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SYNTHESIS AND ORBITAL MAGNETISM OF CORE-SHELL NANOPARTICLES

Duration:1/11/2004-31/10/2008

Abstract

Monodisperse magnetic nanoscale particles have a huge application potential in medical application like tumor therapy, gene sequencing, contrast agents in magnetic imaging, bio-labeling, or drug delivery agents and also in information technology relevant areas like non-volatile data storage and sensor applications. Most of the magnetic nanoparticles have the disadvantage of either being bio-incompatible (except for gadolinium or iron oxides) or not thermally stable due to too small a magnetic anisotropy energy. The goal of the network is to synthesize new types of core shell particles (in the size range between 4 and 200 nm) consisting of a magnetic core with a large magnetic anisotropy (e.g. FePt , CoSm) protected by an inert shell of few atomic layers of Au or iron oxides, which makes these particles biocompatible. Additionally the control over the variation of the shell thickness and the core diameter shall be achieved. The combination of ferromagnetic core and ferri-/magnetic shell materials will yield high coercive nanoparticles which can be used as building blocks for new magnetic materials. By controlling the shell material and thickness the interaction between these nanoscale building blocks can be tuned. Aside from this technological relevant investigation basic research on the magnetism of these complex nanoparticles which are unique in terms of their high surface-to-volume and interface-to-volume ratio respectively. Combining the techniques of ferro-/paramagnetic resonance and magnetic circular dichroism the element specific magnetic moments and the individual contributions of the orbital magnetic moment will be determined. This research should yield the information on the magnetic moments of "loose spins" at the interface between antiferromagnetic shell and ferromagnetic core materials. The results of this basic research are expected to provide a better understanding of the response of magnetic sensors based on interface properties like exchange bias. The added benefit of this network is the focus on the interdisciplinary training in organochemical synthesis of complex nanoparticles, the work at large synchrotron user facilities using unique magnetic and chemical characterization techniques, and the spectroscopic analysis by microwave spectroscopy in the GHz regime.

Partners

The Co-ordinator

1. Universität Duisburg-Essen UDE established in Germany

Other Contractors

2.	Centre National de la Recherche Scientifique	CNRS-TOU	established in France
3.	European Synchrotron Radiation Facility	E.S.R.F.	established in France
4.	Center of Advanced European Studies and Research	CAESAR	established in Germany
5.	Aristotle University of Thessaloniki	AUTH	established in Greece
6.	Universidade de Vigo	UVigo	established in Spain
7.	Institute of Physics, Academy of Sciences of the Czech Republic	IPASCR	establish in Czech Republic
8.	Max-Planck-Society for the Advancement of Science, Institute for Metals Research	MPI-MF	established in Germany