# WBP9-4

## The development of superconducting joint technologies for $MgB_2$ wires

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Magnesium diboride ($MgB_2$) has a high critical temperature ($T_c$ = 39 K) as a metal-based superconductor and one of candidate materials for superconducting application operated free from liquid helium. The superconducting joint between $MgB_2$ wires is an important technique in consideration of applications such as MRI magnet. We have been developing an internal magnesium diffusion method (IMD) wire with high critical current density $J_c$, and succeeded in developing a good superconducting joint for unreacted wires, and its joint resistance is $10^{-13}$ Ω. On the other hand, the superconducting joint of the reacted wire has many unsolved problems. In this research, the superconducting properties and the microstructures about the influence in the second heat treatment for fabricating of superconducting joint part.

We prepared unreacted 19-multifilaments wire made by Hypertech Research Inc. of the United States. These wires heat treated in a tube furnace under an argon atmosphere at 650 °C for 1 hour. Furthermore, the same heat treatment was performed again on the same sample to evaluate the superconducting properties like making a superconducting joint. We have been used a FIB-SEM for understanding the microstructures the obtained image was constructed as a three-dimensional image.

Fig.1 shows the results of the magnetic field dependence of $J_c$ of single heat treatment and dual heat treatment. It was found that $J_c$ of single heat treatment was improved in the entire magnetic field region in the two-time heat-treated wire. As a result of the 3-D microstructural observation, as shown in Fig. 2, a filament containing a large amount of unreacted Mg could be observed in a single heat treatment (a), but those filaments were reduced in a dual heat treatment wires.

Keywords: MgB2, Superconducting joint, 3D images, multifilament

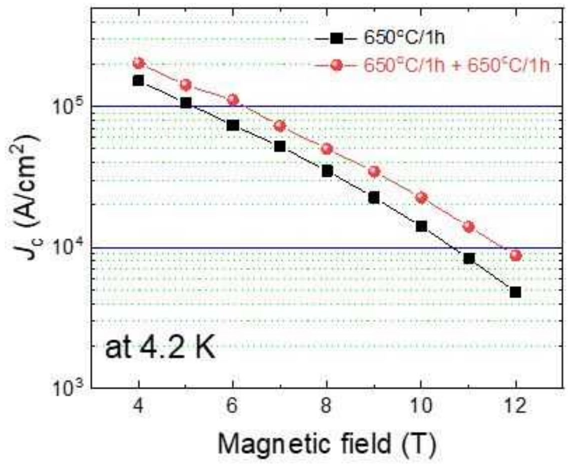


Fig. 1. Magnetic field dependence of critical current density at 4.2 K for single and dual

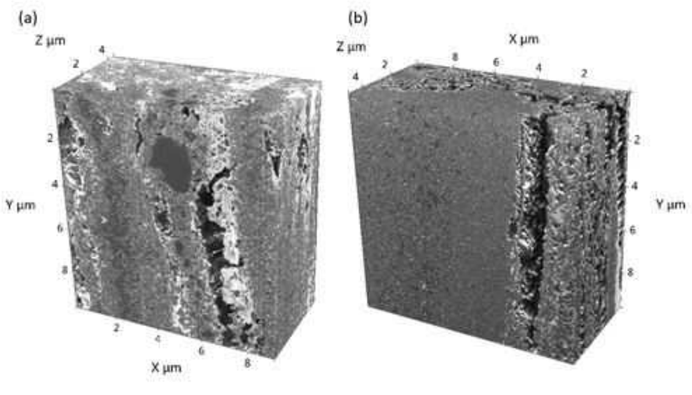


Fig. 2. 3D-microstructure inside filament after (a) heat treatment single and (b) dual.