Groupe d'Etude de la Matière Condensée UVSQ CNRS

Séminaire

Michael FARLE

Distinguished Lecturer of the IEEE Magnetics Society 2017

University of Duisburg-Essen, Germany, and Immanuel Kant Baltic Federal University, Russia

Jeudi 29 juin 2017

UVSQ Campus de Versailles, Bâtiment Fermat - Amphi G
à 9h00

Functionalized Hybrid Nanomagnets: New Materials for Innovations in Energy Storage and Medical Theranostics

Let's dream of materials that store and release energy reversibly by temperature changes between day and night or provide a non-invasive treatment of cancer. These visions may be realized by using magnetic nanoparticles that are functionalized to be biocompatible, environmentally stable and recyclable, self-healing, and low-cost.

In this presentation I will discuss the basic concepts of magnetic nanomaterials and their magnetic properties with a focus on how to tune parameters in a controlled fashion. I will highlight state-of-the-art experimental approaches [1,2,3] that allow us to synthesize multifunctional particles and to understand microscopic properties and interactions in relation to electronic structure changes caused by changes in size, shape, and composition of nanomaterials. The apparently complex behavior of hybrid metal/metal, metal/oxide, or oxide/oxide interface materials –core-shell materials - can be understood from the three fundamental interactions in magnetism: magnetic exchange interaction due to orbital overlap, spin-orbit interaction due to inner- and intra-atomic relativistic corrections (e.g., crystal field effects) and the long-range magnetic dipolar interaction. Several examples will be presented, including the formation of above-room-temperature ferromagnetic interface layers between low-temperature antiferromagnetic layers and the evolution of lattices of magnetic textures (skyrmions) in confined dimensions.

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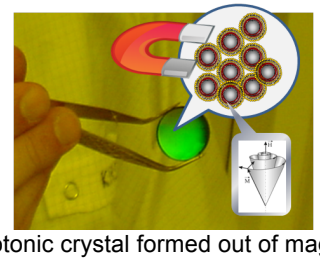
[1] M. Farle Imaging techniques: Nanoparticles atoms pinpointed NATURE (News and Views) **542** (2017) 35

[2] Zi-An Li, et al. Magnetic Skyrmion Formation at Lattice Defects and Grain Boundaries Studied by Quantitative Off-Axis Electron Holography, Nano Lett. **17** (2017) 1395–1401

[3] M. Spasova, et al., Magnetic and optical tunable microspheres with a magnetite/gold nanoparticle shell, J. Mater. Chem. **15** (2005) 2095



A magnetic photonic crystal formed out of magnetic capsules.

Michael Farle received his Diploma in experimental physics, Doctorate, and Habilitation degrees from Freie Universität Berlin in 1984, 1989, and 1998, respectively. During this time he spent three and a half years as a senior researcher at Stanford University, California, and Université de Strasbourg, France. In 1999, he moved to Technische Universität Braunschweig, Germany, where he became a full professor. Since 2002, he has been working as a professor at the Universität Duisburg-Essen, Germany, where he has served as Vice-Rector for Research and Junior Scientific Staff. In 2016 he became, in addition, an adjunct professor at Immanuel Kant Baltic Federal University, Kaliningrad, Russia.

Prof. Farle has published over 230 technical articles in peer-reviewed journals, including book chapters and review articles, and has given more than 60 invited presentations. He coordinated two European Research Networks and served as the vice-spokesman of Collaborative Research Center: Magnetic Heterostructures (SFB 491). Since 2014 he is chairman of the Magnetism Section of the German Physical Society. For many years he has been active on the program committees of several international conferences on magnetism. He is a member of the IEEE Magnetics Society, the German Physical Society, and is a co-editor of *Materials Research Letters* and *Journal of Magnetism and Magnetic Materials.*

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