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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/Fe₃O₄/MgO NPs, followed by the removal of MgO in the presence of hexadecanethiol (HDT) and oleic acid (OA).

For example, the 7 nm fcc-FePt₄₉ NPs were synthesized according to the published method [1]. MgO was coated on these Fe₅₁P₄₉ 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/Fe₃O₄/MgO NPs and SmCo₅ from Co/Sm₂O₃ 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.

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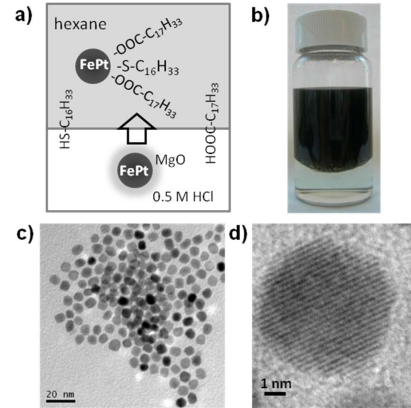


Fig. 1. a) Schematic illustration of FePt NP transfer from 0.5 M HCl aqueous phase to hexane phase; b) the photograph showing the fct-FePt NP transfer from aqueous phase to hexane phase; c) TEM image of the fct-FePt NPs from b); and d) HRTEM image of a single fct-FePt NP.

CC03

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

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The interesting structural property of the quasicrystals (QCs) was first discovered by Schechtman *et al.* QC is characterized by icosahedron structure and exhibit 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 300 of 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 Ti₅₅-XZr₃₃Ni₁₂+X (0 ≤ x ≤ 10) alloys by rapid quenching (1000 rpm) method. The phase purity of the samples were investigated by XRD and TEM., respectively. We have measured the magnetization of these samples magnetic 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) process modes. Our results demonstrated that the magnetic phase transition of the quasicrystals made sample with x=517 at. % of Ni appeared between 75 K and 100 K. The samples made with x ≥ 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 became narrower and an initial magnetization patterns tend to linear, respectively. More detailed results will be presented. Our combined results made us to speculate that the stability of the QCs is largely affected by the ferromagnetic property of Ni.

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