Studies on thermal and magnetic properties of iron oxide nanoparticles for magnetic hyperthermia application

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Abstract

Hyperthermia is an old technique which is recognized as a possible treatment option for cancer.1 Cancer is a severe disease and currently is one of the leading causes of morbidity and mortality in the world, while chemo- and radiotherapy present several side effects due to their lack of specificity to the cancer type and the development of drug resistance.
Iron oxide nanoparticles are having been extensively investigated for several biomedical applications such as hyperthermia and magnetic resonance imaging for cancer treatment. In this context, a work was performed comparing the effect of surfactants on the stability and the heating ability of iron oxide colloids.

Iron oxide nanoparticles were synthetized through chemical precipitation and stabilized using two surfactants: sodium citrate and oleic acid. The as-prepared nanoparticles were characterized by several techniques and their heating ability was evaluated using different sample concentrations and field intensities.

Hysteresis loops measured at temperatures 10 and 315 K for coated iron oxide nanoparticles are shown in Fig. 1. Comparing the effect of sodium citrate and oleic acid it is possible to observe that oleic acid is reducing the magnetic moments at the surface of the nanoparticles probably due to the diamagnetic contribution of the surfactant volume. For higher concentrations of oleic acid it seems to be an increase in the SPA values.
Hyperthermia results (Fig. 2) show a strong reduction on the ILP value when oleic acid is added to the colloids, while for sodium citrate this reduction is not so pronounced. However, ILP values are within the literature values for commercial iron oxide nanoparticles.

These results show oleic acid has a more severe effect on the magnetic properties and heating ability of the nanoparticles. This effect is probably due to the surfactant viscosity and the size of the molecule that is higher than sodium citrate.

References

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Figures

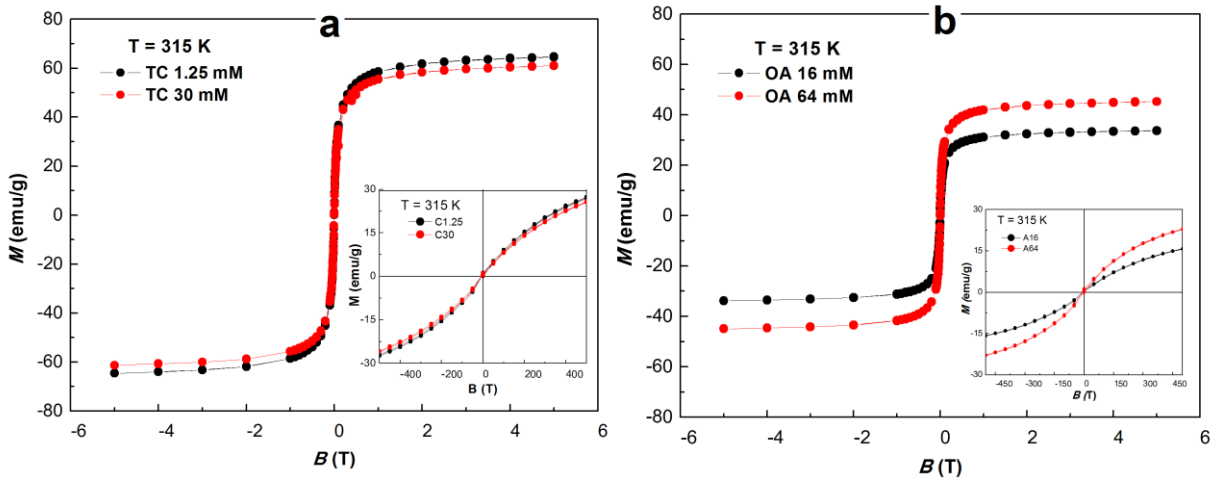

Figure 1 - Magnetization vs. applied magnetic field for Iron oxide nanoparticles coated with sodium citrate (a) and oleic acid (b).

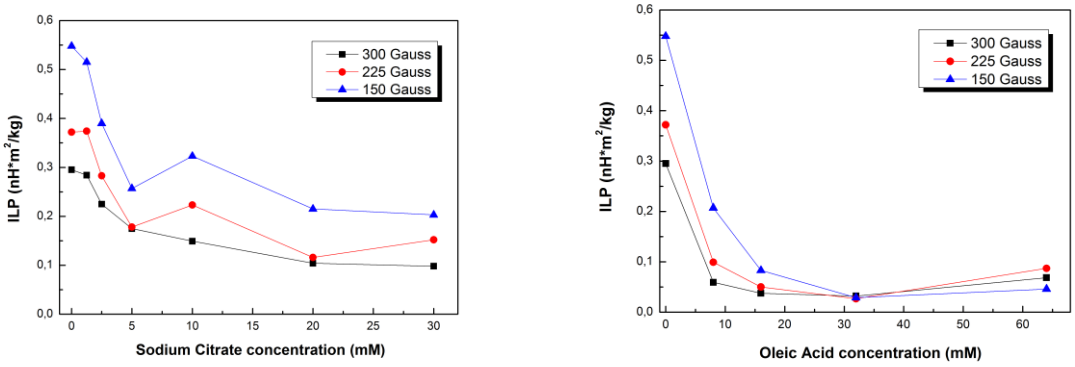

Figure 2 – Intrinsic loss power (ILP) vs. Surfactant concentration (left image – sodium citrate, Right image – Oleic acid) for three field intensities with a frequency of 418.5 kHz.