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Synthesis of Monodisperse Magnetic Nanoparticles and Uniform-sized magnetic Nanorods

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Uniform sized magnetic metal and metal oxide nanocrystals have received much attention because it is expected that they are promising materials for realizing functional building blocks in fabricating nanoscale electronic, magnetic, and optical devices [1]. The ultra-large-scale synthesis of monodisperse nanocrystals was achieved through very simple, inexpensive and environmentally-friendly routes. We synthesized 40 grams of monodisperse magnetite nanocrystals in a single reaction using a 500 mL-sized reactor, without going through a size selection process, which is important for large scale production. Figure 1 shows the normal and high resolution transmission electron microscopic (TEM) images of mass productive iron oxide nanocrystals. The high resolution TEM image demonstrates the highly crystalline nature and monodispersity of iron oxide nanocrystals.

Moreover, the particle size of the nanocrystals was able to be controlled simply by varying the experimental conditions. The current synthetic procedure is a very general method, and has been successfully used to produce the nanocrystals of many transition metal oxides, including MnO, CoO, $MnFe_2O_4$, and $CoFe_2O_4$.

In a continuation of our research on the synthesis of monodisperse nanoparticles, herein we report on the direct synthesis of monodisperse iron nanoparticles from the thermal decomposition of iron-surfactant complexes [2]. By controlling the nucleation and growth processes, we were able to synthesize monodisperse iron nanoparticles with particle sizes of 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 16 nm. The subsequent oxidation of these nanoparticles using a mild chemical oxidant produced monodisperse maghemite nanoparticles. In the current synthesis, no size-selection process is involved, and monodisperse nanoparticles were obtained directly from a single reaction.

The diameter-controlled synthesis of iron phosphide nanorods and nanowires will be also presented [3]. Thermal decomposition of iron-surfactant complexes in the presence of suitable phosphine surfactants produced iron phosphide nanorods with uniform diameters as shown in Figure 2. The high resolution TEM image revealed that the growth of nanorods along the *c*-axis occurred.

Acknolwledgements

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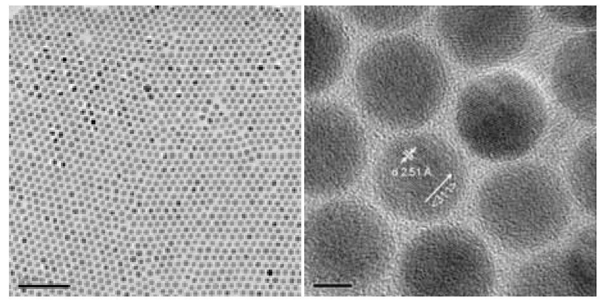

Figure 1. The normal and high resolution TEM images of mass productive iron oxide nanoparticles.

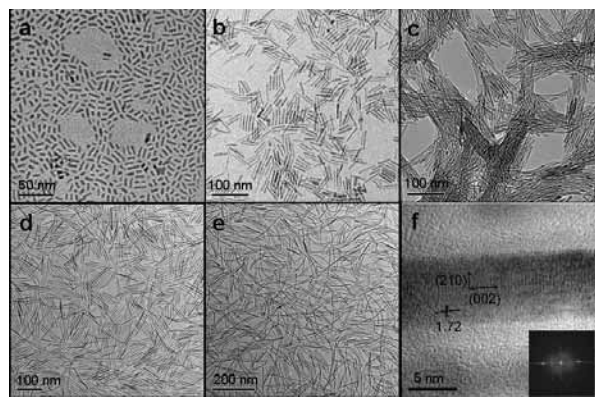

Figure 2. TEM images of iron phosphide nanorods (a) 3 nm × 13 nm, short injection, and (b) 5 nm × 43 nm, double injection, and nanowire (c) 5 nm × 88 nm, flow rate 10 mL/h, (d) 6 nm × 107 nm, flow rate 5 mL/h, and (e) 6 nm × 290 nm, flow rate 3 mL/h using syringe pump, and (f) HRTEM image of single iron phosphide nanowires. Inset is FFT pattern of iron phosphide nanowires lattice image.