物理工学談話会

日時:2019年12月3日 (火) 13:30－14:30

場所:理学研究棟 4階 会議室(404)

講師: Dr. Ulf Wiedwald

Faculty of Physics and Center for Nanointegration,

University of Duisburg-Essen, Germany

題目:“Magnetite-Gold and Ferrite Nanoparticles:

From Physics to Theranostics”

どなたでもいらしてください。

世話人: 物理工学コース・一柳 (内線4185)

Abstract

The application of magnetic nanoparticles (MNPs) in biomedicine is one of the most dynamic and promising fields of nanoparticles research. Two examples for the use of multifunctional MNPs in theranostics are agents in magnetic resonance imaging (MRI) and magnetic particle hyperthermia (MPH) for the localized treatment of cancer. We designed, synthesized and tested various MNPs like ferrites, core-shell architectures, and magnetite-gold (Fe_3O_4-Au) hybrids for optimized properties.

Here, we present pairwise connected Fe_3O_4-Au hybrids with diameters of 6-44 nm Fe_3O_4 and 3-11 nm Au aiming for optimized theranostics response. Figure 1 shows high-resolution transmission electron microscopy (HRTEM) images and corresponding FFT images of 15 nm and 25 nm Fe_3O_4-Au hybrids. The shape of such hybrid MNPs can be tuned from spherical to octahedral motifs depending on the reaction temperature and time. With increasing MNPs diameter from 6 to 25 nm in agarose mimicking tissues, the MPH reveal that the specific loss power increases from 12 to 327 $W \cdot g_{Fe}^{-1}$, while for the MRI, we observe the growth of the r_2-relaxivity from 118 to 612 $mM^{-1}s^{-1}$. The 25 nm and 44 nm diameter MNPs show similar theranostic performances. These values are significantly enhanced in comparison to other Fe_3O_4-Au hybrids due to their octahedral shape and large saturation magnetization. As a practical application, MRI-controlled drug delivery and dual-mode MRI/fluorescent imaging are presented for the optimized MNPs size of 25 nm.