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Reliable Preparation of High Quality Superconducting Thin MgB_2 Films for Application

V. Zdravkov[4] , A. Sidorenko[2,3,4] , A. Rossolenko[5], V. Ryazanov[5], I. Bdikin[5], O. Krömer[7], E. Nold[6], Th. Koch[1,2,3], Th. Schimmel[1,2,3]

[1]Institute of Applied Physics (AP), University Karlsruhe (TH), D-76128 Karlsruhe, Germany
[2]Institute of Nanotechnology (INT), Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany
[3]Center for Functional Nanostructures (CFN), University Karlsruhe (TH), D-76128 Karlsruhe, Germany
[4]Institute of Electronic Engineering and Industrial Technologies ASM, Kishinev MD2028, Moldova
[5]Institute of Solid State Physics, Russian Academy of Sciences, Chernogolovka, 142432, Russia
[6]Institute of Material Science I (IMF I), Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany
[7]Institute of Data Processing and Electronics (IPE), Forschungszentrum Karlsruhe, D-76021 Karlsruhe, Germany

E-mail: Thomas.Koch@int.fzk.de

Abstract. Since the discovery of its superconductivity [1], MgB_2 attracts considerable attention. A number of groups have intensively tried to fabricate high-quality MgB_2 films during the last years. However, the surface quality which is necessary for microelectronic device applications is still far from being achieved In this work we report the growth and the properties of high-quality films which are prepared in a two-step process: 1) deposition of the precursor films and 2) their annealing in Mg vapor with a specially designed, reusable reactor [2]. The films were grown on single crystal substrates of R-cut Al_2O_3 as well as of Al_2O_3 (100), (128^0 rot) $LiNbO_3$ and MgO (100). The highest value of T_c = 39.4 K was observed for films deposited at 770 K on sapphire and MgO and annealed at 1120 K for one hour. Our method allows also the growth of high-T_c smooth films with high reproducibility and opens perspectives for the use of MgB_2 films in microelectronics, especially for high-frequency applications.

1. Introduction

Since the discovery of its superconductivity,[1] magnesium diboride MgB_2 has attracted increasing attention as far as its physical properties and the origin of its superconductivity are concerned. Magnesium diboride has a T_c (critical temperature) which is higher than that of conventional superconductors, a simple crystal structure, and a high coherence length in comparison to other metal-oxide high-T_c superconductors. The critical temperature of 39.3 K makes MgB_2 an attractive candidate material for use in digital superconducting microelectronic devices operating at temperatures above 25

