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Journal of Magnetism and Magnetic Materials 225 (2001) 351–358

journal of magnetism and magnetic materials

www.elsevier.com/locate/jmmm

Magnetic and hyperfine interaction in RFe_4Al_8 (R = Ce, Sc) compounds

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Received 13 September 2000; received in revised form 6 December 2000

Abstract

Magnetic properties of $ScFe_4Al_8$ and $CeFe_4Al_8$ compounds have been studied by magnetization and Mössbauer effect measurements. Magnetic transition temperatures estimated from Mössbauer spectra ($B = 0$) 170 K for $CeFe_4Al_8$ and 225 K for $ScFe_4Al_8$ are not confirmed by magnetization measurements. Contrary, the pronounced maxima at $T_{max} = 130$ and 125 K in DC magnetization curves ($B = 1$ kOe) were found for $ScFe_4Al_8$ and $CeFe_4Al_8$, respectively. Thermomagnetic, the so-called zero field (ZFC) and field cooling (FC) experiments show temperature-dependent irreversibilities below the "freezing" temperature, T_f, which diminishes with application of external magnetic field. The Mössbauer studies show the coexistence of magnetically (sextet) and non-magnetically (quadrupole doublet) split patterns in the wide temperature range far away from T_{max}. All these observations indicate that the systems studied are either a spin-glass or are the mixture of AF and spin-glass state.

Keywords: Mössbauer effect; Magnetic susceptibility; Rare earth compounds

1. Introduction

Magnetic properties of the rare earth compounds of the type RFe_4Al_8 have caused a considerable interest both from the fundamental point of view as well as a potential precursors for hard magnetic materials with higher Fe content like $SmFe_{10}Si_2$ (for a review see Ref. [1]). Magnetic [2,3], neutron diffraction [4,5] and Mössbauer effect [6–8] measurements in the stoichiometric compounds of composition RFe_4Al_8 have confirmed a complex (still controversial) antiferromagnetic (AF) ordering. In spite of a number of techniques that have been used to understand the magnetic properties of these materials, a very complex landscape appears from nowadays-published papers.

RFe_4Al_8 compounds crystallize in the tetragonal $ThMn_{12}$-type crystal structure, which belongs to the I4/mmm space group. There are 26 atoms (two

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0304-8853/01/$ - see front matter
PII: S0304-8853(01)00061-0