CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)
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Project Number
S0515

Project Title
Green Preparation and Characterization of Superparamagnetic Iron Oxide Nanocrystals

Abstract

Objectives/Goals

Many of the approaches for synthesizing superparamagnetic iron oxide nanocrystals require complex processes and the use of toxic materials. I selected a co-precipitation method that follows the green chemistry principle (environmentally friendly and economical) to prepare superparamagnetic iron oxide nanocrystals. Polyacrylic acid (PAA) was then used to create a stable ferrofluid.

The particles were characterized by Optical Microscopy, Transmission Electron Microscopy (TEM), X-Ray Diffraction (XRD), and Raman Spectroscopy. Surprisingly, TEM showed the formation of nanorods, in addition to the expected nanocrystals. Therefore, this could be a good method to synthesize superparamagnetic iron oxide nanorods, as well.

The prepared nanocrystals could have potential in environmental and biomedical applications (such as in targeted drug delivery and in magnetic resonance imaging).

Methods/Materials

Solutions of ferric and ferrous chloride reacted in the presence of a base (sodium hydroxide) to form iron oxide nanocrystals. PAA was used as a surfactant to stabilize the particles.

Results

The reaction produced what appeared to be a black solution, which separated from the solution when a magnetic field was applied. After stabilization the black fluid moved along with the magnet, and no clear solution formed at the top of the beaker.

XRD results confirmed that the precipitate that formed was indeed crystalline Fe3O4. Optical microcopy imaging proved the paramagnetism of the sample. TEM studies found the size of the particles to be nanosized, confirmed its crystallinity, and also found some nanorods. Raman Spectroscopy further confirmed the structure of the nanocrystals.

Conclusions/Discussion

Since the precipitate formed was confirmed to be superparamagnetic, nanosized, and crystalline, it proved that this was a successful method of synthesizing superparamagnetic nanocrystals, and possibly nanorods, of Fe3O4, and that they could have potential in environmental and biomedical applications.

Summary Statement

A green co-precipitation method was used to prepare superparamagnetic nanocrystals of Fe3O4, which were then characterized by Optical Microscopy, TEM, XRD, and Raman Spectroscopy.

Help Received

Used lab equipment at the University of Riverside, CA, in the Yin Labs under the supervision of Dr. Yadong Yin and Dr. Jianping Ge.