§ 10. Superconductivity of the Bi-2223 Sintered Bulk by New Designed Composite

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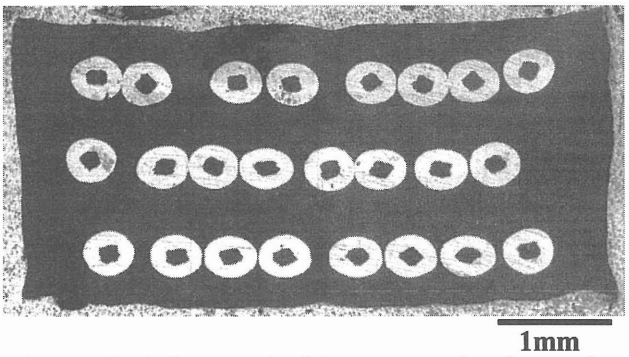

Fig.1 Typical Photograph of the cross-sectional area of the PIT filaments composite sample.

Bi-2223 bulk has some problems to apply for large-scaled application system. One of them is that the J_c value of the bulk material is much smaller than that of the wires and tapes, which is accentuated in larger sized bulk material because the density and grain alignment are lower than those of small sized bulk. Another problem is that they are very brittle and fragile mechanically because Bi-2223 oxide is ceramic. These problems are especially important when large-sized bulk material is applied to high current application such as current feeder of nuclear fusion reactor etc. Recently, it was reported that J_c values of the composite bulk were improved with increasing the number of Ag sheets or wires. We prepared a newly designed Bi-2223 bulks with Bi-2223 oxide mono-cored Ag sheath filaments by Powder-In-Tube (PIT) method instead of Ag wires with the aim of decreasing of metal Ag volume fraction and further improvement of J_c property, and investigated on the microstructure, transport I_c and J_c properties of PIT filaments composite bulks.

The nominal composition of calcined powder was adjusted to be $Bi_{1.85}Pb_{0.35}Sr_{1.90}Ca_{2.05}Cu_{3.05}O_x$. The PIT filaments were prepared by standard PIT process using same calcined powder and pure Ag tube. Prepared Ag tubes were two kinds of dimensions (inner/outer), which were 4mm/6mm and 4mm/8mm. These tubes were deformed to wires of 0.4 mm diameter, and then they were cut 20 mm in length. The composite bulks were prepared by stacking alternately the calcined powder and PIT filaments. They were molded with metal dies, and then they were pressed at about 10 MPa for one minute using the coaxial pressing equipment. The prepared samples were sintered at 840℃ for 50h under the air twice, and intermediate Cold Isostatic Pressing (CIP). Fig.1 shows typical OM photograph of the cross-sectional area on the samples. The gray hollow circles in Fig.1 are Ag sheaths, and the black region is Bi-2223 oxide. And the results of SEM observations, the highly c-axis oriented and densely structured Bi-2223 plate-like grains are formed along the both outer and inner interface of the Ag sheath, but the thickness of such region is different.

Fig.2 shows the relationship between total Ag surface area and J_c value at 4.2 K and self-field. Here, we defined the total interface area between Bi-2223 oxide and metal Ag as total Ag surface area, it was dimensionless in respect to the difference between composite materials. The J_c values of normal Bi-2223 bulk were less than 600 A/cm^2, and the J_c values of PIT samples were estimated to be about 2000 A/cm^2 and 2100 A/cm^2, respectively. J_c values of the samples composed with PIT filaments were about three times larger compared to the normal bulk sample.

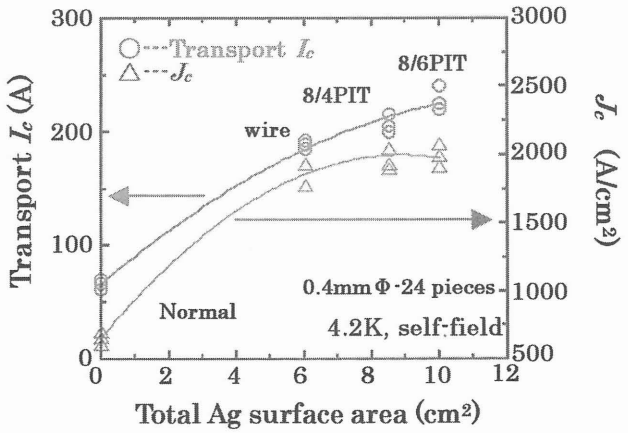

Fig.2 The relationship between total Ag surface area and transport I_c, J_c value at 4.2 K and self-field.