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Multifunctional Magnetic-luminescent CoPt-CdSe Core-shell Nano-particles

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Smart nanoparticles comprising cores and shells offer exciting opportunities in fundamental studies and technological applications, owing to their unique spatial arrangement, multiple functionalities and enhanced properties in comparison to those of their single-component counterparts [1]. In spite of the fact that comprehensive studies have been conducted to assemble core-shell nanoparticles through sequential reduction methods, genuine multifunctional samples remain scarce. We synthesized CoPt-CdSe multifunctional magnetic-luminescent core-shell nanoparticles, which incorporate the luminescent properties of CdSe nanoparticles and the magnetic properties of the CoPt into single entities. The CoPt core nanoparticles were prepared first by polyol reduction of Co and Pt precursors and then the CdSe shell was coated by reduction of Cd and Se precursors onto the surface of the preformed nanoparticles at high temperature. It is found that the fusion of the two materials into a core-shell nanostructure retains the luminescentand magnetic properties of the respective components. Fig. 1(a) is the XRD diffraction pattern of the nanoparticles, assigned to the cubic phase of the CdSe shell which substantiates the core-shell nanostructure, while the morphology from the TEM image indicates a tight particle size distribution. The magnetic measurement reveals that the core-shell nanoparticles are superparamagnetic at room temperature, whereas the photoluminescent properties were demonstrated in Fig. 1(b), showing the bandgap and surface-related emissions.

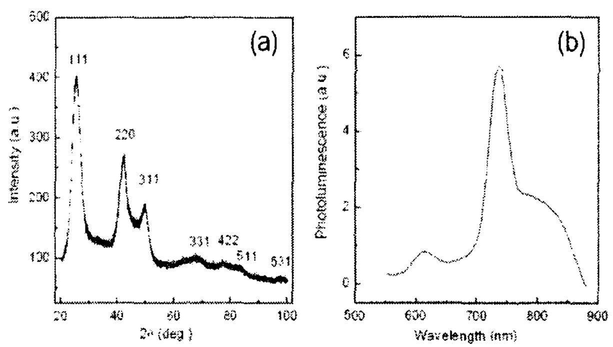

Fig. 1. Structure and optical properties of the CoPt-CdSe core-shell nanoparticles. (a) XRD pattern, and (b) Photoluminescent spectrum.

This work was supported by the Korea Research Foundation grants KRF-2004-005-D00057 and KRF-2005-210-D00023, by grant A050750 of the Korea Health 21 R & D Project, Ministry of Health & Welfare, and by grant M10500000105-05J0000-10510 from the National Research Laboratory Program of the Korea Science and Engineering Foundation.

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Electron-spin-resonance Study on the Size Effect of $La_{0.7}Sr_{0.3}MnO_3$ Nanoparticles

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One of the interesting phenomena in perovskite manganites $R_{1-x}A_xMnO_3$ (where R denotes the rare-earth ion and A is a divalent ion) is the electronic phase separation (PS). The PS state is recognized as a driving mechanism for the colossal magnetoresistance (CMR) in doped manganites. According to the previous reports, the intrinsic local chemical/structural inhomogeneities in CMR manganites may provoke the coexistence of magnetically ordered regions of different type and be the nucleation centers for the PS state. Furthermore, the ratio of different separated phases can be significantly affected by the grain size, thus the study of size effect on the CMR nanoparticles is important to provide the detailed magnetic structures of CMR nanoparticles for the future development of nanotechnology. In this work, the $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) nanoparticles are prepared by sol-gel method at various sintering temperatures to control the grain sizes. Since the spectrum of electron spin resonance (ESR) is sensitive to both minute magnetic phase and short-range interaction, ESR is an ideal probe for investigating the magnetic state of magnetic nanoparticles. Our ESR results reveal that the LSMO samples with the grain size larger than 25 nm have two magnetic states below the Curie temperatures And, the samples with different grain sizes show different magnetic properties in term of the ratio of phase 1 (P1) and phase 2 (P2). Figure 1 is the plot of the temperature dependent ratio of P1 vs. P2 for samples with grain size larger than 25 nm. The ratio above 350 K is defined as 1.00 to denote a pure phase at paramagnetic (PM) state. Figure 1 shows that the sample with a size of 47 nm has a shaper transition than that of 27 nm, and with a ratio close to 60 % (P1) to 40% (P2) at low temperatures. The possible magnetic states representing P1 and P2 will be discussed.

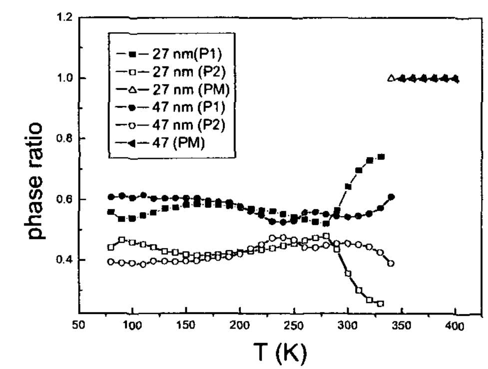

Fig. 1. Ratio of phase 1 vs. phase 2 for LSMO samples with sizes of 27 and 47 nm.

*The authors acknowledge the financial support from the National Science Council of R. O. C. under Grant No. NSC95-2120-M-002-002 and 95-2752-M-002-006-PAE.