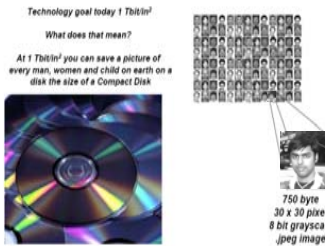
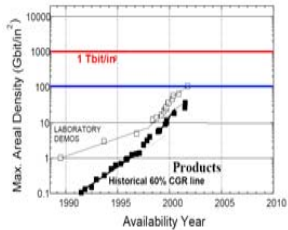


Abstract

Chemically synthesized magnetic nanoparticles have drawn much attention due to the unique magnetic properties derived from small particle sizes and uniform size distribution. FePt hard magnetic nanoparticles are of special interest as they may be used for future ultrahigh-density magnetic recording media and high performance permanent magnetic nanocomposites. The mechanism to synthesize these monodisperse nanoparticles is based on a short burst of nucleation followed by slow controlled growth. The particle sizes and shapes of nanoparticles can be controlled by systematically adjusting the reaction parameters, such as concentrations of surfactant, solvent heating rate and time. These tiny particles are covered with a layer of surfactant and dispersed in non polar solvents. Because of their homogeneous size and monodispersity, they can self assemble on the substrate and make mono and multilayer. The as-synthesized particles have chemically disordered FCC structure and can be transformed into the chemically ordered FCT structure after proper thermal treatments. The FCT structured nanoparticle exhibit very high magnetic properties. Because of their ultra fine size, these magnetic nanoparticles can also be used in various biomedical applications. Although the cost of these nanoparticles is high but their high chemical stability makes them very important for the future technological applications.

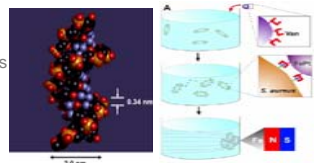
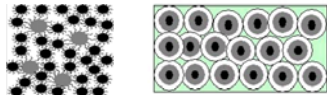
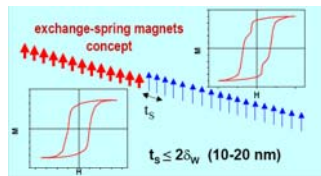
Motivation



Stronger permanent magnets



material requirements: High M_s , high H_c , high $(BH)_{max}$
 nature limits: M_s vs. H_c
 solution: exchange-spring magnets



- Ferrofluids
- Magnetic refrigeration systems
- Enhanced MRI
- Catalysis
- Targeted drug delivery
- Bio separation and detection

Results

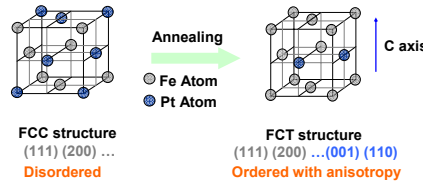


Fig. 1 Structural Transition of FePt

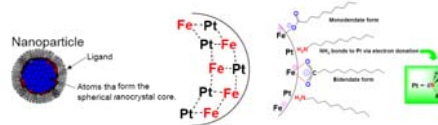


Fig 2 Interesting Chemistry of FePt Nanoparticles

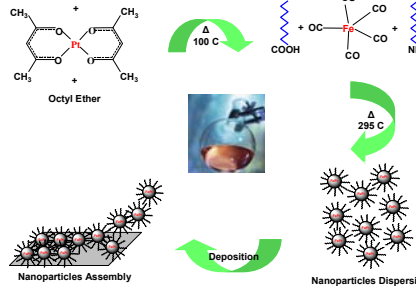


Fig. 3 Schematic showing the chemical synthesis of the FePt nanoparticles.

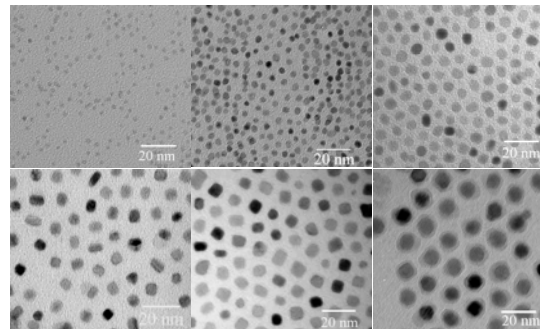


Fig 4 TEM image of 2.4, 6, 7, 8 and 16 nm FePt particles

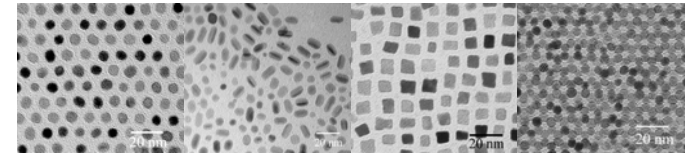


Fig 5 TEM image of as synthesized FePt nanoparticles (a) spherical (b) rod shape (c) cubic (d) multilayers

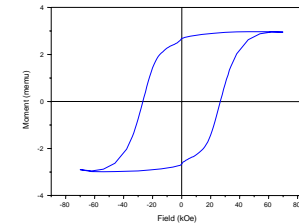


Fig. 6 Magnetic hysteresis loop of nanoparticle assembly

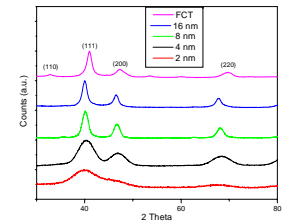


Fig. 7 X ray diffraction patterns of the as-synthesized particles

Conclusions

Monodisperse FePt particles have been successfully synthesized by wet chemical methods. Size and shape of these particles were controlled by adjusting reaction parameters. All the synthesized particles are homogeneous and monodisperse, hence make self assemblies. Some important applications of these particles are following

- Best suited material for future hard disk media due to its very high anisotropy.
- DNA tagging especially with 2 nm particles (almost same diameter as DNA).
- Different size particles to achieve high EP in exchange coupled nanomagnets.
- In various biomedical application because of their superparamagnetic nature.

References

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2. H. Zeng, J. Li, J.P. Liu, Z.L. Wang, S. Sun, *Nature*, **420**, 2002, 395.
3. D. Weller et al. *IEEE. Trans. Magn.*, **36**(1), 2000, 10.

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