MAR06-2005-001769

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Biomedical Applications of Magnetic Nanoparticles and Fluids.[1]

DIANDRA LESLIE-PELECKY, University of Nebraska - Lincoln

Nanomaterials play an increasingly important role in the research, diagnosis and treatment of numerous pathologies. Biomedical applications such as drug delivery, magnetic resonance imaging and hyperthermia require magnetic nanoparticles with a large saturation magnetization that are biocompatible, form stable suspensions in water-based fluids, and can be functionalized. We use chemical synthesis and inert-gas condensation into fluids to produce biocompatible magnetic nanoparticle fluids that allow magnetic targeting of drugs and simultaneous magnetic resonance imaging. We have developed a water-dispersible oleic-acid/Pluronic/iron-oxide nanoparticle formulation that can be loaded with high doses of water-insoluble anti-cancer drugs. An external magnetic field is used to attract the nanoparticles to the treatment region and MRI is used to verify their location. A primary limitation on magnetic targeting, however, is the low moment of iron-oxide nanoparticles. Inert-gas-condensation into fluids produces iron and cobalt nanoparticles from 5-45 nm in diameter. Coating or passivation of these materials is required to prevent oxidation; however, the interaction between surface atoms and surfactant or other functionalizing molecules can greatly diminish the magnetic moment. A study of surfactant interactions with iron nanoparticles shows that the physical barrier provided by a concentric shell of polymeric surfactant offers significantly more protection against oxidation than the radial barrier formed by most linear surfactants. The talk will conclude with a brief overview of the opportunities and challenges for condensed matter and materials physicists in biomagnetic materials. This work is done in collaboration with V. Labhasetwar and T. Jain at the University of Nebraska Medical Center, and Marco Morales, Nguyen Hai, Shannon Fritz, Kishore Sreenivasan and David Schmitter at the University of Nebraska – Lincoln.

[1]This work was supported by the National Science Foundation MRSEC program and the Nebraska Research Initiative.