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Magnetic and structural properties of Co nanoparticles in a polymeric matrix

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Abstract

Magnetic, magnetic resonance and structural properties of Co nanoparticles in polyethylene matrix have been investigated. The materials were prepared by a method of thermal decomposition of cobalt formate in the polyethylene melt in a mineral oil and contained 4 wt% of Co. Transmission electron microscopy data showed that the particles diameter was 4 nm. According to EXAFS studies the particles can be presented as consisting of metallic core and a surface shell interacting with the surrounding matrix. Magnetic and magnetic resonance studies showed that the material has high blocking temperature (about 600 K) and the magnetic anisotropy constant of the nanoparticles is of an order of magnitude higher than that in a bulk cobalt. The origin of the high magnetic anisotropy of the Co nanoparticles is related to the surface effects. The material has relatively high hysteresis at room temperature (590 Oe), which makes it promising for magnetic recording applications.

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1. Introduction

Materials containing magnetic particles of nanometer sizes have been attracting the special attention of investigators in recent years. The unique properties of nanoparticles are determined first of all by the fact that a large number of atoms (10%) in a nanoparticle belongs to its surface. The violation of crystal symmetry, coordination number, ligands type, etc. on the surface subject the surface atoms to conditions radically different from that in the bulk of the material. Besides, the surface atoms interact with the material of matrix where they are contained. From this point of view a matrix should have an essential influence on the properties of the particles. Investigation of the

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