Carbon-encapsulated iron carbide nanoparticles in the thermal conversions of ferrocene at high pressures

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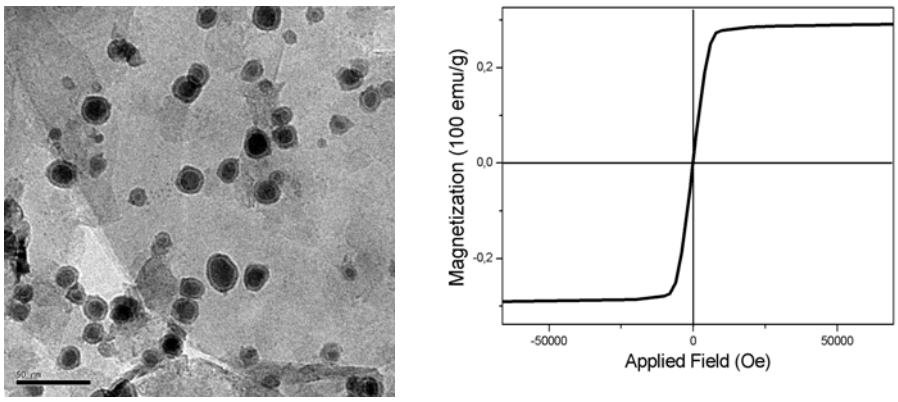
Pressure-temperature-induced transformation of ferrocene at pressures up to 8 GPa and temperatures up to 1000°C have been studied by X-ray diffraction, transmission (TEM) and high resolution transmission electron microscopies (HRTEM). As a result, an evolution of products of high-pressure high-temperature treatment of ferrocene as function of temperature at 2.5 and 8.0 GPa has been investigated. It was shown that a thermal conversions of ferrocene under high pressures can give rise to the formation of carbon-encapsulated iron carbide (Fe_3C) nanoparticles with diameter from 5 nm to 30 nm. The Fe_3C nanoparticles were uniformly dispersed in carbon matrix and contain Fe_3C nuclei surrounded by several carbon layers (onions –like) with well ordered arrangement (Fig.1a).



a) **b)**

Figure 1. (**a**) TEM image and (**b**) field dependence of magnetization of iron carbide nanoparticles synthesized from ferrocene at 80 kbar and 500°C.

Magnetic measurements indicated that these nanoparticles were ferromagnetic at the room temperature, with some variation in the values of saturation magnetization, remanences and coercive forces that depend on the size of the particles. A superparamagnetic-like behaviour at room temperature was observed for the carbon-encapsulated Fe_3C particles which belong to the smallest sized fraction of this material (Fig.1b).

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