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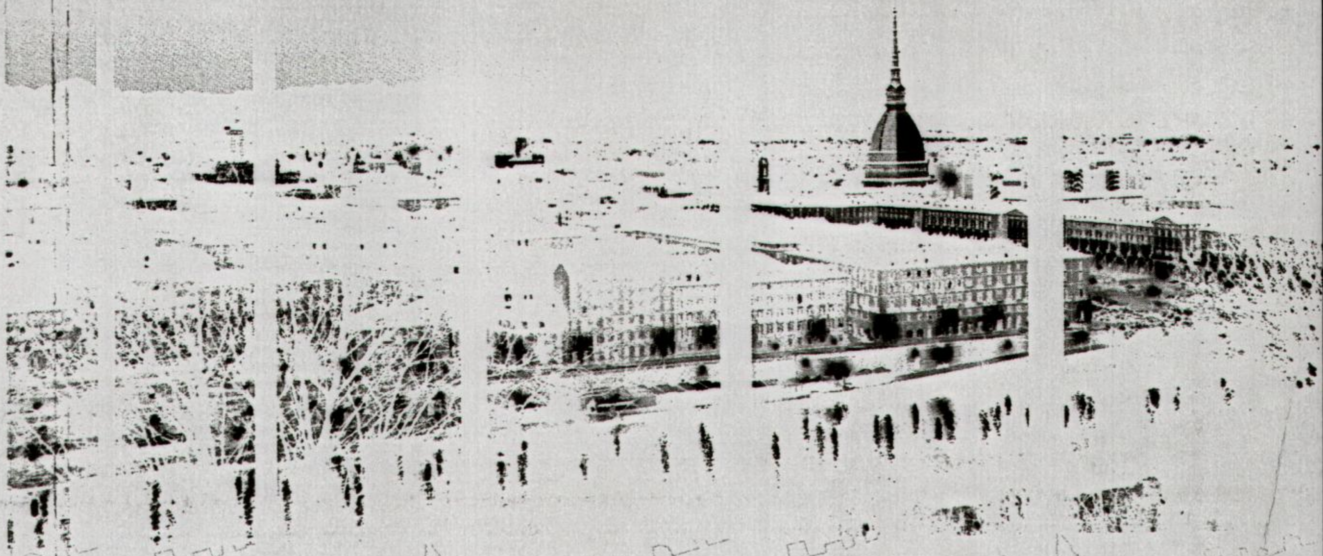

Soft Magnetic Materials 19

Conference Program and Book of Abstracts

Effect of iron-oleate precursor on the magnetic properties of magnetite nanoparticles

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When the size of nanoparticles is below a critical value, their magnetic properties are different from their bulk counterpart. Each nanoparticle becomes a single magnetic domain and shows superparamagnetic behavior when the temperature is above the blocking temperature. These features make superparamagnetic nanoparticles (NPs) very attractive for biomedical applications such as; drug delivery, hyperthermia for cancer treatment, the purification of enzyme and protein, and also magnetic sensors [1]. In this study, monodisperse magnetite NPs were synthesized by thermal decomposition. For this reason, iron-oleate precursor is prepared by the solvothermal synthesis using iron powder and oleic acid at 200°C in hexane. The solvothermal reaction was carried out at a teflon-lined stainless steel autoclave with a capacity of 25 ml and heated to 200°C and kept at that temperature for six hours.

In the first step of the synthesis of superparamagnetic magnetite NPs, the synthesized iron-oleate precursor without purification was aged at the solvent of 1-hexadecene in order to prepare magnetite NPs. The effect of the oleic acid used in solvothermal synthesis on the magnetic properties of the NPs was studied. Vibrating sample magnetometer measurements showed that all NPs are superparamagnetic. Figure 1 shows a typical example of superparamagnetic NPs with zero coercivity and remanence. For this sample, saturation magnetisation of the superparamagnetic NPs is 61 emu/g and magnetic size of NPs was calculated to be around 6 nm by using Langevin function.

In the second part of the study, the iron oleate obtained by solvothermal method was washed with ethanol and acetone to remove free oleic acid. At this time, the purificated precursor was used to produce the magnetite NPs in the same way except the addition of the oleic acid to the 1-hexadecene. In this way, the effect of oleic acid used in boiling process on magnetite NPs have also been studied, and the results were compared with the findings obtained from the unpurificated samples. The percentage of oleic acid on the surface of NPs was determined by thermal gravimetric analysis. Figure 2 shows the spectrum of an iron oleate precursor and magnetit NPs obtained from Fourier Transform Infrared Spectropcopy (FTIR). It is seen that the increase of the oleic acid in the solvent resulted in the decrease of the superparamagnetic nature of the NPs having a small amount of corecivity and remenance as the size of the NPs increased.

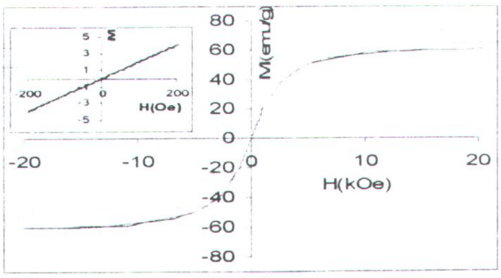

Figure 1: The hysteresis curve of nanoparticles showing superparamagnetism.

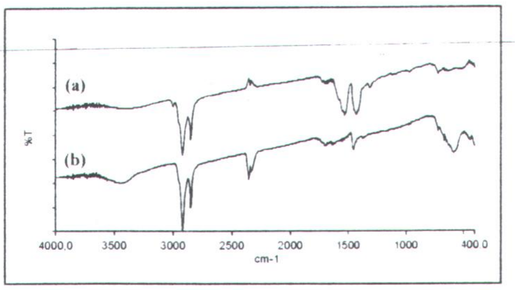

Figure 2: FTIR spectrum of a) iron oleate precursor, and b) magnetic nanoparticles.

[1] An-Hui Lu, E.L.Salabas, and F. Schüth. Angew. Chem.Rev. **46** (2007), 1222-1244.

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