carbon (CFC) for plasma-facing components (PFC) armour. Since years, laboratories and industries have carried out studies and experiments to make possible the use of tungsten as main PFC armour in the near future. This is now mainly driven by the use of W for the ITER divertor and can be divided in two lines: on the one hand, the technological development of relevant PFC, aiming at withstanding very high heat fluxes up to 20 MW/m² and, on the other hand, integrated operational implementation of W PFCs in present tokamaks such as JET and ASDEX Upgrade. CEA/IRFM has been active for the last two years in both lines by participating in the qualification of the development achieved by Fusion for Energy to procure the European part of the ITER divertor and also by the preliminary studies launched in the frame of the WEST project (Tungsten Environment for Steady State Tokamak) [1]. This project aims at installing a W divertor in Tore Supra, in order to operate the 1st tokamak with a full W actively cooled divertor in long plasma discharged.
The paper describes the main studies and their results, which have been performed at IRFM within the last 2 years, in the field of W PFC: heat removal capabilities and thermal fatigue testing of the latest monoblock designed for ITER divertor targets and also foreseen for WEST, components surface shaping to take into account local particles flux orientations and leading edges effect, transient (ELMs) and steady state cumulated loads and their link with the issue of W recrystallization, and finally the acoustic monitoring of the cooling regimes to prevent critical heat flux events.

[1] J. Bucalossi, et al., Fusion Engineering and Design 86 (2011) 684–688

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