Comment on "Thermoinduced magnetization in nanoparticles of antiferromagnetic materials" - Reply

Mørup, Steen; Frandsen, Cathrine

Published in:
Physical Review Letters

Link to article, DOI:
10.1103/PhysRevLett.94.039708

Publication date:
2005

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
Mørup and Frandsen Reply: In their Comment Silva et al. [1] point out that an apparent increase of the magnetic moment of antiferromagnetic nanoparticles with increasing temperature can be explained by the moment distribution. Thus the thermoinduced magnetization, described in our Letter [2], may not be the only reason for the anomalous temperature dependence of the magnetic moment, which has been found in several experimental studies.

The experimental data in earlier studies of the magnetization of antiferromagnetic nanoparticles have in most cases been analyzed with rather simple models like a single Langevin function in combination with a linear term. Therefore, we agree that there may be other contributions to the temperature dependence of the estimated magnetic moments, including effects related to the distribution of magnetic moments as suggested by Silva et al. [1]. The magnetic anisotropy can also give rise to deviations from a simple Langevin behavior [3], and this has also been ignored in most studies. In a detailed analysis it must also be taken into account that the (sublattice) magnetization of nanoparticles decreases with increasing temperature in a way that may differ from the bulk behavior.

In our Letter [2] we proposed a model for thermoinduced magnetization and we fitted data for the temperature dependence of the magnetic moment, obtained in previous experimental studies [4,5], with the model. We found surprisingly good agreement between the data and the theoretical model, without taking into account that there might be contributions to the estimated magnetic moments due to other mechanisms. Thus thermoinduced magnetization can explain the main features of the experimental data. Comparing data for the temperature dependence of magnetic moments, obtained without taking into account the moment distribution, the results are quite similar for ferrihydrite [4], with a broad size distribution, and for ferritin [5] with a narrow size distribution [6]. Although there may not be a simple relationship between particle size and magnetic moment these results suggest that the size distribution is not the main reason for the temperature dependence of the magnetic moments. However, detailed studies of well-characterized samples are needed to clarify the relative importance of the different contributions to the apparent magnetic moment of antiferromagnetic particles.

Steen Mørup and Cathrine Frandsen
Department of Physics
Building 307
Technical University of Denmark
DK-2800 Kgs. Lyngby, Denmark

Received 17 September 2004; published 24 January 2005
DOI: 10.1103/PhysRevLett.94.039708
PACS numbers: 75.50.Ee, 75.75.+a, 76.50.+g