CVC법에 의해 제조된 Fe/Co 나노분말의 특성

Characteristics of CVC-prepared Fe/Co nano powders

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1. Introduction

Research on nanomaterials has been stimulated by the interest for basic scientific investigations and their technological applications, such as catalysts, medical diagnostics, color imaging, drug delivery systems, pigments in paints, ceramics, etc. Because the particle size is often less than the magnetic domain size, magnetic nanoparticles can have the special characteristic of exhibiting single-domain magnetism and can be used in magnetic tapes, ferrofluids, magnetic refrigerants, etc.

We synthesized nanoparticles of Fe and Co by Chemical Vapor Condensation (CVC) method from organometallic precursors. The structural and magnetic properties of free-standing particles were discussed.

2. Experimental Details

Fe and Co nanoparticles were synthesized by the pyrolysis of $Fe(CO)_5$ and $Co2(CO)_8$, respectively, using CVC process. Experiments were conducted with a tubular furnace uniformly heated at a temperature over the range 400-1100°C. The morphologies and lattice images of particles were determined with HRTEM. Identification of the phases in the samples was carried out in X-ray diffractometer. Magnetic characterization of the samples was made using vibrating sample magnetometer (VSM).

3. Results and Discussion

Magnetic Fe or Co particles can form intricate long strands when they agglomerate to minimize the magnetic energy. HRTEM shows the typical morphology and lattice image of passivated Fe nanoparticles with median diameter about 10 nm. The particle shape is nearly spherical with a core-shell type structure. The core is metallic and the shell is composed of metal oxides. TEM micrograph of passivated Co nanoparticles showed similar morphology and structure to those of Fe nanoparticles. X-ray diffraction patterns of Fe and Co nanoparticles show that the crystalline metal nanoparticles were synthesized by the CVC method. Fe particle is bcc-type and Co particle is fcc-type structure. The mean size of nanoparticles increased with increasing of decomposition temperature due to the difference of the kinetic energy of nuclei. The reduction in saturation magnetization with decreasing size is expected because of the presence of surface oxides due to passivation, namely, the volume ratio of the oxides to metal becomes larger as particle size decreases. No strong size dependence of Hc is found.

4. References

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