RA04

Influence of Synthetic Conditions on Iron Oxide Nanoparticles

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In recent years, iron oxide nanoparticles have been intensively pursued because of their fundamental scientific importance and potential applications [1, 2]. All these applications required that the nanoparticles are with nanoscale size and the overall particles size distribution is narrow. Magnetite particles synthesized by chemical methods with the desired size and acceptable size distribution have consistently been a problem. In this work, we presented influence of synthetic conditions on monodisperse iron oxide nanoparticles. The particles magnetic properties were also discussed.

The magnetite nanoparticles were prepared by thermal decomposition of iron pentacarbonyl. To investigate the effect of synthetic conditions on particles properties, several particles samples were synthesized by various the conditions. The particles were imaged by TEM. Identification of phases in the samples was carried out by XRD. Magnetic properties were measured by VSM.

Fig.1 shows micrograph of particles synthesized at various the reactive temperatures for 2 hours. It can be observed the particle size increase and particles size distribution gradually improved with increasing temperature. The particles shape was also modified with increasing temperature. Fig.2 shows the dependence of particles size and size distribution on the reactive time at 285 ℃. Firstly, the precursor decomposed to many nuclei. Fe molecule deposited on surface of the nuclei and the nuclei grew up to clusters. The clusters continually grew up to nanoparticles in the reaction condition. The particle growth process is not proportional growth from small to big with prolonging the reaction time. The particles cannot finish ripening stage in a short time. It needs enough reaction time from nucleation to formation of nanoparticles with uniform size. The nanoparticles magnetic properties were also studied. Hysteresis of particles is very small and observed saturation magnetization is smaller than the bulk value of 95 emu/g. This is due to the nanoparticles superparamagnetic behavior. The hysteresis loop of nanoapricles synthesized by different reactive conditions show that the coercivity decreases with decrasing nanoparticles size. The saturation magnetization drops with decreasing nanoaprtticle size because of the increase in the nanoparticle surface-to-volume ratio.

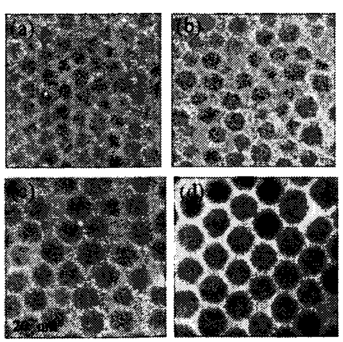

Fig. 1. Micrograph of particles synthesized at various the reactive temperatures of (a) 185, (b) 215, (c) 250, and (d) 285 ℃.

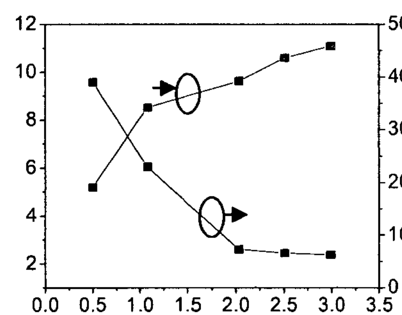

Fig. 2 The dependence of particles size and size distribution on the reactive time

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RA05

Hexagonal Ferrite Nanoparticles With Soft Magnetic Feature

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Lead ferrite nanoparticles were prepared by a modified polymerized complex technique. Lead nitrate, iron nitrate, citric acid, and ethylene glycol were used as precursor materials. The thermal decomposition characteristics and crystallization behavior of the precursor were study by the thermogravimetric analysis (TGA) and X-ray diffraction. The phases of the nanoparticles can go from amorphous to spinel ferrite and hexagonal ferrite depending on the annealing temperatures. Single hexagonal ferrite phase nanoparticles with average particle size of 15 nm could be obtained through thermal decomposition of precursor at low temperature (600 °C). Magnetic force measurements of various particle sizes show that there is a Hopkinson transition peak at around 452 °C and this peak shifts toward higher temperature and becomes broader as the particle size decreases(Fig. 1) The Hopkinson transition is governed by the temperature dependence of both the spontaneous magnetization and magnetic anisotropy [1]. Magnetic measurements display that the initial magnetization curves I1 lies outside the hysteresis loop for a certain field range and finally enters the loop again at a higher field (Fig. 2).It is suggest that there is an irreversible field induced anisotropy in the lead ferrite nanoparticles resulted from the nanosize effect. The obtained hexagonal ferrite nanoparticles exhibit a soft magnetic feature with a low saturation magnetization. Moreover, both the saturation magnetization and coercivity increase as the particle sizes increase.

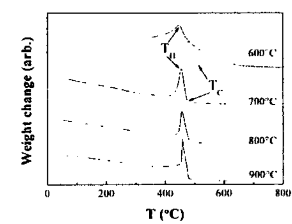

Fig. 1. TGA curves for lead ferrite nanoparticles obtained at various temperatures under a magnetic field. TH and TC are defined as Hopkinson transition and Curie temperature, respectively.

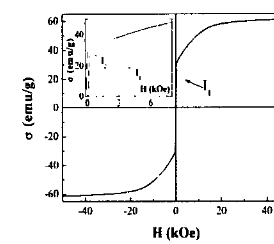

Fig. 2. The magnetization curves (H) and hysteresis loop of lead ferrite nanoparticles. Inset: the curves on expanded scales. I1 indicates the initial curve for the first time measurement; and I2 shows the initial curve from the demagnetized state.

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