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The Synthesis of Core-Shell Iron@Gold Nanoparticles and Their Characterization

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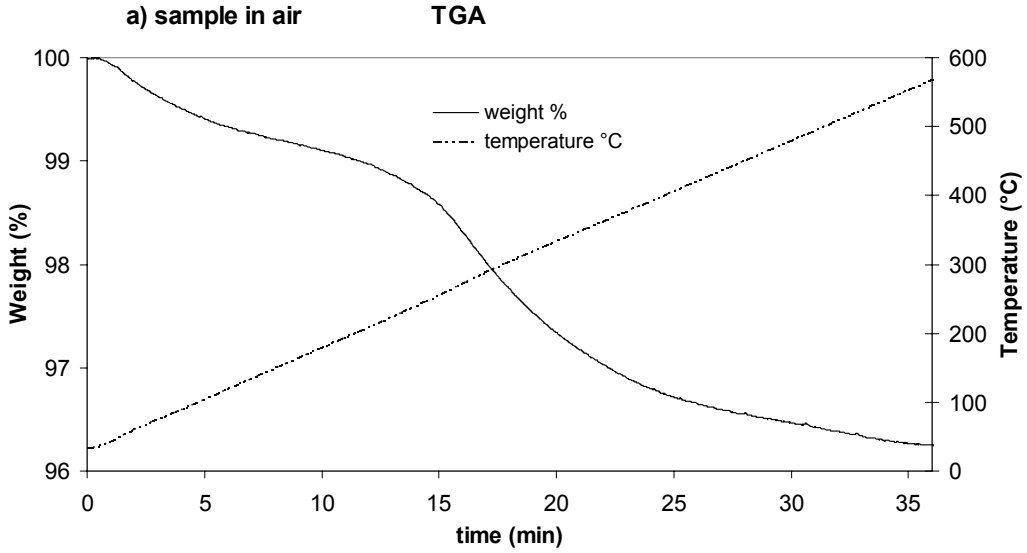
The characterization of the core-shell structure of the sample can be studied by TGA measurements in different atmospheres. The TGA curves of the obtained sample in air (a) and 8% H_2 in argon (b) atmospheres are shown in Fig. 1. In air atmosphere, one can only see the weight loss that is due to the decomposition of organic ligands in the sample. A similar TGA curve was obtained in hydrogen atmosphere. There is also only weight loss. However, one can notice that, in the case of air atmosphere, the weight loss is a little bit smaller than it is in hydrogen. This difference is probably due to the fact that some iron nanoparticles in the as-synthesized sample were coated with both gold and organic ligands instead of being completely coated with only gold. During the measurement of TGA in air atmosphere, the organics were decomposed, and the inside iron was oxidized (i.e., weight gain), which diminishes the absolute value of weight loss in air atmosphere.



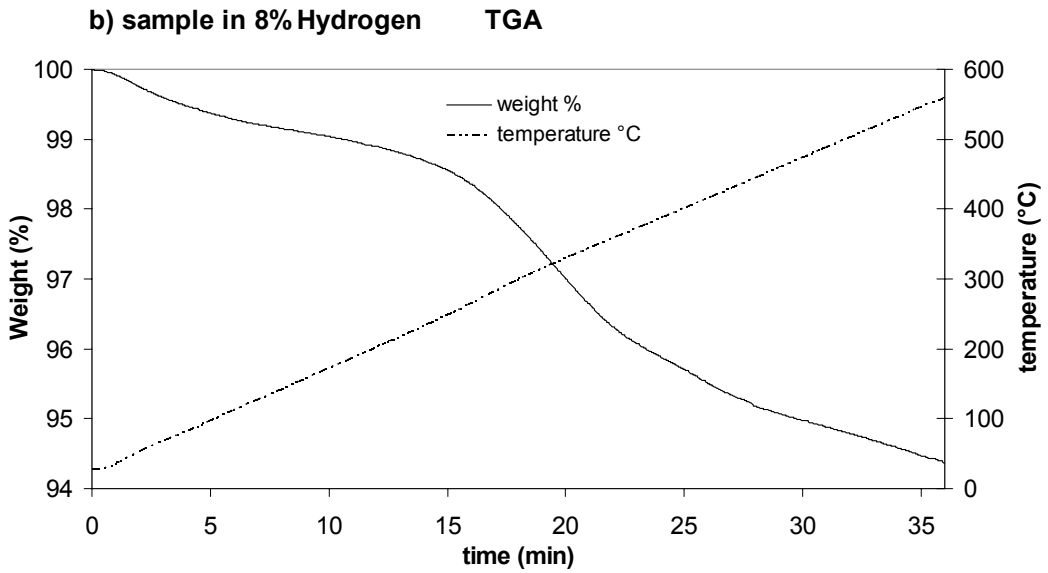


Fig. 1 TGA of Fe@Au (a) in air; (b) in 8% hydrogen in argon.

The Fe@Au core-shell nanoparticles are ferromagnetic at room temperature. The hysteresis loop measured at room temperature was shown in Fig. 2. The core-shell particles have coercivity (H_c) of 25 Oe. The magnetic saturation is 45 emu/g. By calculation of the composition from EDS and TGA data, one can estimate the value of the magnetic saturation, which is equal to 170 emu/gFe. Bulk iron has a large magnetic saturation of 216 emu/g. However, magnetic saturation of iron powders is 60-70% of that of pure iron, which is 130-151 emu/g.[1] The value that is obtained is a little higher than the value reported for iron powder. This may correspond to better crystallinity of the Fe core, as well as well passivation of its core by the gold shell. It should be mentioned that iron oxides (Fe_3O_4, γ-Fe_2O_3) are superparamagnetic in this size range, and can have a maximum magnetic saturation about 100 emu/g.

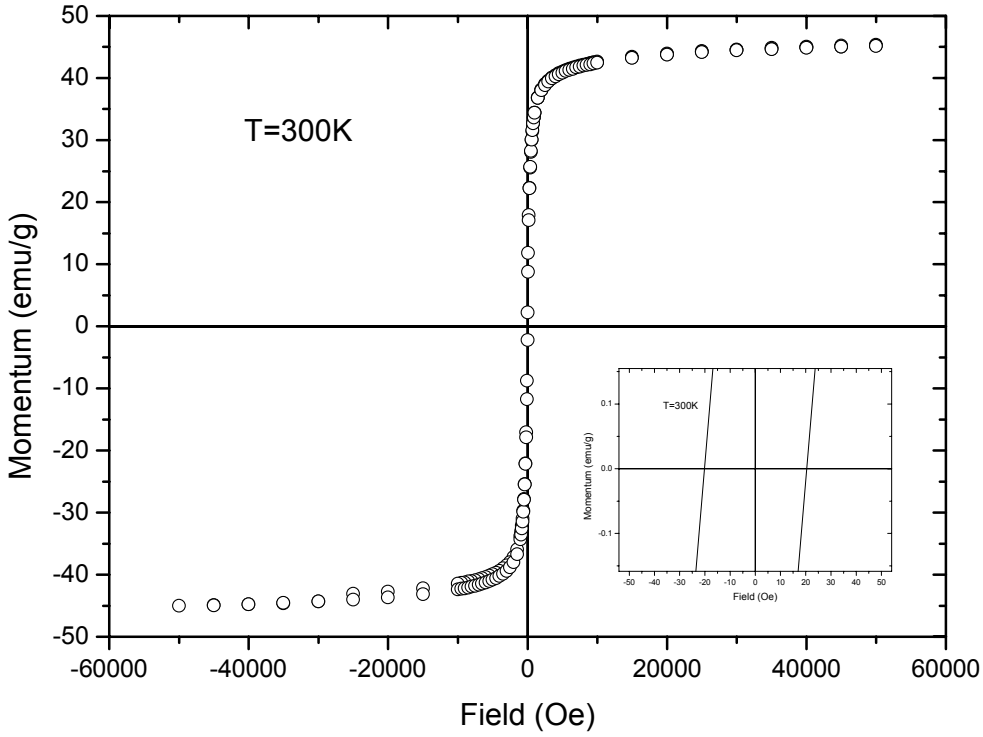


Fig. 2 Magnetic hysteresis loop at room temperature for Fe@Au core-shell nanoparticles after being washed with 8% hydrochloric acid

References

1. Asada, S. *Nippon Kagaku Kaishi*, **1984,** 1372.