§16. Effect of MgO and Ag_2O on Microstructure and Superconducting Properties of (Bi, Pb)-2223 Phase in Partial-Melting and Sintering Process

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Bi-2223 superconductor is the most promising material for tapes and wires for high-current applications. Critical current densities (J_c) of Bi-2223 superconductors are strongly influenced by the grain alignment of Bi-2223 phase and the presence of pinning centers. Therefore, the influence of Ag and MgO substrate on texture and formation of Bi-2223 phase during sintering after partial-melting was investigated. Then, the effect of MgO, Ag_2O or PtO_2 additions on the microstructure and superconducting properties of Bi-2223 tapes fabricated by partial-melting and sintering process.

Texture and formation of Bi-2223 phase

The (Bi, Pb)-2223 powder of the atomic ratio Bi:Pb:Sr:Ca:Cu=1.8:0.4:1.9:2.1:3.5[1] was calcined at 800°C for 12h and then pressed to pellets of mm thick, which were set on a Ag or MgO substrate and then partial-melted at 875°C for 1h and finnally sintered at 840°C for 240h. The texture and formation of Bi-2223 phase were investigated by X-ray diffraction. Fig. 1 shows the dependence of the alignment of Bi-2223 phase on the distance from both Ag and MgO interfaces. A well-aligned Bi-2223 phase exists at the Ag and MgO interfaces and their alignment decreases with increasing distance from the interfaces. Fig. 2 shows the volume fraction of Bi-2223 phase as a function of the distance from the Ag and MgO interfaces. It is clear that the highest volume fraction of Bi-2223 phase exists in the Ag interface layer and the volume fraction decreases with increasing distance from the Ag interface. In the MgO interface layer, although well-aligned Bi-2223 grains exist at the MgO interface, a large volume fraction of Bi-2223

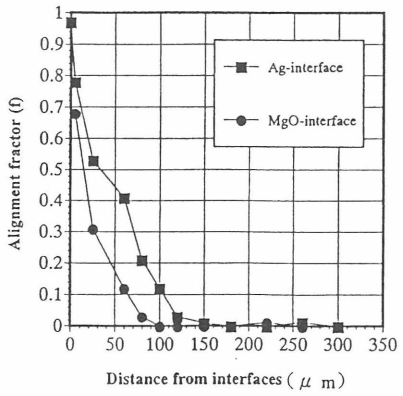

Fig. 1 Dependence of alignment factor of Bi-2223 phase on distance from Ag and MgO interfaces

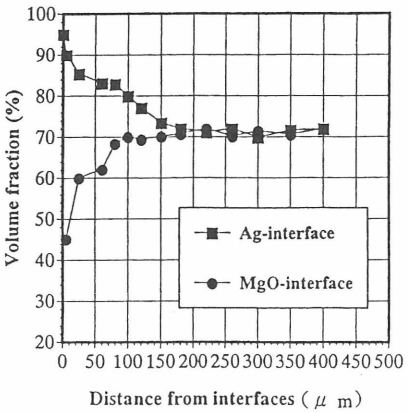

Fig. 2 Dependence of volume fraction of Bi-2223 phase on distance from Ag and MgO interfaces

phase appeares in the center rather than at the MgO interface. These results indicate that Bi-2223 phase in the partial-melting and sintering process has preferentially formed along the Ag substrate.

J_c of Bi-2223 tapes fabricated by partial-melting and sintering process

5wt%MgO, Ag_2O or PtO_2 particles were added to the starting powder. After calcined, pressed to pellets, the samples were heat treated by partial-melting and sintering process, wrapped with Ag sheet, then rolled to tapes of 0.2mm thick and finally sintered at 840°C for 240h. Fig. 3 shows the J_c (77K, 0T) of tapes with MgO, Ag_2O and PtO_2 particles and without additions. As can be

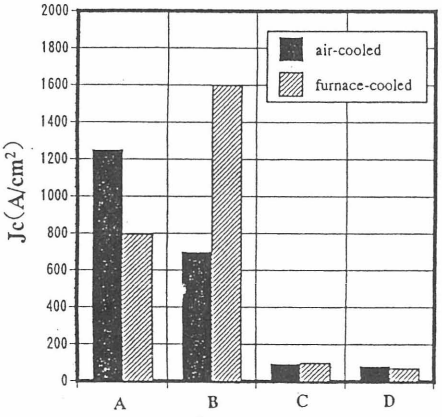

Fig. 3 J_c of tapes at 77K and zero field; A:undoped, B:MgO-doped, C:Ag_2O-doped, D:PtO_2-doped

seen in Fig. 3, the addition of MgO makes almost no effect on J_c, but Ag_2O and PtO_2 additions degrade J_c strongly. In the present study, we could not observed any pinning effects by additionof MgO, $AgO_2$and PtO_2 particles to Bi-2223 tape superconductors.

Reference

1) Lu, X. Y., Nagata, A., Sugawara, K., Kamada, S., J. Japan Inst. Metals, **61**, (1997) 892.