BD03

Synthesis of Metal and Ceramic Magnetic Nanoparticles by Levitational Gas Condensation (LGC) Method

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The development of new methods for the synthesis of nano powders such as magnetron sputtering, melt spinning, and mechanical alloying opens up new possibilities for the non-equilibrium phases and nanocrystalline materials with new physical properties. The various synthesis procedures, which involve several treatment steps, were used to prepare metal particles [2]. The levitational gas condensation (LGC) method is a physical approach to fabricate nanoparticles [3]. This method is one approach to fabricate nanoparticles of metal and metal oxide powders in one step procedure, while the other methods have a little complex procedures. In this article, metal and ceramic nanoparticles such as nickel, iron and ferrite (Fe_3O_4, $NiFe_2O_4$) nanoparticles were synthesized by the LGC method using both wire feeding (WF) and micron powder feeding (MPF) system and phase evolution and magnetic properties were investigated in details. According to the results of hysterisis and Mössbauer spectrum, the Ni and Fe nano powder include magnetic ordered phase. The synthesis by LGC yields spherical particles with large coercivity. The abnormal initial magnetization curve for Ni indicates non-collinear magnetic structure between core and surface layer of particles. Since the XRD pattern cannot actually distinguish between magnetite (Fe_3O_4) and maghemite(γ-Fe_2O_3) because they have a spinel type structure, the phase of iron oxide in samples was unveiled by Mössbauer spectrum. Nanoparticles of Fe_2O_3 and Fe_3O_4 with narrow size distribution and high specific surface area can be obtained by LGC method. The amount of γ-Fe_2O_3 and α-Fe in as-prepared sample under O_2 flow rate from VO_2=0.5 (*l*/min) to VO_2=0.15 (*l*/min) is composed about 93 % and 7 %, respectively, whereas the amount of Fe_3O_4 and α-Fe in as-prepared under O_2 flow rate from VO_2=0.15(*l*/min) to VO_2=0.2 (*l*/min) is composed about 92 % and 8 %, respectively.

It was found that phase transformation into Fe_3O_4 from both γ -Fe_2O_3 and α-Fe strongly depends on increasing O2 flow rate in the chamber. The Ni-ferrite synthesized by a LGC method consisted of single domain particles including an unusual ionic state. The Mössbauer spectrum revealed the presence of superparamagnetic phase with ionic states of Fe^{2+} and Fe^{3+}. The presented simple and environmental friendly synthesis using metal powder as parent materials can be extended to prepare other nanoparticles with scientifically interesting properties

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BD04

Studies on the Induced Magnetic Anisotropy by Magnetic Annealing for Permalloy Thin Film

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It have been reported that the heat treatment of a binary ferromagnetic alloy in a magnetic field creates an induced magnetic anisotropy. During the annealing in a magnetic field, the diffusion of the atoms on the lattice leads to anisotropic distributions of the A-A, A-B, and B-B links, and this state can be conserved at room temperature by quenching. The same interaction energy between the nearest neighbor links and magnetization causes an induced magnetic anisotropy [1],[2]. But, the study on the relation between ordering process and magnetic annealing effect has not yet been completely done.

This study investigates the effect of magnetic annealing on the atomic pair ordering and magnetic properties of permalloy films. EXAFS has been used to detect the presence of atomic pair ordering in permalloy thin films determine if such a pair ordering is the main cause of their induced magnetic anisotropy. The magnetic anisotropy induced in permalloy thin films by magnetic anneal has been determined as functon of the magnetic annealing temperature, direction and duration.

We can see that considerable changes took place for crystal structure after annealing without and with a magnetic field in Fig.1. But as shown in Fig. 2, we could not observe conclusively the atomic pair ordering as the origin of the induced magnetic anisotropy in the permalloy film heatreated in a magetic field.

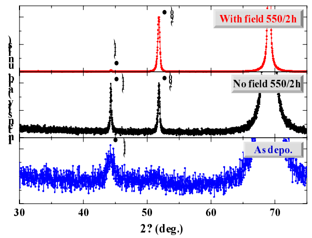

Fig. 1. X-ray diffraction pattern of permalloy films after heat treatent with and without a magnetic field.

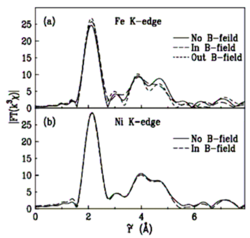

Fig.2. EXAFS spectra of permalloy films (a) at Fe K-edge and (b) at Ni K-edge.

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