



Contribution ID: 1098 Contribution code: TUE-PO1-LN1-11

Type: Poster

Trapped field properties of MgB₂ bulks prepared via an in-situ infiltration-reaction process using refined boron powders

Tuesday, November 16, 2021 1:15 PM (2 hours)

An infiltration and reaction (IR) process realizes the dense MgB₂ bulk without the external physical pressure. The trapped field, B_T , of MgB₂ bulk prepared by the IR process was 2.4 T at 15.9 K, which was as high as that of MgB₂ bulk prepared by in-situ hot isostatic pressing method [1]. However, we found quite a large amount of unreacted micrometric B particles due to the incomplete diffusion of liquid Mg into a B precursor [2]. Therefore, overcoming this problem should give a further enhanced B_T for the IR-processed MgB₂ bulks. In this paper, we report the refining effects of B powder on the formation of MgB₂ and the trapped field properties. Crystalline B powder was refined by ball-milling at various rotation speeds up to 600 rpm for 1 h. The Mg pellet was placed on the B pellet in a stainless steel container and heat-treated at 900 °C for 24 h. The B_T of the IR-processed MgB₂ bulk increased with reducing the grain size of starting B powder, which originated mainly from the increase of the grain boundaries in the MgB₂ bulks. Moreover, the volume fraction of MgB₂ using ball-milled B powder is larger than that of MgB₂ using as-purchased B powder, which also contributes to the enhancement of B_T . We also attempted to fabricate the IR-processed MgB₂ bulks using the ball-milled amorphous B powders, however, the MgB₂ bulks were not created. We discuss the relationship of the creation of MgB₂ with the grain size and crystallinity of B.

References

- [1] T. Naito et al., Supercond. Sci. Technol. 29 (2016) 115003.
- [2] A. Ogino et al., IEEE Trans. Appl. Supercond. 27 (2016) 6800905.

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Session Classification: TUE-PO1-LN1 Late News I

Track Classification: E: Magnet Technology for Power, Energy, Transport, and other Applications: E04 Superconducting Bulk and Permanent Magnets