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Manufacturing and testing of flat type small size tungsten PFC mock-ups by HIP process

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W/CuCrZr PFCs will be used in ITER divertor and are strong candidate for the use in high heat flux regions of the upgraded KSTAR and K-DEMO. Development of hot isostatic pressing (HIP) bonding technology is in progress for the fabrication and qualification of tungsten divertor. We manufactured the first W/CuCrZr flat type small size mock-ups by HIP technology using PVD for interlayer formation. In the developed HIP process, we applied PVD method for interlayer coating of high purity Ni and Cu. The interlayer coating is selected to enhance the diffusion between W and Cu during the HIP bonding process. The Ni and Cu were deposited by two kinds of thicknesses on W surface. The bonded PFC of Ni/Cu coated W, copper interlayer and CuCrZr were manufactured by means of HIP technology employing two kinds of processing conditions. We observed the microstructure of the deposited Ni and Cu layer on the bonding interface by FE-SEM. The HIP processed samples were subjected to shear strength test and high heat flux (HHF) test. There is no significant difference in shear strength due to PVD coating thickness. But the shear strength of samples fabricated by 70 MPa and 700 °C HIP condition is higher than those fabricated by 60 MPa and 600 °C condition. HHF tests were performed to compare the thermal conductance through the bonded layer and thermal fatigue behavior of the samples in the tested condition as a preliminary test of the HIP process parameters. The layers between W and CuCrZr of samples were observed and compared by FE-SEM before and after HHF test. And bonding with Ti interlayer is compared to those of Ni interlayer in bonding strength and stability. All these results were analyzed synthetically to establish the optimum fabrication conditions and to find a method for performance qualification.

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