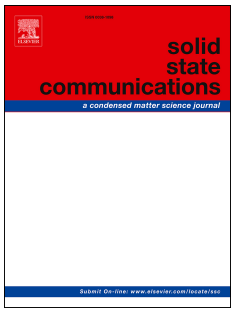
Accepted Manuscript



A new carbon source MgB_2C_2 for the synthesis of carbon-doped MgB_2 materials

Momoko Sawada, Jun-ichi Shimoyama, Natsumi Takagi, Takanori Motoki, Motomune Kodama, Hideki Tanaka

PII: S0038-1098(18)30232-1

DOI: 10.1016/j.ssc.2018.06.011

Reference: SSC 13458

To appear in: *Solid State Communications*

Received Date: 14 May 2018

Accepted Date: 20 June 2018

Please cite this article as: M. Sawada, J.-i. Shimoyama, N. Takagi, T. Motoki, M. Kodama, H. Tanaka, A new carbon source MgB_2C_2 for the synthesis of carbon-doped MgB_2 materials, *Solid State Communications* (2018), doi: 10.1016/j.ssc.2018.06.011.

A new carbon source MgB_2C_2 for the synthesis of carbon-doped MgB_2 materials

Momoko Sawada[1], Jun-ichi Shimoyama[1], Natsumi Takagi[1], Takanori Motoki[1], Motomune Kodama[2], Hideki Tanaka[2]

[1] Department of Physics and Mathematics, Aoyama Gakuin University, 5-10-1 Fuchinobe, Chuo-ku, Sagamihara-shi, Kanagawa 252-5258, Japan

[2] Research & Development Group, Hitachi Ltd., 7-1-1 Omika-cho, Hitachi-shi, Ibaraki, 319-1292, Japan

E-mail: c5617051@aoyama.jp

Abstract

One of the major problems of superconducting MgB_2 materials for extensive application is a large decrease in J_c with an increase of magnetic field. Carbon substitution for the boron site of MgB_2 has been well known to reduce this problem and numerous carbon containing compounds have been proposed as carbon sources thus far. However, the actual carbon substitution level, which is dependent on carbon source materials and sintering conditions, tends to be lower than the nominal one. In addition, impurity phases or hydrogen gas generate from most of the carbon sources during heat-treatment except for pure carbon and B_4C. In this paper, MgB_2C_2 is proposed as a promising new carbon source for preparation of carbon-doped MgB_2. Although synthesis of MgB_2C_2 has been considered to be difficult through a simple solid state reaction under an ambient pressure, we found that this phase can be obtained from powder mixture of nano-carbon (carbon black), boron and magnesium by sintering in a sealed stainless tube. The carbon-doped MgB_2 polycrystalline bulks using MgB_2C_2 as a carbon source contained almost the same carbon level as nominal one and exhibited improved J_c characteristics in magnetic field.

Keywords

MgB_2; MgB_2C_2; PIT method; superconductivity

1. Introduction

Numerous studies have been made for development of MgB_2 tapes and wires applicable for various applications since the discovery of its superconductivity in 2001 [1]. MgB_2 has the highest T_c ~39 K among metallic superconductors and shows high critical current density, J_c, even for randomly oriented polycrystalline materials due to long superconducting coherence length with small electromagnetic anisotropy. The main application target for long MgB_2 conductors are supposed to be superconducting magnets installed in MRI systems operating at 15–20 K without using liquid