Nanomanufacturing as a Route to Enhanced MRI Agents

Magnetic resonance imaging (MRI) has become a widely used medical diagnostic tool, able to benignly image deep within the body. A key to the success of MRI has been the development of chemically synthesized contrast agents. Such agents are routinely used to image blood flow, distinguish between healthy and abnormal tissue, delineate regions or organs of interest, and identify numerous relevant biomarkers. They have become so prevalent, that the market size for contrast agents now rivals even that of the MRI machines themselves.

Different contrast agents function in different ways, but typically they all rely on modifying the local magnetic fields experienced by surrounding water molecules. Despite their success, however, existing contrast agents possess surprisingly crude control over these magnetic fields. Micro- and nanofabrication technologies offer entirely new ways to create MRI contrast agents with better defined compositions and geometries that lead to better controlled field profiles and, in turn, enhanced MRI sensitivity and functionality. As examples, we consider how nanofabrication enables agents that (i) can boost existing MRI contrast agent signal-to-noise levels by one to two orders of magnitude, and (ii) can add a new dimension of "color" to traditional MR images.

Gary Zabow
NIH and NIST

Dr. Zabow is a senior research fellow at the National Institutes of Health (NIH), where he works within the National Institute of Neurological Disorders and Stroke (NINDS). He also holds a concurrent guest researcher position at the National Institute of Standards and Technology (NIST) in Boulder, Colorado. His interests range widely, including atomic physics, microfluidics, magnetic resonance imaging (MRI), and micro- and nanofabrication technology. His current research focuses on novel microfabrication techniques and on leveraging such techniques for bio-related applications including enhancing magnetic resonance imaging and sensing functionalities. He holds a PhD in physics from Harvard University.

