



Institut de Nanociència
i Nanotecnologia



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

Imagine a future in which food is used to activate specific immune reactions in a human body based on an external noninvasive magnetic stimulus. Dream of a material that stores and releases energy reversibly by temperature changes between day and night. 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 specific parameters in a controlled fashion to achieve the dreams of the future. I will highlight state-of-the-art experimental technologies that allow us to understand microscopic properties and interactions in relation to electronic structure changes caused by changes in size, shape, and composition of nanomaterials. Then I will discuss how this understanding is used when nanomagnets are functionalized for targeted drug delivery or composed to form macroscopic materials for new energetic applications like magnetic refrigeration. I will demonstrate that the seemingly complex behavior of hybrid metal/metal, metal/oxide, or oxide/oxide interface 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. The talk will end with an episode in the life of an imaginary golf-playing couple in the year 2040 who use their “Smart Magnet” (SMAG) phone to energize and heal their bodies on the green.



By **Professor Michael Farle**: IEEE Magnetics Society Distinguished Lecturer 2017 (University of Duisburg-Essen, Germany, and Immanuel Kant Baltic Federal University, Russia)

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