UNIVERSITY OF DELAWARE

CHEMICAL & BIOMOLECULAR ENGINEERING

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IN VIVO QUANTITATIVE TRACKING OF NANOPARTICLES AND CELL THERAPIES USING MAGNETIC PARTICLE IMAGING

Magnetic particle imaging (MPI) is a new molecular imaging technology capable of unambiguous and quantitative tomographic imaging of the distribution of superparamagnetic nanoparticle tracers in vivo. While the term MPI is reminiscent of magnetic resonance imaging (MRI), the two rely on distinct physics. In MPI, a tomographic image of the distribution of superparamagnetic nanoparticles is constructed by scanning a so-called field free region (FFR) through the domain of interest. Magnetic nanoparticles inside the FFR give rise to a signal due to their nonlinear dynamic magnetization response to an alternating magnetic field. Outside the FFR there is a quasi-static bias field strong enough to saturate the magnetic moments of the nanoparticles, abrogating their response to the excitation field. At the field amplitudes and frequencies used in MPI there is no appreciable attenuation in signal strength due to tissue. Further, while there are magnetic species in the body (e.g., ferritin), they do not contribute an appreciable signal for MPI, allowing for unambiguous imaging of the distribution of one of the superparamagnetic nanoparticle tracers. This talk will explain the physics of MPI in relation to design of high sensitivity and resolution magnetic nanoparticle tracers, as well as applications of MPI in tracking nanoparticles and cell therapies in the context of cancer, traumatic brain injury, and other conditions.