Analysis of the Crystalline Structure and Magnetic Properties of Fe Nanoparticles

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We have developed a solution based synthesis for oxide-free, surfactant coated iron nanoparticles. By controlling the parameters of the synthesis, the reaction can produce particles with a diameter anywhere between 2 and 10 nm. These particles are both synthesized and characterized under inert conditions in order to prevent any oxide formation. Through characterization of the nanoparticles using SQUID magnetometry we have shown that they have a saturation magnetization slightly below that of bulk iron and an anisotropy far greater than bulk iron. In an attempt to explain the magnetic behavior of these Fe nanoparticles we have studied them using high energy x-ray diffraction and analyzed the data using the atomic pair distribution function (PDF) technique. The diffraction data shows that our nanoparticles have short correlation lengths (on the order of 2 nm or less), a distorted bcc lattice, and a larger lattice spacing than bulk iron. These observations may begin to explain the magnetic behavior we observe in these nanoparticles. Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Information Page

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We do not plan on publishing in the DXC proceedings because we are preparing a manuscript for journal submission which may contain some of the data covered in this abstract