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Characterization of maghemite ferric oxide crystals processed by an aerosol technique

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Abstract

An aerosol technique is used to produce submicrometer-sized γ-Fe_2O_3 particles in two steps using ferrous oxalate dihydrate as the starting precursor. In the first step, a submicrometer-sized powder was produced by decomposing the precursor solution in an aerosol reactor. In the second step the powder was heat treated in a reducing ambient to produce maghemite (γ-Fe_2O_3). The kinetics of the maghemite formation are elucidated using a microscopic probe.

Keywords: Aerosol processing; γ-Fe_2O_3; Mössbauer spectroscopy; Magnetic powders

1. Introduction

Magnetic recording media in the form of tapes, flexible disks and rigid disks are broadly used for analog audio and video recording and for digital audio, video and data storage. Although recording surfaces can be formed by deposition of thin magnetic films on a substrate material, most commercially available media are made by coating the substrate material with a dispersion of magnetic particles [1]. This approach has been used for decades and is capable of being extended for future applications, such as by the chemical vapor deposition (CVD) technique. The first commercially available magnetic recording tapes were produced in the late 1940s using iron oxide particles [1]. Gamma ferric oxide, γ-Fe_2O_3 (maghemite), is the most useful of the oxides because of its chemical and physical stability, but particularly because of its ideal magnetic properties such as high saturation magnetization (M_s), high coercivity (H_c) and squareness ratio (M_r/M_s), where M_r is the residual moment. Generally γ-Fe_2O_3 is used in the form of single-domain (SD) particles of acicular shape for obtaining a good signal-to-noise ratio [2].

The traditional synthesis techniques used to prepare acicular γ-Fe_2O_3 particles are rather complicated and involve multiple steps. There are several microstructure problems, such as porosity, with important consequences on the magnetization reversal mechanism leading to poor recording performance. The conventional method of preparing iron oxide particles begins with the nucleation and growth of α-FeOOH (goethite) or γ-FeOOH (lepidocrocite)

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