§28. Superconducting Property of Extruded MgB_2/Al Composite Material via 3 Dimensinal Penetration Casting Method

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Studies on MgB_2 have focused on application for superconducting magnets as well as Nb-based intermetallic compounds, and many projects for fabrication of wires and/or sheets are actively being pursued. We are trying to fabricate its wire from the MgB_2/aluminum metal matrix composite (MMC) material billet from the industrial point of view. In our previous studies, we fabricated MMC formed from Al or age-hardenable Al alloys matrix reinforced by ceramics particles, and investigated their hardening behaviors, microstructures, and aging properties. Our special technique for fabricating composite materials (3DPC method) can disperse particles in the matrix homogenously without any aggregation and control their volume fractions within the range of 4-40 %, even when particle size is less than 1 μm. Thus, these composite materials can be processed by machining, extrusion and rolling. It is also well known that MgB_2 and Al are better materials for the advanced nuclear fusion reactor because of their shorter decay time of induced radioactivity. In our recent work, we applied our technique to fabricate billets of composite materials consisting of Al matrix reinforced by MgB_2 particles, it was successfully extruded for 10, 3 and 1 mmϕ rod and wires[1-2]. In this study, addition of In and application of Mg-alloy for the matrix have been performed to modify and to develop MgB_2 particle dispersed MMC.

Three kinds of MMCs, MgB_2/Al, MgB_2/Al-In and MgB_2/Mg(AZ91) were fabricated using the 3DPC method, and extruded for 10mmϕ rods. Fig. 1 shows relations between temperature and resistivity (a), and magnetization and temperature (b) obtained for 3 MMCs. T_c for 3 MMCs are almost 37-39K, T_c of MgB_2/Al-In was modified rather than MgB_2/Al, and MgB_2/Mg(AZ91) was the highest of 39K. The magnetization was also modified by In addition or using Mg alloy as shown in Fig. 1(b). J_c of 3 MMCs were calculated using Bean's equation and they were summarized in Fig. 2. A curve of MgB_2/Mg(AZ91) was highest among 3 MMCs. MgB_2/Al-In was better J_c than MgB_2/Al.

In the future work, we will try to fabricate long wires using these 3 MMCs.

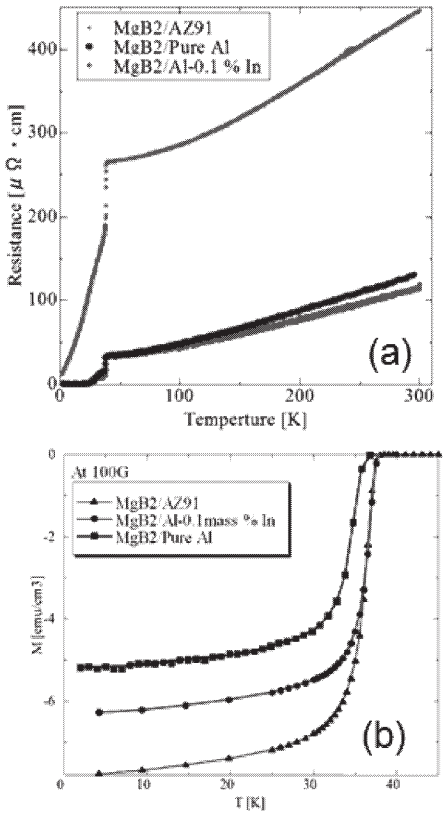

Fig. 1. Relation between temperature and resistivity for 10mmϕ rods of 3 MMCs.

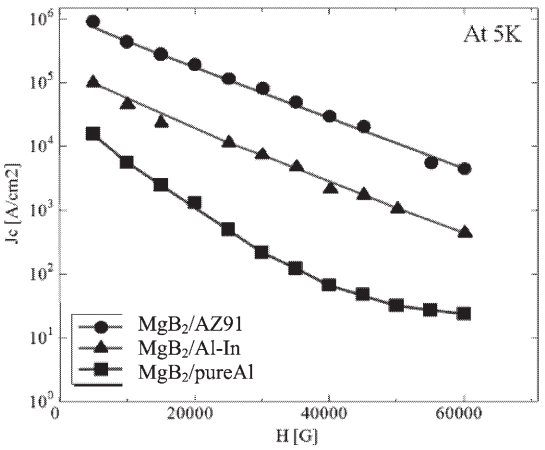

Fig. 2. J_c v.s. applied magnetic field calculated by Bean's equation for 10mmϕ rods of 3 MMCs.

Acknowledgement
Authors thanks to Prof. K. Tachikawa for his useful comment about In-addition.

1) Matsuda, K. et al: Materials Transactions 47 (2006) 1214
2) Matsuda, K. et al.: J. Physics **97** (2008) 012230