# 27pB05 Development of Oxide dispersion strengthened-Copper using a MA-HIP Method

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本 文

【Introduction】The divertor surface receives the high thermal heat load. In the helical reactor FFHR, the steady thermal load is assumed approximately 10 MW/m$^2$, and the development of heat sink material having a high heat removal is required. From a viewpoint of the material selection, the copper alloy has a large advantage for the thermal conductivity. In the ITER case, use of the PS-Cu (Cu-Cr-Zr) cooling pipes is considered. However PS-Cu have problems such as instability of the metallographic structure at high temperatures. On the other hands, ODS-Cu has a high potential for application to high temperature structural components because at high temperatures, it has the structural stability and strength. In conventional technique of DS-Cu is produced by internal oxidation and extrusion. Where, use of this method may cause inhomogeneity of dispersed particles, coarsening of dispersed particle oxide particle and formation of anisotropic microstructure.

【Experiment Method】In this study, we research to improvement of DS-Cu using the Mechanical Alloying method (MA) and the Hot Isostatic Pressing method (HIP). MA method can disperse particle finely, and the HIP method can form microstructure. In addition, Cu-1wt.%Al (Cu-Al) is alloyed using planetary ball mill, the rate of rotation is approximately 250 rotation per minute (rpm) and time of MA process 0 hour (hr) to 32 hrs. Sintering process is carried out at 950℃ for 1 hour in an argon atom sphere of 150MPa with HIP. These materials are investigated by optical microscopy, Scanning Electron Microscopy (SEM), X-Ray Diffractometer (XRD) and Transmission Electron Microscopy (TEM). The hardness of microstructure is measuredly Vickers test.

【Result】In result of grain size distribution from optical pictures, the grain size for the HIPed materials was below 10 μm, and average grain size was about 2 μm.

The Vickers hardness (HV) increased with MA time, and the hardness was 135 HV.

Examination of particles after MA shows that the original particles start to combine with each other around 250 rpm from 1hr to 32 hrs, which is considered to be the starting point of alloying. An examination with XRD shows the peak of Al, which is presented before the MA treatment, disappear after the MA treatment as shown Fig.1. HIPed materials following MA show reduced grain size and increased hardness relative to those of the unalloyed copper HIPed in the same condition. Large precipitates or inclusions are not observed either in matrix or on grain boundaries.

The present study has demonstrated that MA-HIP of Cu with Al can produce homogeneous structure with refined grains.

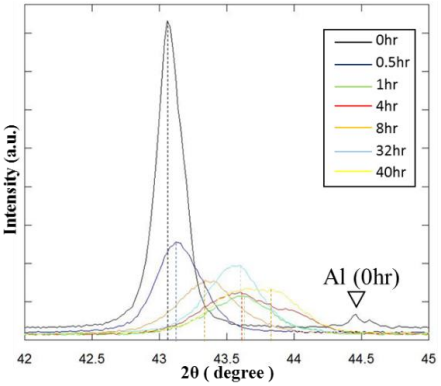


Fig.1, XRD analysis of Cu-Al with MA time