Comment on "Thermoinduced magnetization in nanoparticles of antiferromagnetic materials" - Morup and Frandsen reply

Mørup, Steen; Frandsen, Cathrine

Published in:
Physical Review Letters

Link to article, DOI:
10.1103/PhysRevLett.94.089702

Publication date:
2005

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

Link back to DTU Orbit

Citation (APA):

DTU Library
Technical Information Center of Denmark

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.
- Users may not further distribute the material or use it for any profit-making activity or commercial gain
- Users 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 [1], MacDonald and Canali claim that the magnetization of nanoparticles of antiferromagnetic materials cannot increase with increasing temperature as described in our Letter [2]. They argue that there are two equivalent degenerate spin-precession modes in an antiferromagnet with opposite magnetic moments, and the net magnetic moment therefore is zero.

As we have pointed out [2], the average value of the thermoinduced magnetic moment of an antiferromagnetic particle is zero in the absence of an applied magnetic field. However, MacDonald and Canali seem to have failed to notice that Eq. (4) in our Letter [2] gives an expression for the average of the numerical value of the magnetic moment (which, of course, is identical to the average value of the + mode). Equation (1) in their Comment [1] gives the net magnetic moment in the absence of an applied magnetic field. If a magnetic field is applied, the degeneracy of the + and − modes is lifted and the populations will differ, resulting in a nonzero contribution to the magnetization. For \( S_A = S_B \) one obtains the expression for the initial susceptibility given by Eq. (5) in our Letter.

It has been realized in earlier studies that the uniform mode in bulk antiferromagnetic materials has an associated magnetic moment. If this were not the case one would not be able to excite the uniform mode by an ac field; i.e., this magnetic moment is a prerequisite for antiferromagnetic resonance experiments. In our Letter we point out that the uniform mode, which can be excited by an ac field in bulk antiferromagnetic materials, can be thermally excited in nanoparticles, and in an applied magnetic field it gives rise to the thermoinduced magnetization in the nanoparticles.

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

Received 1 October 2004; published 2 March 2005
DOI: 10.1103/PhysRevLett.94.089702
PACS numbers: 75.50.Ee, 75.75.+a, 76.50.+g