F. Joseph Halcomb III, M.D.
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College of Engineering

BME Seminar Series, Spring 2019

Magnetic Nanomaterials – from Targeted Delivery to Controllable Genome Editing

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Synopsis: Magnetic iron oxide nanoparticles (MNPs) bridge the electromagnetic control with the microscopic world. The nanomagnetism that allows the delivery of magnetic, mechanical, and thermal signals to individual cells or molecules provides unique tools for molecular imaging, drug delivery, magnetic bio-manipulation and hyperthermia/thermal ablation. In this talk, I will cover the synthesis of multifunctional MNPs through the modular assembly of structural/functional elements and our recent work on the applications of MNPs in *in vivo* genome editing and disease detection. MNPs complexed with a baculoviral vector (MNP-BV) provide a unique platform for *in vivo* gene delivery. Here the magnetic force and the complement system in the body form the on- and off-switch for BV transduction in the body. MNP-BV-mediated Cas9 expression can be activated with a local magnetic field, which allows the spatially controlled *in vivo* genome editing. Next, I will present the development of an iron oxide nanoparticle linked immunosorbent assay (ILISA) utilizing the dense atom packing in nanocrystals and their size-compatibility with proteins. In ILISA, signal amplification is achieved by quantifying Fe atoms in IONPs with a chemically and optically stable ferrozine method that is not hampered by operational errors. ILISA exhibits superior simplicity, linearity, and stability and can be a cheaper and more robust alternative to conventional ELISA in biological assays and clinical diagnostics. In the end, I will briefly talk about the potential applications of MNPs in neural engineering and cancer therapy.

Wednesday, May 29, 2019
2:00 PM, Room 202A BBSRB