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Synthesis and characterization of fluid magnetic nano-graphite

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Abstract – In the recent years, the scientific community has been strongly interested in the Physics and applications of carbon-based materials like fullerenes, graphite and diamond. The main reasons for that are the excellent basic properties and, mainly, the large applicability of carbon in new devices. In this work we report the physical properties of fluid magnetic carbon, a typical carbon-based material, with interesting magnetic properties that remain stable even at room temperatures. This new material, which is similar to the so-called ferrofluid (FF), has an enormous advantage when compared to FF: it is 100% organic, and most probably, biocompatible. If so, it will allow applications on drug delivering, medical devices, contrasts for medical imaging, among other novel applications. Also, in this work we show the synthesis of magnetic graphite (MG) as a precursor of the fluid magnetic nano-graphite (FMNG). The results show good magnetization properties of MG that were conserved in the new material, FMNG.

In the last decade, scientists have shown a strong interest in carbon-based materials, like fullerenes, graphite and diamond, due to their excellent properties and, mainly, due to their large applicability on new devices. The fluid magnetic carbon is a typical carbon-based material, with interesting magnetic properties, mainly at room temperatures, that allows its applicability to obtain different devices in areas like engineering, medicine and pharmacy. In this work we show the structural and physical properties on both magnetic graphite (MG) and fluid magnetic nano-graphite (FMNG). The last one was obtained from MG powders through the addition of a surfactant, resulting on the stabilization of the FMNG phase. The MG was obtained from the redox controlled vapor reaction of the conventional synthetic graphite (from FLUKA) by using CuO, as reported by some of us in the literature [1]. The magnetic properties of the FMNG were studied by magnetization measurements as a function of the temperature. These results show that both peaks observed in MG (at T_c = 125 and 250 K) remain even in FMNG as shown in Figure 1. The magnetic hysteresis loops, at 15 and 150K, reveal the typical ferromagnetic behavior of the FMNG. From the diffuse reflectance technique obtained by using infrared spectroscopy (DRIFT) it has been possible to understand how the surfactant (CTAB) is bonded on the MG surface, as shown in Figure 2. Also, from the transmission electronic microscopy (SEM) it was possible to see the formation of agglomerates. However, MG primary structure was kept, even after the surfactant addition. These novel results on MNGF show new perspectives of its application in medicine, biotechnology and engineering, mainly due to its biocompatibility.

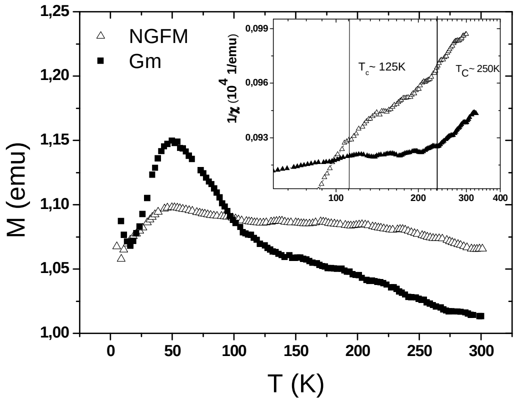

Figure 1. Magnetization as a function of temperature for two different chemical etching, showing the Curie Temperature at *T ≈ 125 e 250 K.* The inset shows the 1/χ *vs*. temperature.

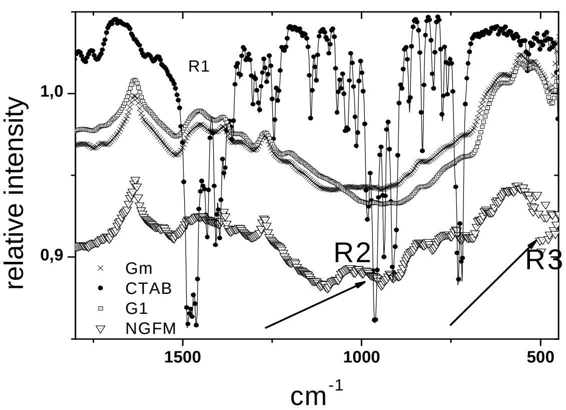

***Figure 2. DRIFT of MG**, CTAB, G1 e MNGF. The arrows show the influence of the surfactant on the MG surface.*

References

[1]- A. W. Mombrú, H. Pardo, R. Faccio, O. F. de Lima, A. J. C. Lanfredi, C. A.Cardoso, E. R. Leite, G. Zanelatto and F. M. Araújo-Moreira; *Phys. Rev. B* **71**, 10, 404 (Rapid Comm.) (2005).