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Synthesis and Analysis of Boron Powders for the Superconducting MgB_2 Composite Wires

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The requirements of boron powders for high J_c MgB_2 superconducting materials are finer powders, high purity, and amorphous structure. In this work, we investigated the size distribution, phase purity, and powder structure from the commercially purchased boron powders and synthesized boron powders by the self-propagating high temperature synthesis (SHS). For the as-received commercial boron powders, the size of boron powders was more than 1μm and crystalline phase of boron powders was identified by XRD. After ball-milling, the size of boron powders was reduced to less than 250nm and large amounts of crystalline peaks disappeared and broad peaks, which indicate the amorphous phase of boron, were recognized. However, the ball-milling have limitation in further reduction in size less than 100nm and impurity incorporation. In SHS route, the amorphous boron powders with size of ~350nm were prepared with some crystallites. And this initials results may come from using the high temperature more than 2000°C in SHS method. To suppress the crystallization and grain growth, we modified the SHS method to get the finer and amorphous boron powders. With modified SHS process, we can reduce the size less than 100nm and obtain the amorphous phase of boron powders. Also, discussed are the properties of MgB_2 wires processed by the powder-in-tube method using the different boron powders and optimization of SHS method for the future application of MgB_2 wires with high J_c in the magnetic fields.

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