University of Duisburg-Essen
Priv. Doz. Dr. Ulf Wiedwald

Compact interdisciplinary classes on

"Magnetic Nanoparticles for Biomedical Applications"

In this short course, I will cover all the ingredients needed to gain a thorough understanding of the properties of magnetic nanoparticles and their application in biomedicine. For a non-physicist, magnetism is one of the most fantastical phenomena in nature leading to certain obstacles in its scientific understanding. This course is addressed to materials and natural science students with basic knowledge in physics.

Lecture 1: Basics in Magnetism and Measurement Techniques

October 28, 14:30h, room B607

After a brief view on the history of magnetism and related phenomena, I am discussing the basic quantities needed for materials characterization followed by a view on the magnetic elements. The ordering schemes of atomic spins in solids are introduced. The second part of the lecture presents various magnetic characterization techniques and their possibilities and problems discussed in several case studies before the major applications of magnetic materials in multi-billion dollar markets are presented.

Lecture 2: Nanomagnetism and Magnetic Nanoparticles in Biomedicine

October 31, 12:40h, room B607

Symmetry breaking at surface and interfaces leads to structural distortions and often to an enhanced magnetocrystalline anisotropy in nanostructures. The consequences for small particles are presented. Thermal excitation results in superparamagnetic behaviour that is a major drawback for their exploitation. I briefly give hands-on arguments for improved application-driven materials design. The second part of the lecture presents the concepts of various biomedical applications like contrast agents in magnetic resonance imaging (MRI), magnetic particle imaging (MPI), magnetic particle hyperthermia (MPH), magnetically guided drug delivery, or magnetic sensors in biomedicine.

Lecture 3: Meeting the Experts - Student Projects in Microseminars

November 1, 16:20h, room B607

Students enrolled at NUST MISiS present their projects in microseminars. The short presentation of their results is followed by detailed scientific discussion with the lecturer, the two hosts, and the audience. After the seminar further personal discussions are planned.