Progress in R&D on Plasma-Facing Materials and Components for Fusion Devices

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To extend the reliability and lifetime of the highly loaded plasma facing components (PFCs) in fusion devices, the development of advanced materials and components is highly desirable. The materials not only have to withstand high steady state power loads, but also a high number of thermal cycles and shocks. Moreover, in the case of a future reactor, the change of thermo-mechanical properties by damage and transmutation through fusion neutrons has to be considered when designing PFCs and selecting the adequate armour and structural materials. Presently, still water cooled PFCs are foreseen for next generation fusion devices in order to provide a reliable heat transfer, which only moderately extrapolate the technology developed and tested for ITER. When thinking about the improvement of PFCs, one has to be aware that armour and heat sink together with the joining technique form a complex system which ultimately needs to be optimized as a whole.

Besides ITER, there are several devices planned, under construction or intending to switch to all metal PFCs where actively cooled (divertor) PFCs are needed. The European activities for R&D on PFCs for JT60-SA, W7-X, DTT and DEMO are performed under the umbrella of the EUROfusion work package 'Divertor' (WPDIV). Whereas for DTT and DEMO solutions based on W monoblocks similar to those of ITER are under consideration, a flat-tile design is presently favoured for application in JT60-SA and W7-X. This contribution will present the status of the ongoing European research on divertor PFCs and will provide some insight into materials development for armour and heat sink. Additionally, alternative designs and manufacturing methods will be presented which eventually could lead to more robust PFCs with either increased operational space or a more economic production.