PC04

Effects of Ta on the Structure and Magnetic Properties of FePt Thin Films

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As magnetic recording pushes to higher area densities, superparamagnetism restricts the thermal stability of the media. FePt with hard magnetic $L1_0$-ordered structure has been attractive as a candidate, because its large magnetic anisotropy would suppress the thermal fluctuation and lower the superparamagnetic limit. In general, an as-deposited FePt thin film has a soft magnetic disordered face-centered cubic (fcc) structure as a major phase and possesses low coercivity. In order to form the ordered $L1_0$ phase, the as-deposited film needs to be post-annealed at 600℃ or higher, which is too high to be compatible with the manufacturing process[1, 2].

This paper investigates the effect of Ta on the structure, magnetic properties and the ordering temperature of FePt(Ta) thin films. The samples are prepared by dc and rf magnetron co-sputtering method with 3 single element targets. After deposition, the samples are annealed in the pressure of 7×10^{-7}torr at various temperatures. They are characterized by VSM, XRD, TEM, EDS.

The more Ta added to the FePt, the larger the coercivity. The coercivity of an annealed FePt+5% Ta film reaches about two times as large as the pure FePt. The plane view TEM image of the film measures the grain size about 20 nm. The TEM images and delta M curves show that diffusion of Ta atoms into the grain boundary leads to the reduction of inter-granular exchange coupling and the enhancement of coercivity.

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PC05

Composition-dependent Magnetic Properties of $L1_0$-FePt Nanoparticles Synthesized by the SiO_2-nanoreactor Method

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FePt nanoparticles attract much attention as one of the most promising candidates for the future recording media with ultra-high densities beyond 1 Tbit/in^2. The synthesis of FePt nanoparticles by chemical solution based methods has been appreciated for the feasibility of morphological control [1]. However, thesemethods can produce only disordered face centered cubic (fcc) or partially ordered L10-FePt nanoparticles, and thus a post-thermal annealing is necessary to transform them into the desired $L1_0$ structure. This post-annealing results in coalescence and coarsening of the nanoparticles, leading to difficulties in fabricating desirable arrays on a substrate.

Recently, we have succeeded in solving these problems by developing a new synthetic strategy named "SiO_2-nanoreactor" method [2]. Previous studies revealed that annealing at 900℃ for 1 hour could convert almost all of the fcc-$Fe_{56}Pt_{44}$ nanoparticles to the well-crystallized L10 structure with a high coercivity although only minor part of the sample remained unconverted [3].

Here, we report composition-dependent magnetic properties of $L1_0$-FePt nanoparticles synthesized by the SiO_2-nanoreactor method by means of SQUID magnetometry.

The fcc-FePt nanoparticles with different compositions were synthesized according to the reported method[4], which were subsequently coated by SiO_2. Thus-obtained SiO_2-coated fcc-FePt nanoparticles were annealed at 900℃ for 1 hour to convert them to the $L1_0$ structure. Elemental compositions of the FePt nanoparticles were determined to be $Fe_{41}Pt_{59}$, $Fe_{48}Pt_{52}$, $Fe_{54}Pt_{46}$ and $Fe_{60}Pt_{40}$ by using an atomic absorption spectrometer.

Fig. 1 shows the room temperature hysteresis loops for the $L1_0$-FePt nanoparticles after dissolution of the SiO_2 shell. This figure clearly shows that amount of magnetically soft phase, i.e. the fcc phase, included in the samples depends on the compositions. The amount of the fcc phase becomes minimum at the composition of $Fe_{54}Pt_{46}$, revealing that this composition is the best to produce high quality $L1_0$-FePt nanoparticles.

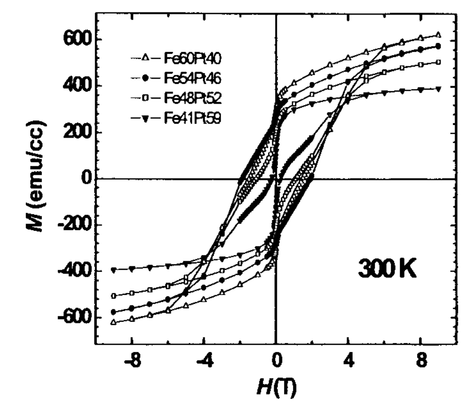

Fig. 1. hysteresis loops of the SiO_2-coated FePt nanoparticles annealed at 900 ℃ for 1 hour.

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