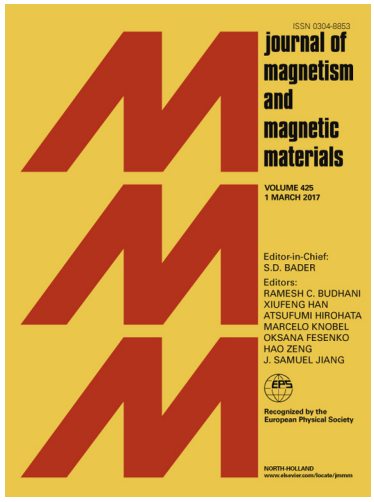

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The electrical transport and magnetic properties of $Fe_{1.08}Sb$ single crystal

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Abstract

Interstitial iron (Fe_i) has strong influence on physical properties of $Fe_{1+x}Sb$ ($0.08 \leq x \leq 0.38$) compounds. We synthesized $Fe_{1.08}Sb$ single crystals with Fe_i content close to the lower limit of solution area and investigated its transport and magnetic properties. The ac susceptibility and field dependence of magnetization measurements demonstrate that the transition at ∼9 K is a spin glass transition. By analyzing temperature dependence of susceptibility (χ vs T) and resistivity ($\mathrm{d}^2\rho/\mathrm{d}T^2$ vs T) results, we found a change of scattering in transport properties caused by the ordering of Fe_i moments in this compound. In addition, the Hall resistivity results reveal that the hole-type carrier is dominant and the topological Hall effect induced by spin chirality is negligible in $Fe_{1.08}Sb$.

Keywords: transition metal monoantimonide, spin glass, Honda-Owen method, electrical transport properties, spin chirality

1. Introduction

Transition metal metalloids (T_rX) exhibit a large variety of physical properties that are of great importance for both practical applications and fundamental researches. For example, the Skyrmion state found in MnSi[1, 2] and FeGe[3, 4] has potential applications in data storage; the study of unconventional superconductor FeSe contributes to understanding superconducting mechanisms[5, 6].

Transition metal monoantimonides belong to T_rX and crystallize in a NiAs type crystal structure with a space group $P6_3/mmc$[7, 8]. They exhibit various magnetic properties, ranging from paramagnetic (TiSb, NiSb) to strong antiferromagnetic (CrSb) and ferromagnetic (MnSb)[9, 10, 11, 12, 13]. $Fe_{1+x}Sb$ is known to be nonstoichiometric and of single phase with $0.08 \leq x \leq 0.38$[14, 15, 16]. Fe atoms possess two kinds of Wyckoff positions in this material and are thus devided into two types, i.e., lattice iron (Fe_l) and interstitial iron (Fe_i). From the view of crystal structure, Fe_i atoms randomly occupy vacancies in Sb layers[14]. More importantly, the physical properties are closely related to Fe_i.

According to previous investigations, $Fe_{1+x}Sb$ experiences two transitions with decreasing temperature [7, 14, 15, 17, 18]. It is interesting that both transition temperatures are strongly dependent on Fe_i content. The high temperature antiferromagnetic (AFM) transition is caused by the ordering of moments at Fe_l.

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