Crystal -growth kinetics of magnetite (fe3o4) nanoparticles using the ostwald ripening model

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Abstrak

Magnetite nanoparticles (Fe_3O_4) are a type of magnetic particle with huge potential for application as a drug carrier due to their excellent superparamagnetic, biocompatible, and easily modified surface properties. One characteristic of nanoparticles is that they can be controlled by studying the evolution of crystal growth. The purpose of this research is to study the evolution of magnetite-crystal growth and determine the crystal growth kinetics using the Ostwald ripening model. Magnetite nanoparticles were synthesized from $FeCl_3$, citrate, urea, and polyethylene glycol using the hydrothermal method at 220oC for times ranging from 1–12 hours. The characterizations using X-ray diffraction (XRD) indicated that the magnetite began to form after 3 hours synthesis. The crystallinity and crystal size of the magnetite increased with the reaction time. The diameter size of the magnetite crystals was in the range of 10–29 nm. The characterizations using a transmission electron microscope (TEM) showed that magnetite nanoparticles had a relatively uniform size and were not agglomerated. The core-shell nanoparticles were obtained after 3 hours synthesis and had a diameter of 60 nm, whereas the irregular-shaped nanoparticles were obtained in 12 hours and had a diameter of 50 nm. The characterizations using a vibrating sample magnetometer (VSM) revealed that magnetite nanoparticles have superparamagnetic properties. The magnetization saturation (Ms) value was proportional to the degree of crystallinity. The magnetite-crystal growth data can be fitted to an Ostwald ripening model with the growth controlled by the dissolution of the surface reaction (n?4).