Beilstein Journal of Nanotechnology

Enhancement of the critical current density in FeO-coated MgB_2 thin films at high magnetic fields

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Letter

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Keywords:
critical current; magnesium diboride; nanoparticles; pinning; superconductivity

Beilstein J. Nanotechnol. **2011,** *2,* 809–813.
doi:10.3762/bjnano.2.89

Received: 05 September 2011
Accepted: 18 November 2011
Published: 14 December 2011

Associate Editor: P. Ziemann

Abstract

The effect of depositing FeO nanoparticles with a diameter of 10 nm onto the surface of MgB_2 thin films on the critical current density was studied in comparison with the case of uncoated MgB_2 thin films. We calculated the superconducting critical current densities (J_c) from the magnetization hysteresis (M–H) curves for both sets of samples and found that the J_c value of FeO-coated films is higher at all fields and temperatures than the J_c value for uncoated films, and that it decreases to ~10^5 A/cm^2 at B = 1 T and T = 20 K and remains approximately constant at higher fields up to 7 T.

Introduction

After the discovery of superconductivity in MgB_2 [1], this material became attractive for researchers all over the world not only because of its special physical properties but also due to its possible technical applications. This material, with a hexagonal crystal structure and a critical temperature of T_c = 39 K, raised a lot of questions about its transport properties. This strong type-II superconductor has a fairly high critical current density in zero magnetic field, i.e., up to $J_c \sim 1.6 \times 10^7$ A/cm^2 at 15 K [2]. This superconducting parameter makes it a very attractive candidate to replace Nb in various superconducting devices,