

The development of W/Cu PFCs for EAST upper Divertor

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Abstract

EAST has realized the actively-cooled W/Cu upper divertor in May 2014. W/Cu Plasma Facing Components (PFCs) for EAST upper divertor consists of W/Cu mono-block vertical targets, W/Cu flat type baffle and dome. The manufacturing W/Cu mono-block and flat type PFCs have been performed by the technological combinations of “HIP+HIP” i.e., W armor joining with a pure copper interlayer by means of HIP technology and then the pure copper interlayer welding to CuCrZr heat sink by means of HIP technologies. The thermal fatigue testing shows that the W/Cu mono-block and flat type PFCs withstood 1000 cycles of heat loads up to 10MW/m^2 and 5MW/m^2 with the cooling water of 4m/s , 20°C , respectively. To realize the seal joint of W/Cu mono-block target and baffle, the dome upper W/Cu/CuCrZr tile and lower CuCrZr heat sink, the cooling tubes and CuCrZr heat sink, the electron-beam welding (EBW) technique has been applied. After completion of the seal welding, high pressure helium leak detection has been carried out with helium pressure of 1.5Mpa at 180°C .

In 2014 EAST operation campaign, some leaks in the EBW “tube-plate” seams were observed during the baking of the device and the leaking of “plate-plate” seams occurred during plasma discharges. The causes of leaking has been analysed and some new measures are being developed to control the seam quality of the W/Cu PFCs. The first is developing the nondestructive testing technique for the welding seam of “tube-plate” joints. The second is changing the join style between cooling tube and Cassette Body (CB) to relieve thermal stress during baking stage. The third is performing helium leak detection for pre-assembled “PFCs+CB” modules before installation into Vacuum Vessel with helium pressure of 1Mpa at 250°C .