Recent Progress on the Development of MgB_2 Wires in Hitachi

Motomune Kodama, Hiroshi Kotaki, Takaaki Suzuki, Hideki Tanaka, Ryuya Ando, Takeshi Nakayama

Research & Development Group, Hitachi Ltd., Japan

Email: motomune.kodama.yf@hitachi.com

***Abstract*—Owing to the relatively high critical temperature (~40 K) and the low manufacturing cost, MgB_2 wires are promising for liquid helium-free superconducting applications. We have been developing MgB_2 wires, using the in situ powder-in-tube process, in which a metallic billet filled with magnesium and boron powders are processed into a thin wire.**

For the in situ-processed MgB_2 wires, as is well known, the use of fine boron powder, the appropriate way of carbon addition, and the increase in the filling density of powder through wire processing are effective to enhance the critical current density, J_c. Optimizing these manufacturing conditions carefully [1–3], we obtained the J_c of 103 A/mm^2 at 10 K and 5.4 T, 15 K and 4.2 T, and 20 K and 2.8 T. By using a 300-meter-long MgB_2 wire with 10 filaments 1.5 mm in diameter, we fabricated a coil 120 mm, 190 mm, and 41 mm in inner- and outer-diameters and height, respectively. The coil was successfully driven in a maximum field of 2.3 T at 24 K and the longitudinal homogeneity of the wire was confirmed [4].

To further improve J_c, we have been developing the mechanical milling method. In this method, magnesium and boron powders are mixed with a planetary mill, and the characteristic precursor particles, in which boron particles are dispersed in a magnesium matrix, are formed. We demonstrated that a monofilamentary wire fabricated from the mechanically milled powder has superior J_c to wires prepared by sufficiently optimized in situ-process [3].

Acknowledgements: The authors thank A. Matsumoto, G. Nishijima, H. Kumakura (NIMS); M. Inoue, K. Higashikawa, and T. Kiss (Kyusyu Univ.); A. Yamamoto (Tokyo Univ. of Agriculture and Tech.); and J. Shimoyama (Aoyama Gakuin Univ.) for the measurements of superconducting properties and valuable discussion. Part of this work was supported by JST-ALCA and by "Nanotechnology Platform" (project no. 12024046) of MEXT, Japan.

[1] M. Kodama et al, Supercond. Sci. Technol. **27** (2014) 055003
[2] M. Kodama et al, Supercond. Sci. Technol. **29** (2016) 105016
[3] M. Kodama et al, Supercond. Sci. Technol. **30** (2017) 044006
[4] H. Tanaka et al, IEEE Trans. Appl. Supercond. **27** (2017) 460904

***Keywords (Index Terms)*— MgB_2, wire, critical current density, mechanical milling.**

Received February 28, 2018; Selected March 7, 2018. Reference STP623; Category 5.