MA 20.87 Mo 14:00 Poster TU C

Jahn−Teller Effect in $CuFe_2O_4$ Nanoparticles — •Balaji Gopalan[1], Jörg Weissmüller[1,2], and Namdeo Gajbhiye[3] — [1]Institute for Nanotechnology, Forschungszentrum Karlsruhe, P. O. Box 3640, D-76021, Germany — [2]Universität des Saarlandes, Fachrichtung Technische Physik, Saarbrücken, P.O. Box 151150, D-66041, Germany — [3]Department of Chemistry, Indian Institute of Technology, Kanpur, 208016 India

Nanosize $CuFe_2O_4$ particles are prepared by coprecipitation method. The particles of various sizes are obtained by heat treatment at temperatures between 573−1273 K and are characterized by X−ray diffraction, Mössbauer spectroscopy and magnetization measurements. X−ray diffraction pattern indicates that the crystal structure of nanosize $CuFe_2O_4$ particles obtained above 973 K is tetragonal while that prepared below 973 K is cubic. The room temperature Mössbauer spectrum indicates that the isomer shift, quadrupole splitting and hyperfine field values are found to change with heat treatment temperature. These changes in Mössbauer parameters may also be due to the Jahn−Teller effect that essentially arises due to the migration of Cu^{2+} ions from tetrahedral sites to octahedral sites resulting in crystal structure change from cubic to tetragonal system. The maximum coercivity obtained has been 700 Oe at heating temperature of 823 K. The enhanced coercive force can be mainly attributed to uniaxial magnetic anisotropy produced by crystal distortion.

MA 20.88 Mo 14:00 Poster TU C

FMR an Fe_xPt_{1-x} Nanopartikeln: Messung der temperaturabhängigen Anisotropieenergie — F. Wiekhorst[1,2], •D. Görlitz[1] und J. Kötzler[1] — [1]Institut f. Angewandte Physik, Univ. Hamburg, 20355 Hamburg — [2]Physikalisch-Technische Bundesanstalt, 10587 Berlin

Es werden zwischen 10 K und 500 K bei 9 GHz gemessene FMR-Spektren von 4-6 nm großen Pt-reichen nanokristallinen FePt-Partikeln untersucht. Die zu tiefen Temperaturen zunehmend breiter werdenden Resonanzen lassen sich sehr gut mit der Gilbert-Shape beschreiben, die das Resonanzfeld und den Gilbert-Parameter definiert. Aus Magnetisierungs- und AC-Suszeptibilitätsmessungen [1] ist eine starke Anisotropie bekannt, woraus $H_A(0) > \omega/\gamma$ resultiert. Für diesen Fall gibt es kein analytisches Modell zur Analyse der FMR-Spektren. Wir beschreiben daher ein Mittelungsverfahren für die Resonanzfeldstärke, dessen Ergebnisse recht gut mit vorliegenden temperaturabängigen Anisotropieenergien aus aufwendigen Analysen von Magnetisierungsisothermen [2] übereinstimmen.

[1] F. Wiekhorst et al., Phys. Rev. B 67, 224416 (2003)
[2] F. Wiekhorst et al., J.Magn.Magn. Mat.272-276 ,1559 (2004)

MA 20.89 Mo 14:00 Poster TU C

Magnetization of blocked magnetic nanoparticles — •H. Bremers, O. Michele, and J. Hesse — Institut für Metallphysik und Nukleare Festkörperphysik, Technische Universität, Mendelssohnstrasse 3, D-38106 Braunschweig, Germany

The basic properties of magnetic nanoparticle systems can be understood in the highly idealized well known Stoner-Wohlfart (SW) model. The simplicity of this model sometimes becomes more complex when considering the energy minima of the particles magnetic moments and very special the equilibrium angles corresponding with respect to the direction of the applied external magnetic field [1]. We show that in a rather simple vector model representing the effective behaviour of the nanoparticle system the estimation of the mean equilibrium angles can be simplified. The description of the magnetization of a blocked nanoparticle system versus magnetic field becomes easy and applicable to measurements performed on real magnetic particle systems. [1] H. Pfeiffer, phys. stat. sol. (a) 118(1990)295-306.

MA 20.90 Mo 14:00 Poster TU C

Magnetization measurements on frozen ferrofluids - an attempt to separate interaction and anisotropy influences — •H. Bremers, O. Michele, and J. Hesse — Institut für Metallphysik und Nukleare Festkörperphysik, Technische Universität, Mendelssohnstrasse 3, D-38106 Braunschweig, Germany

In this contribution we focus on a novel way to perform magnetization experiments on frozen ferrofluids or magnetic nanoparticles fixed in space. The basic idea is to project the behaviour of a real particle system onto a Stoner-Wohlfart (SW) particle ensembly behaviour. Therefore first an ideal SW particle system with unique size and orientation of easy axis was studied numerically by introducing a particle - particle interaction via an demagnetizing field. We have shown that for non-interacting SW particles the universal mean value rule holds that the magnetization measured after ZFC (zero field cooling) can be expressed as a mean value of the magnetization measured after PHFC and NHFC (positive and negative high field) [1] cooling processes. Any deviation from this mean value rule is due to interactions only and can be derived from the magnetization measurements and assigned to equivalent behaviour of a SW particles system. By this new method it is possible to determine the mean value of the particles anisotropy and the mean interaction which is expressed as magnetic field. [1] O. Michele, J. Hesse, H. Bremers, E.K. Polychroniadis, K.G. Efthimiadis, H. Ahlers; J. Phys.: Cond. Matter 16 (2004) 427-443

MA 20.91 Mo 14:00 Poster TU C

Magnetic property of a weakly interacting nanoparticle system — •Xi Chen[1], Subankar Bedanta[1], Wolfgang Kleemann[1], S. Cardoso[2], and P. P. Freitas[2] — [1]Angewandte Physik, Universität Duisburg-Essen, D-47048 Duisburg, Germany — [2]INESC, Rua Alves Redol 9-1, 1000, Lisbon, Portugal

The magnetic property of a weakly interacting nanoparticle system $[CoFe(0.7\ nm)/Al_2O_3(3\ nm)]_{10}$ is investigated by a Superconducting Quantum Interference Device (SQUID) magnetometer. The temperature T dependence of the field cooled magnetization shows a clear increase at low temperature following a simple Curie law, which can be due to the “lost” spins undetectable in Transmission Electron Microscopy (TEM) images. The relaxation curves of the thermoremanent magnetic moment at different temperatures collapse onto one master curve under $T\ln(t/\tau_0)$ scaling. Aging and memory effects are also observed, which evidence a collective spin glass-like behavior in this nanoparticle system.

MA 20.92 Mo 14:00 Poster TU C

Segregation properties of Fe-Ni clusters — •Sanjubala Sahoo, Georg Rollmann und Peter Entel — Theoretical Low-Temperature physics, University of Duisburg-Essen, Lotharstr. 1, D-47048 Duisburg

Structure optimisation of Fe_nNi_{N-n} clusters has been performed using density functional theory and the generalised gradient approximation allowing for noncollinear magnetisation density. The calculations are carried out without imposing any symmetry constraints. Evaluation of the mixing energy of the clusters shows that mixed clusters are energetically more favourable than pure Fe and Ni clusters. Furthermore, the mixing energy not only depends on the size and composition of the clusters but also on their geometrical structures. Significant difference in energy is found for different arrangement of Fe and Ni atoms in the mixed cluster.

MA 20.93 Mo 14:00 Poster TU C

Entwicklung von Leiterbahnstrukturen zum Transport von magnetischen Teilchen — •A. Shoshi, M. Panhorst und H. Brückl — Universität Bielefeld, Fakultät für Physik, Universitätsstr. 25, 33615 Bielefeld

Paramagnetische Teilchen, wie beispielsweise Fe3O4 Beads, die in vielen unterschiedlichen Konfigurationen für biotechnologische Anwendungen kommerziell erhältlich sind, lassen sich durch externe Magnetfelder manipulieren.

Bei dem hier vorgestellten on-chip Manipulationssystem erzeugen Ströme durch Leiterbahnen radiale Magnetfelder, die den Transport von magnetischen Markern und eine genaue Positionierung auf der Chipoberfläche ermöglichen. Diese Magnetfelder können durch zusätzliche ferromagnetische Schichten, die als Flusskonzentratoren wirken, verstärkt werden. Direkt auf die Gold-Leiterbahnen wird dazu eine ferromagnetische Schicht variabler Dicke gesputtert. Die Leiterbahnstrukturen bestehend aus Gold und Permalloy (NiFe) werden auf einem Si-Wafer mit optischer Lithographie strukturiert. Der Transport paramagnetischer Teilchen in Flüssigkeiten ist in einem optischen Mikroskop beobachtbar und die wirkenden Kräfte auswertbar.