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Studies on the magnetic Properties of $\text{Fe}_3\text{O}_4@\text{SiO}_2$ Core-shell Microspheres

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Magnetic microspheres consisting of $\text{Fe}_3\text{O}_4@\text{SiO}_2$ have attracted attention as Bio/Medical application for its low coercivity, high saturation magnetization, and chemically stabilization. Microstructures of $\text{Fe}_3\text{O}_4@\text{SiO}_2$ spheres were prepared according to the previously reported method [1]. Crystal structure of Fe_3O_4 core is determined to be a cubic structure with space group of $Fd-3mZ$. $\text{Fe}_3\text{O}_4@\text{SiO}_2$ core-shell structures were confirmed by TEM as shown in Fig. 1. The magnetization measurements were carried out using VSM. According to the analysis of M-H curves at room temperature (RT), the saturation magnetization of Fe_3O_4 and $\text{Fe}_3\text{O}_4@\text{SiO}_2$ microspheres are determined to be 77.0 and 17.0 emu/g, respectively. In order to analysis of the local hyperfine interactions in Fe ions, we obtained ^{57}Fe Mössbauer spectra at RT. The Mössbauer spectra for the samples were composed of two six-line hyperfine patterns. The hyperfine fields obtained from Mössbauer spectra of Fe_3O_4 are $H_{\text{hf}} = 488$ and 457 kOe, and $\text{Fe}_3\text{O}_4@\text{SiO}_2$ spheres are $H_{\text{hf}} = 487$ and 449 kOe. The fitted data apparently verified that the prepared Fe_3O_4 and $\text{Fe}_3\text{O}_4@\text{SiO}_2$ samples have magnetite $[\text{Fe}^{3+}]_{\text{A}}[\text{Fe}^{2+}\text{Fe}^{3+}]_{\text{B}}\text{O}_4$. It is noticeable that the Mössbauer absorption area ratio between 16d and 8a site of the $\text{Fe}_3\text{O}_4@\text{SiO}_2$ shows enormous change compare with that of Fe_3O_4 , as shown in Fig. 2.

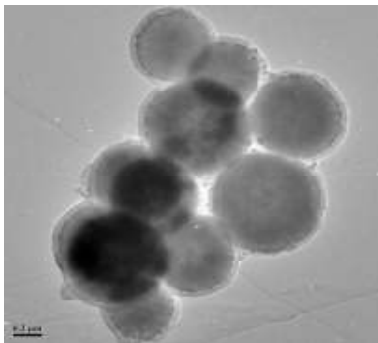


Fig. 1 TEM images of $\text{Fe}_3\text{O}_4@\text{SiO}_2$ microspheres.

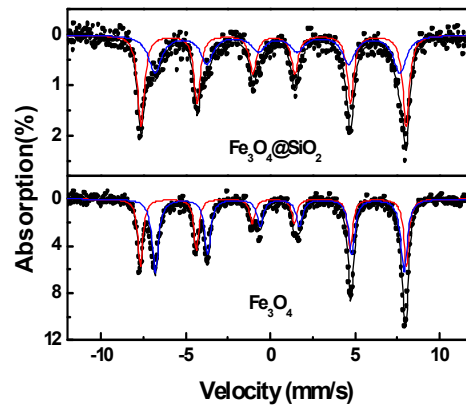


Fig.2 Mössbauer spectra of Fe_3O_4 and $\text{Fe}_3\text{O}_4@\text{SiO}_2$ microspheres at RT.

Reference

1. Xu, X. Q.; Deng, C. H.; Gao, M. X.; Yu, W. J.; Yang, P. Y.; Zhang, X. M. *Adv.Mater.* **18**, 3289 (2006).