To Synthesize and Analyze the Magnetic Iron/Manganese Nanoparticles

Sue-Bin Hsu (許書斌), Chih-Hao Lee (李志浩),
Tzu-Wen Huang (黃子文), and Yen-Fa Liao (廖彥發)

Department of Engineering and System Science, National Tsing Hua University, Hsinchu, Taiwan

In the study, we synthesized the iron oxide and iron/manganese oxide nanoparticles by chemical procedure. 1 mM of $Fe(acac)_3$, 5 mM of 1,2-hexadecanediol, 0.3 mM of oleic acid, and 0.3 of mM oleylamine were mixed in 10 ml of phenyl ether in reaction block under a flow of nitrogen. The mixture was heated to 200 for 30 min and then heated to 265 degree C for another 30 min under reflux system. The black nanoparticles would be precipitated after adding the ethanol in. Final, the nanoparticles were dispersed in hexane after centrifuged and washed. If part of the $Fe(acac)_3$ was substituted by $Mn(acac)_2$, iron/manganese oxide nanoparticles can be obtained. By changing the amount the surfactant and adding the seed particles in, we synthesized the nanoparticles from 4 to 25 nm.

The iron oxide nanoparticles were analyzed by XRD, VSM, and X-ray absorption spectroscopy. We demonstrated the structure of the iron oxide is 60 % Fe_3O_4 and 40 % γ-Fe_2O_3 by the Fe L-edge absorption spectra (see Fig. 1).

After adding the manganese precursor, the XRD peaks shift to lower q, which indicates that the $MnFe_2O_4$ structure might be appeared. From the M-H loop measurement, we can see the saturation magnetization increases with the compostion of Mn, and the center of M-H loops of the iron/manganese nanoparticles shift up to 50 Oe. We speculate that it is a core/shell structure judged from the Mn L-edge (Fig. 2), O K-edge absorption spectra and an exchange bias effect were occurred at the core/shell interface.

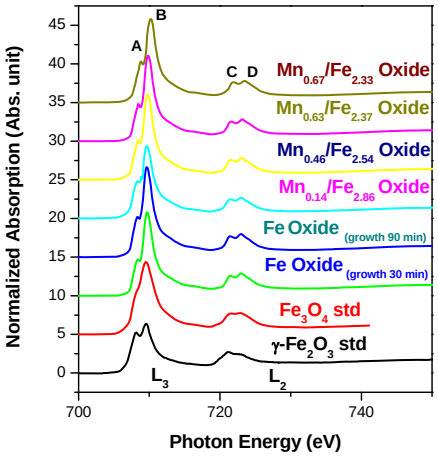

Figure 1. The Fe L-edge absorption spectra.

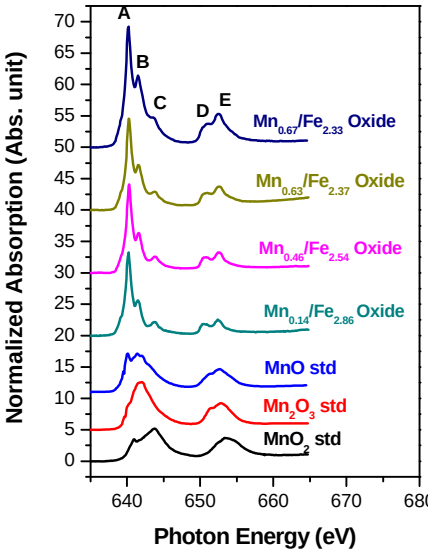

Figure 2. The Mn L-edge absorption spectra