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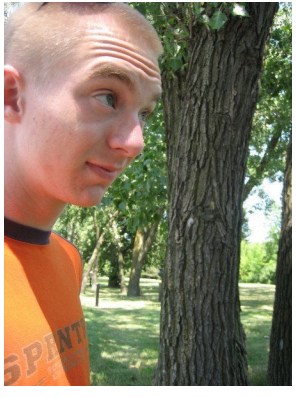
Oriented Aggregation of Iron Oxide Nanoparticles

Iron oxide nanoparticles are commonly found on or near the surface of the Earth and play a key role in many environmental and industrial processes such as water treatment and magnetic recording. Oriented aggregation is a nonclassical crystal growth mechanism by which a variety of these nanocrystalline materials often grow. The oriented aggregation mechanism follows a second order rate law with respect to the concentration of primary particles. This mechanism involves the self-assembly of primary nanocrystals into larger nanocrystals in patterns specific to the material and offers the potential for controlling morphology. This research involves the quantization of iron oxide nanoparticle growth under various conditions by counting particles imaged using a transmission electron microscope. The particle counts are then converted to particle concentrations, and the rate constant for growth by oriented aggregation can be determined by calculating the drop in particle concentration with respect to time. Results indicate that iron oxide nanocrystalline growth under varying pH is consistent with the oriented aggregation mechanism. Furthermore, the effect of pH on nanocrystalline growth is independent of the precursor particle size. Secondly, growth by oriented aggregation with varying concentrations of a surface-active agent is anticipated to support this mechanism as well. The rate constants will then be compared to those produced by a simulation based on DLVO theory which takes into account electrostatics and van der Waals interactions through a liquid medium.



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