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Magnetic and magnetocaloric properties of single crystal $(Nd_{0.5}Pr_{0.5})_2Fe_{14}B$

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Abstract

In this work the magnetic and magnetocaloric properties of a $(Nd_{0.5}Pr_{0.5})_2Fe_{14}B$ single crystal have been investigated in a wide range of temperatures and magnetic fields. Magnetic phase transition temperatures (spin-reorientation transition (SRT) at T_{SR} = 73 K and Curie point at T_c = 570 K) were determined together with the values of saturation magnetization M_s and magnetocrystalline anisotropy constants K_1 and K_2.In the vicinity of a spin-reorientation magnetic phase transition, the value of the magnetocaloric effect was determined as an isothermal magnetic entropy change (ΔS_M). The universal curve of $\Delta S'(\theta)$ around T_{SR} under various magnetic field changes has been constructed by using a phenomenological procedure. It is found that this approach is applicable to materials with a second-order spin-reorientation phase transition.

Keywords: hard magnetic materials, rare earth intermetallics, single crystal, magnetocaloric effect, magnetic anisotropy, high magnetic field

Introduction

Since their discovery in 1984 [1,2], the $R_2Fe_{14}B$ (R is a rare earth) type of compounds receive considerable scientific attention [3-8]. Permanent magnets based on $Nd_2Fe_{14}B$ show best hard magnetic properties [9]. In recent years, a significant progress has been achieved both in the material preparation techniques [10-13] and in studying intrinsic properties of the $Nd_2Fe_{14}B$ on successfully prepared single-crystalline specimens [14-16].