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Deformation and fracture behavior of the ODS-Cu/W joint fabricated by the improved brazing technique

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In our previous work, the joint between oxide dispersion strengthened copper alloy (ODS-Cu) and tungsten (W) demonstrated superior fracture strength (~200 MPa). In the present study, deformation and fracture behavior of the bonding layer and its vicinity after the three-point bending test was investigated. Consequently, it was found that the crack initiation site was dominantly in the tungsten bulk side, although it was not clear that the crack initiated from grain boundary or not. In addition, the crack propagation proceeded towards the bonding layer and seemed to end at the interfaces. These results indicate that the strength of the bonding interface is higher than that of the tungsten bulk and the present bonding technique is applicable for severe environments such as a high heat flux component on the fusion reactor.
The copper alloy has been considered to be useful as a divertor heat sink or cooling tube not only in the helical reactor FFHR-d1 but also in the tokamak DEMO reactor. The special feature of the basic option of the FFHR-d1 divertor is that the ODS-Cu, GlidCop® (Cu-0.3wt%Al2O3) is applied for the heat sink, and the flat plate tungsten armour is supposed to be bonded on the heat sink by using the improved brazing technique with BNi-6 (Ni-11%P) filler material.
The thickness of the bonding layer between GlidCop® and W was extremely narrow, and the joint strength and toughness were superior. This fact demands attention because it could be generally predicted that the bonding layer itself has a brittle feature. If we would want to obtain much higher fracture strength, tungsten bulk with better mechanical properties should be used. In this paper, the mechanism for producing such a fine and toughened bonding layer, and deformation and fracture behavior of the joint will be discussed.

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