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Dispersible Ferromagnetic FePt Nanoparticles

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We report a simple method for producing ferromagnetic fct-FePt nanoparticle (NP) dispersion by thermal annealing of core/shell structured fcc-FePt/MgO or reductive annealing of fcc-FePt/ Fe_3O_4/MgO NPs, followed by the removal of MgO in the presence of hexadecanethiol (HDT) and oleic acid (OA).

For example, the 7 nm fcc-Fe51Pt49 NPs were synthesized according to the published method [1]. MgO was coated on these $Fe_{51}Pt_{49}$ NPs by the decomposition of $Mg(acac)_2$ in the presence of 1,2-tetradecanediol, OA and oleylamine in benzyl ether [2]. The fct-FePt/MgO NPs were obtained by annealing the fcc-FePt/MgO NPs at 750°C for 6 h. Their coercivity values reached 1.8 T (at 5 K), 1.6 T (at 100 K), and 1 T (at 300K) respectively.

MgO can be removed readily by washing the fct-FePt/MgO NPs with the dilute HCl aqueous solution (0.5 M). During this process, the fct-FePt NPs were extracted from their aqueous phase to the organic phase that contained HDT and OA. We found that HDT-OA gave the most efficient protection of the fct-FePt NPs. Fig. 1 outlines the chemistry of transferring the fct-FePt/MgO NPs from the aqueous solution to hexane.

The chemistry illustrated above can be extended to the synthesis of fcc-FePt from FePt/Fe_3O_4/MgO NPs and $SmCo_5$ from Co/Sm_2O_3 NPs. Such hard magnetic NPs dispersed in liquid media should serve as ideal building blocks for constructing ferromagnetic nanostructures and for information and energy storage applications.

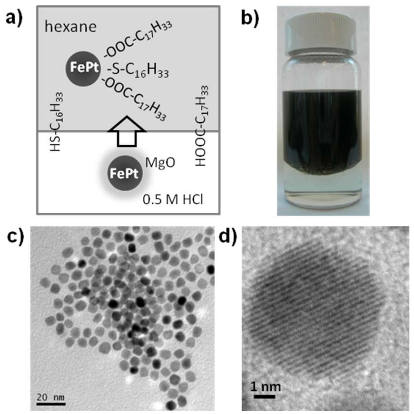

Fig. 1. a) Schematic illustration of FePt NP transfer from 0.5 M HCl aqueous phase to hexane phase; b) the photograph showing the fct-FePt NP transfer from aqueous phase to hexane phase; c) TEM image of the fct-FePt NPs from b); and d) HRTEM image of a single fct-FePt NP.

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The Role of Ni for Magnetism in Ti-Zr-Ni Quasicrystals

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The intersting structural property of the qQuasicrystasl (QCs) was first discovered by Schectman et al. QC is characterized by icosahedron structure andexhibit of a five-fold symmetry which is forbidden in crystal. The atomic positions of the QCs are contains quasi-periodic ordered atoms explained by the Fibonacci sequence. Most of QCs are obtained by rapid quenching from molten ingots, suggesting that they are meta-stable. Since their first discovery in 1982, Hundreds more than 300of QCs are found in Al-based and Ti-based alloys. Recently, Among them, the Ti-Zr-Ni QCs are good model to explain the reasons for the formation of the quasicrystals due to the relatively long range order of the coherence length. Although many previous data revealed that the formation of the QCs is very sensitive to the atomic concentration of the Ni, have drawn much attention due to their interesting properties and possibility for a renewable energy storage, but only a few results are reported on their magnetic properties such as superconductivity in quasicrystals dominant Ti-Zr-Ni alloys [1], and magnetism in hydrogenated Ti-Zr-Ni alloys [2]. no clear explanation on the role of Ni for the stability of the QCs phase has been made yet.

We have prepared Ti_{55}-$XZr_{33}Ni_{12}$+X ($0 \leq x \leq 10$) alloys by rapid quenching (1000 rpm) method. The phase purity of the samples were investigated by A pure icosahedral phase was confirmed at $x \geq 5$ by indexing scheme [3] and five-fold symmetry by using XRD and TEM., respectively. We have measuredThe magnetization of these samplesmagnetic properties were measured by using a VSM. Magnetization as a function of temperature was measured in the zero-field-cooling (ZFC) and field-cooling (FC) processmodes. Our results demonstrated that Tthe magnetic phase transition of the quasicrystals madesample with x=517 at. % of Ni appeared between 75 K and 100 K. The samples made with $x \geq 7$higher than 19 at. % of Ni showed a magnetic hysteresis and non-linear initial magnetization curves versus applied magnetic field at room temperature. As decreasing the Ni concentration decreased, hysteresis loops and initial magnetization curves becoame narrower and an initial magnetization patterns tend to linearer, respectively. More detailed results will be presented Our combined results made us to speculate that the stability of the QCs is laregely affected by the ferromagentic property of Ni..

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