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Study of Mössbauer spetroscopy for nano fibrous Fe_2O_3 derived from hydrolysis of Fe nano powders

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1. Introduction

The nanoceramic fibrous materials have many attractive unusual properties depending on the size and homogeneity for more interesting practical applications such as high temperature insulating materials, catalyst, and medical filler [1-2]. However, studies on magnetic fibrous nanoparticles are few compared to those on other catalytic fibrous materials. It is well known that the morphology of Fe_2O_3 has noteworthy effects on its properties and its relative application. In these studies, using a nano iron powder produced by pulsed wire evaporation (PWE) of metal wire as a staring material for synthesis of nano fibrous Fe_2O_3 [3], conditions for growth of nano fibrous Fe_2O_3 were optimized and their morphologies and magnetic properties were investigated.

2. Experimental Technique

The Fe powders were spherical shapes with well-defined boundaries and average sizes of about 80-120 nm. These nano powders were immersed into distilled water and ultrasonically treated for 10 min. A small amount of acid was added into the distilled water. The hydrolysis was carried out at 60 °C for 6 hours to produce the precipitation of iron hydroxide gel. The produced gel was drawn through a 0.2 μm filter and subsequently dried in an oven at 60 °C for 12 h, which yielded the solid precipitates with a yellow color. Thermal treatment for the as-dried samples was performed in the range of 250 °C to 700 °C for 1 h. After thermal treatment, the solid products were air-cooled.

3. Results and Discussion.

The nano-fiberous Fe_2O_3 have been successfully synthesized by employing an *ex-situ* simple two-step process consisting of the hydrolysis and subsequent dehydration of spherical Fe nanoparticles prepared by the PWE technique. The fibrous shape of Fe_2O_3 depends on the original morphology of iron hydroxide as shown in Fig. 1. It is obvious that the phase control of FeOOH and $Fe(OH)_3$ is a very important way to produce the desired nano-fiberous Fe_2O_3. The Mössbauer spectrum for Fe_2O_3 dehydrated at 300 °C consists of two sets of sextets as shown in Fig. 2. The magnetic hyperfine interaction and isomer shifts correspond to Fe^{3+}.

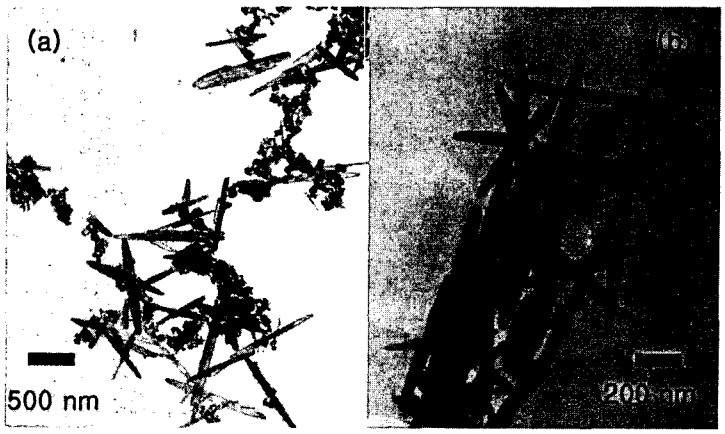

Fig. 1. TEM images showing nanofibrous structure for (a) the goethite FeOOH and trihydroxide form of $Fe(OH)_3$ as dried at 60 °C, (b) the Fe_2O_3 phase sintered at 300 °C

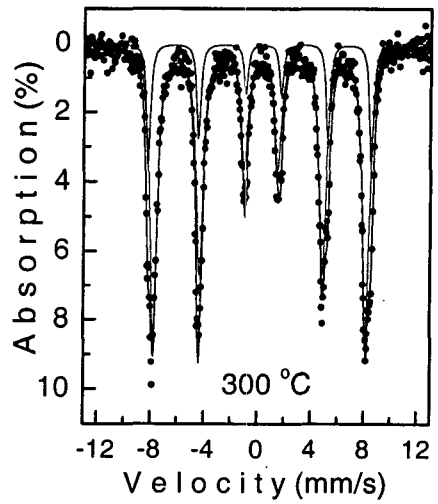

Fig. 2 Mössbauer spectra measured at room temperature, for Fe_2O_3 powders sintered at 300 °C.