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Synthesis and Growth Mechanism of Ultrathin Iron Oxide Nanowhiskers

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Abstract :

Ultrathin one-dimensional nanostructures have attracted great interest due to their unique physical and chemical properties. Here, we report the synthesis of ultrathin iron oxide nanowhiskers (2 x 20 nm) through a ligand-directed self-assembly method. These ultrathin nanostructures were systematically characterized with a comprehensive set of tools, which includes: thermogravimetric analysis (TGA), transmission electron microscopy (TEM), electron diffraction pattern, Raman spectroscopy, x-ray photoelectron spectroscopy (XPS),alternating gradient magnetometer (AGM), and Fourier transform infrared spectroscopy (FTIR). Based on an understanding of ligand coordination environments of Fe (III) oleate precursor, we propose a ligand-directed growth mechanism for iron oxide nanowhisker formation. Complementarily, this proposed mechanism was supported by our density functional theory (DFT) simulation. The formation of the nanowhiskers provides a unique shape-control example of nanostructures based on a deep understanding of the precursor ligand chemistry, offering additional insights into nanoparticle synthesis. In particular, the effects of the ligand microenvironment present another synthetic strategy for nanoparticle shape control.

References :

1. Palchoudhury, S.; An, W.; Xu, Y. L.; Qin, Y.; Zhang, Z. T.; Chopra, N.; Holler, R. A.; Turner, C. H.; Bao, Y. P., Synthesis and Growth Mechanism of Iron Oxide Nanowhiskers. Nano Letters 2011, 11 (3), 1141-1146.
2. Palchoudhury, S.; Xu, Y. L.; Goodwin, J.; Bao, Y. P., Synthesis of iron oxide nanoworms. Journal of Applied Physics 2011, 109 (7).