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Understanding the role of EGBE solvent in the thermal decompositon of iron-oleate: From low to high oleic acid concentration

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Superparamagnetic iron oxide nanoparticles have received much attention due to their broad applications including biomolecule tagging, imaging, sensing and separation as well as targeted drug and gene delivery [1-3]. In this work, they were synthesized by thermal decomposition of iron oleate using triethylene glycol monobutyl ether (EGBE) as a novel solvent at 280 °C. During the study, the oleic acid amount was varied from 0.4 ml to 2.2 ml to be able to understand interactions between EGBE and oleic acid. In order to investigate the sizes and shapes of the synthesized nanoparticles, high resolution electron microscopy (HRTEM) was used and it was found that the particles size increased from 9.2 nm to 11.4 nm with the increase of oleic acid amount. In addition it was observed that the particle size distribution became broader and the particle shape changed from spherical to quasi-cubic in the micrographs. The crystal structure of nanoparticles which was analysized by x-ray diffraction method showed the composition of magnetite or maghemite. The size analysis, called crystal size, also was calculated by Scherer equation using XRD data. The increase of particle size was confirmed by XRD, however the particles sizes were found smaller than the ones obtained from HRTEM because of oleic acid layer the surrounding nanoparticles. Magnetic measurements by vibrating sample magnetometer showed the iron oxide nanoparticles are superparamagnetic with zero coercivity and have saturation magnetisation decreasing from 65 emu/g to 31 emu/g at high concentration of oleic acid. Infrared spectrum revealed that the characteristic band of EGBE at 1116 cm^{-1}(-R-O-R) was present on iron oxide nanoparticles indicating the binding of EGBE to iron oxide nanoparticles due to esterification reaction with oleic acid. Thus the coating percentage of oleic acid, which affects surface magnetism, on surface of nanoparticles was found highly low by thermal gravimetric analysis. Consequently, EGBE solvent provides that the nanoparticles have fine magnetic properties.

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