INVITED

IN IIA-4

Enhancement of the Superconducting Properties of MgB_2 with Refined Boron Powder; Glycerin Addition and Low Temperature Heat Treatment

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Mechanical milling is known to be an effective technique for reducing particle size and refining starting materials, resulting in a smaller grain size, a better reactivity, and an enhancement of the superconducting properties of MgB_2. Previous ball milling studies have reported on the effects of ball-milled magnesium (Mg) and Mg + boron (B) on the superconducting properties. However, the Mg powder was easily oxidized because of its activity properties during the milling. Recently, it has been reported that a ball milling of only B powder is a very effective method for improving the critical current density (J_c) of MgB_2. As a first theme, a combined process of the mechanical ball milling and glycerin treatment of boron powder in MgB_2 has been conducted to enhance the carbon incorporation and superconducting properties. One of the most promising methods is the development of C source dopants with a high reactivity. In particular, a pre-coating on milled B powder by C could be more effective. In the MgB_2 pellets prepared with milling + glycerin treatments, the J_c was enhanced due to a smaller grain size and a greater C substitution compared to MgB_2 without any pre-treatment of the B powder. The upper critical field and irreversibility field were further raised by combining a mechanical milling and glycerin addition of the B powder. As a second theme, *in situ* PIT MgB_2 wires were synthesized by a low temperature heat treatment process at 500, 550, and 600 ^oC. The phase formation, crystallinity, microstructure, critical current and critical field properties were investigated as a function of the heat treatment temperature and time. MgB_2 wires using mechanically milled B powder have enhanced superconducting properties due to a smaller grain size and a higher disorder compared to conventional heat treatment of 800 ^oC and 30 min.

Keywords : MgB_2, mechanically milled boron, glycerin addition, low temperature heat treatment

This research was supported by a grant (R-2006-1-248) from Electric Power Industry Technology Evaluation & Planning, Republic of Korea.