Enhanced critical current density in MgB2 prepared by reaction of MgB4 and Mg

Abstract

Instead of reacting B and Mg powders, MgB4 was used as precursor to react with Mg to obtain the polycrystalline samples of nominal composition MgxB2 (x = 1.2, 1.5, and 1.7). Upon increasing the sintering temperature to 750 °C, the reaction between MgB4 and Mg was thermodynamically intensified leading to the formation of larger MgB2 weight fraction as estimated from X-ray diffraction (XRD) data using the Rietveld method. Despite no further improvement to the weight fraction of this phase by increasing the excess nominal Mg, it was shown that the critical current density (Jc) was enhanced by almost one order of magnitude. At 5 K, 2 T, Jc for the sample Mg1.5B2 is estimated to be 4.5×105 A cm−2. The enhancement of Jc is attributed to the collective effect of improved grain connectivity and flux pinning by unreacted Mg. Incorporation of nano-SiC for reaction resulted in a more gradual drop of Jc with applied magnetic field. Hence, Jc can be tailored to meet the range of fields intended for various applications via optimization of excess nominal Mg and dopant additions.

Keyword: Critical current density; MgB2; MgB4; SiC; Superconductivity.