GW-13

Morphology-controlled growth of magnetic iron oxide components on gold nanoparticles as bi-functional agents.

L. LI[1], C. LEUNG[1], A. RUOTOLO[2], C. JIANG[1], P. PONG[1]

1. Department of Electrical and Electronic Engineering, The University of Hong Kong, Hong Kong; 2. Department of Physics and Materials Science, City University of Hong Kong, Hong Kong

Hybrid nanostructure can inherit the physiochemical properties of its individual components to realize its multi-functionality. The coupling of plasmonic effect of gold nanoparticles with magnetic properties of iron oxide nanoparticles has shown great promise as bi-functional agents allowing simultaneous magnetic resonance imaging (MRI)/ computed tomography (CT) imaging and magnetic/photonic thermal therapy.[1, 2] However, since gold and iron oxide are two dissimilar materials, the precise morphology and structure control for the hybrid nanostructure remains a great challenge, and there are few published studies on the correlation between composites morphologies and the optical/magnetic properties. In this work, we aim to fabricate gold/iron oxide hybrid nanostructures using less toxic precursors, control the morphology growth of iron oxide component on gold nanoparticles surface, and study the effects on optical and magnetic properties of final products. Here, nearly monodisperse gold/iron oxide hybrid nanoparticles were fabricated through thermal decomposition method. (Fig. 1a-1f) Spherical gold nanoparticles were pre-synthesized and used as seeds for the reduction of iron precursor to produce hybrid nanostructures. Various morphologies of iron oxide grown on the gold nanospheres surfaces were realized, including nano-shell, nano-octahedron, nano-flower, and dumbbell-shaped end. (Fig. 1c-1f) Pure gold nanospheres and iron oxide nanospheres were synthesized for comparison. The morphology and structure of obtained products were characterized by using TEM, EDX, electron diffraction pattern, and SEM. Their optical and magnetic properties were studied using UV-Vis spectroscopy and VSM. The plasmonic property of gold nanoparticles was shown to be affected by the optical index of its environment, and its absorbance peak was right-shifted after iron oxide shell coating. (Fig. 2a) The gold/iron oxide dumbbell-shaped nanostructures displayed typical superparamagnetic behavior with no coercivity (Fig. 2b), while the coercivity of gold/iron oxide nano-octahedron was about 45 Oe (inset in Fig. 2b). The morphology-related blocking temperatures of the gold/iron oxide nano-structured samples were also studied through their ZFC/FC curves.

[1] K. C.-F. Leung, S. Xuan, X. Zhu, D. Wang, C.-P. Chak, S.-F. Lee*, et al.*, "Gold and iron oxide hybrid nanocomposite materials," *Chemical Society Reviews,* vol. 41, pp. 1911-1928, 2012.

[2] C. Hoskins, Y. Min, M. Gueorguieva, C. McDougall, A. Volovick, P. Prentice*, et al.*, "Hybrid gold-iron oxide nanoparticles as a multifunctional platform for biomedical application," *J. Nanobiotechnol,* vol. 10, p. 27, 2012.

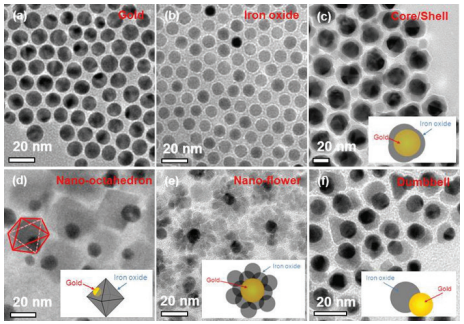

Figure 1. TEM images of (a) gold nanoparticles, (b) iron oxide nanoparticles, (c) gold/iron oxide core/shell nanoparticles, (d) gold/iron oxide nano-octahedrons, (e) gold/iron oxide nano-flowers, and (f) gold/iron oxide dumbbell-shaped nanoparticles. Insets in Fig. 1c-1f are the illustrations of corresponding nanostructures.

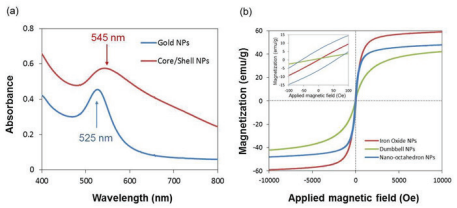

Figure 2. Preliminary results for the optical and magnetic properties of gold/iron oxide hybrid nanostructures. (a) UV-Vis spectrum of gold nanoparticles and gold/iron oxide core/shell nanoparticles. (b) Full view of magnetization curves of iron oxide nanoparticles, gold/iron oxide dumbbell-shaped nanoparticles, and gold/iron oxide nano-octahedrons. Inset in Fig. 1b, magnified views of the magnetization curves in the low magnetic field.