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P2.122 China's technological achievements on ITER enhanced heat flux first wall in the pre-PA qualification

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The Chinese Domestic Agency (DA) is procuring ITER Enhanced Heat Flux (EHF) First Wall (FW) panels, representing 12% of the total number of ITER FW panels being procured. The EHF FW panel shall withstand a surface heat load up to 4.7 MW/m² during ITER operation. Prior to the implementation of the ITER Procurement Arrangement (PA), several key technologies in manufacturing the EHF FW panel have been qualified in China. In the pre-PA task, ITER grade CN-G01 high-purity beryllium has been developed; its chemical composition, mechanical properties and grain size satisfy the ITER requirements, and it has been qualified as a choice of material for the ITER FW PAs. The use of strict quality control in the manufacturing of CuCrZr alloy was aimed at increasing the reliability of the hypervapotron (HVT) concept in the EHF FW fingers, while a minor design improvement on HVT cooling channel helped improve the fatigue performance as shown by thermo-mechanical analysis results. Investigation showed that sputtering Ti/Cu coating on the beryllium tiles helps in reducing possible defects and results in better quality of Be-Cu hot isostatic press (HIP) bonding interfaces. As a result of such measures, China DA completed two EHF FW semi-prototypes with one successfully passing the high heat flux test at 4.7 MW/m² for 7500 cycles and 5.9 MW/m² for 1500 cycles. Neither damage to the semi-prototype nor off-normal surface temperature increase was observed, which brought the semi-prototype qualification campaign to a successful conclusion. China DA then signed the PA in 2016 for production of the ITER EHF FW panels. In the PA implementation, China DA plans to investigate the maximum acceptable beryllium tile size for CN EHF FW panels, as well as the acceptable defect size in the Be-Cu HIP bonding interface, which will help control PA cost and schedule.

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