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A neutron polarization analysis study of Ce_2Fe_{17} in its paramagnetic phase

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Abstract. Spin-flip (paramagnetic) scattering and neutron depolarization studies were performed on Ce_2Fe_{17} in its paramagnetic phase on the Dhruva neutron polarization analysis spectrometer. The absence of normal Q dependence of the scattered spin flip intensity shows that Ce_2Fe_{17} is not a normal paramagnetic and there exist superparamagnetic clusters of sufficiently large dimensions (~ 100 Å). The observed neutron depolarization gives an indication of the dynamics of these Ce_2Fe_{17} superparamagnetic clusters.

Keywords. Ce_2Fe_{17}; superparamagnetic clusters; neutron polarization analysis; spin-flip.

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1. Introduction

The R_2Fe_{17} compounds (R = rare earth) are the most iron rich of all binary rare earth iron intermetallics. They exist across the whole lanthanide series except for La itself, crystallizing in the hexagonal Th_2Ni_{17} structure for R heavier than Dy and in the rhombohedral Th_2Zn_{17} structure for R lighter than Gd; both structures may coexist for R = Gd, Tb and Dy. Compounds of the R_2Fe_{17} class have large magnetization values but low ordering temperatures and magnetocrystalline anisotropies. These make the R_2Fe_{17} compounds less attractive for applications as permanent magnet materials. By alloying these systems with carbon (Gubbens *et al* 1989; Zhong *et al* 1990) and nitrogen (Coey and Sun 1990; Jaswal *et al* 1991), considerable enhancement of the Curie temperature and anisotropy can be achieved. While magnetization and Mössbauer studies exist in these alloyed compounds (Gubbens *et al* 1989; Zhong *et al* 1990; Coey and Sun 1990; Hu *et al* 1991), very few neutron investigations have been reported (Jaswal *et al* 1991). Our interest therefore is in elucidating the magnetic structures of these alloyed compounds using the neutron diffraction technique. In this context, the compound Ce_2Fe_{17} was prepared. This paper reports some interesting features observed by us in Ce_2Fe_{17} in its paramagnetic phase, using the neutron polarization analysis technique.

2. Experimental details

The compound Ce_2Fe_{17} was prepared from the constituent elements of at least 99·9% purity by repeated arc melting in purified argon atmosphere. After arc melting, the ingots were sealed into an evacuated quartz tube and annealed for about 150 hours at