Improved Synthesis and Easy-Axis Alignment of Partially Ordered FePt Nanoparticles

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Abstract

A new procedure of controlled synthesis of partially ordered FePt nanoparticles has been developed. It involves the simultaneous reduction of iron acetate (or iron chloride) and Pt(acac)2. The high boiling point chemical hexadecylamine or trioctylamine was used as a solvent. Oleic acid or 1-adamantanecarboxylic acid was used as a surfactant. The reflux temperature of the mixture solutions ranged from 330°C to 360°C, where disordered FePt particles can be partially transformed into the ordered L1₀ phase. Compared with our previous results, XRD patterns of as-made samples prepared with the new synthesis show obvious L1₀ phase, indicating partial chemical ordering of FePt particles. The room-temperature coercivity of as-made samples ranged from 1 kOe to 4.9 kOe, depending on the particle composition and the refluxing temperature. The remanence ratio parallel and perpendicular to the aligning field direction is about 1.6.

Synthesis of FePt (Sample A)

Pt(acac)₂ (0.35 mmol) + Oleic acid (0.5 mL) + Fe(CH₃COO)₂ (0.5 mmol) + Hexadecylamine (HDA) 10g + 1,2-hexadecandiol (420 mg)

↓ Heat to 80 °C in 30 min.
↓ Quickly Heat to 360 °C @ 10°C/min
↓ Reflux for 3 hours
↓ Cool down to 50 °C
↓ Participate particles
Isolate Particles by Centrifuging

Synthesis of FePt (Sample B)

Pt(acac)₂ (0.5 mmol) + Oleic acid (0.5 mL) + FeCl₂ (1 mmol) + Hexadecylamine (HDA) 10g + 1,2-hexadecandiol (420 mg)

↓ Heat to 80 °C in 30 min.
↓ Quickly Heat to 360 °C @ 10°C/min
↓ Reflux for 3 hours
↓ Cool down to 50 °C
↓ Participate particles
Isolate Particles by Centrifuging

Conclusions

● Partial chemical ordering of FePt nanoparticles was obtained using iron acetate and FeCl₂ in high-boiling-point solvent (~360°C).
● Coercivity of partially ordered FePt ranges from 1 kOe to 4.9 kOe.
● Easy axis alignment was achieved by drying the particles in external magnetic field. However, the remanence ratio is lower than the modeling result.

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