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# P3.212 Microstructure of oxide dispersion strengthened copper fabricated by mechanical alloying and hot isostatic pressing

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A copper (Cu) alloy, having a high thermal conductivity, is a promised material for heat sink of diverters in a force free helical reactor (FFHR). Recently, Hishinuma's group succeeded in fabrication of oxide dispersion strengthened (ODS) Cu alloys using mechanical alloying (MA) and hot isostatic pressing (HIP) process. ODS is expected to bring about high-temperature strength and irradiation resistance to Cu alloys. The three important properties for their practical use thermal conduction, high-temperature strength and irradiation resistance, which have strong dependence on the internal structure. We therefore investigated the internal structure of ODS-Cu, fabricated by MA-HIP process.

The precursor powders of ODS-Cu were prepared by ball-milling the initial powders at 250 rpm for 32 hrs in an argon (Ar) atmosphere. We then mixed Cu, yttrium (Y) and CuO powders with a mass ratio of 98.17 : 0.79 : 1.04. Here, the samples is labeled Cu-1wt%Y according to the mass ratio of Cu and Y2O3. The mixed precursor powder was sintered by a HIP process at 950°C for 1 hr under the pressure of 150 MPa. The internal structure was observed using electron microscopy.

Macroscopic observation showed that Cu-1wt%Y bulk was consisted of large Cu grains of more than 10 μm surrounded by fine Cu grains smaller than 1 μm. Many of Y2O3 particles of about 20 nm were distributed on grain boundaries of fine Cu grains, which presumably to act to inhibit grain boundary movement during heat treatment. On the other hand, our microscopic observation have shown that fine Y2O3 particles of 5 nm were dispersed in the fine Cu grains. These observation suggested that ODS-Cu alloys fabricated by MA-HIP process possess inhomogeneous structure, which is necessary for enhancing the aforementioned three important properties for applications as a diverter material.

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