Curie Temperature Measurements Of Disordered fcc FePt Nanoparticles

Hitesh G. Bagaria1,2, J. W. Harrell1,3, Mohammad Shamsuzzoha1,4, David E. Nikles1,5, Duane T. Johnson1,2

1MINT Center, 2Department of Chemical and Biological Engineering, 3Department of Physics, 4Central Analytical Facility and 5Department of Chemistry, The University of Alabama, Tuscaloosa, AL.

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Abstract

- During Magnetic Fluid Hyperthermia (MFH), a potential therapy for cancer treatment, cancerous tissue is annihilated by the heat generated when magnetic nanoparticles within the cancerous tissue are exposed to an alternating magnetic field.
- Self-regulated MFH uses magnetic nanoparticles with a Curie temperature equal to the therapeutic temperature (typically 45°C). Such particles self-control the temperature within the cancerous tissue.
- Disordered fcc FePt nanoparticles are potential candidates for self-regulated MFH.
- This study describes a method to determine the Curie temperature of FePt nanoparticles.

Characterization of FePt nanoparticles

- Three compositions of FePt particles were synthesized.
- XRD confirmed disordered fcc structure and crystalline size of 3 nm (Scherrer analysis).
- Indicated compositions are from SEM-EDX measurements.
  - The bar on the TEM images is 10 nm.
  - TEM confirms the particle size to be 3 nm.

Langevin Fit of M-H Loop Data

- Single and double Langevin fit of M-H loop data of Fe66Pt34 at 390K
- Double Langevin functions gave very good fit, indicating a bimodal distribution of magnetic moments.

Determination of Curie temperature (Tc)

- Larger fraction of the double Langevin equation, ‘M1’ accounts for most of the moment.
- This fraction was utilized for Tc determination.
- M1 Vs. T1/2 relation was followed to get the Tc.
- Tc of Fe66Pt34 nanoparticles found to be 422K.
- Bulk Fe66Pt34 has a Tc of ~600 K.

Conclusions and Future work

- Curie temperature of superparamagnetic disordered fcc FePt nanoparticles determined by Langevin fit of their M-H Loop.
- Curie temperature of Fe66Pt34 was determined to be 422K.
- Determine Curie temperature of 3 nm FePt nanoparticles of different compositions.
- Determine Curie temperature of FePt nanoparticles of other sizes and get a relation between the size and Curie temperature.

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