The High Field MRI Facility at Penn State

T. Neuberger and S. Gullette

The High Field Magnetic Resonance Imaging (HFMRI) facility at Penn State features two state-of-the-art preclinical MRI systems, along with two micro-computed tomography (micro-CT) systems to support multimodal imaging. All equipment is accessible to researchers through the iLab platform.

Magnetic Resonance Imaging (MRI) is a highly versatile, non-invasive tool that has gained increasing traction within the materials research community in recent years. This rise in popularity is due in part to advancements in hardware, novel acquisition and reconstruction methods, and a growing recognition of the technology's capabilities among researchers. Applications extend beyond traditional medical imaging to include the characterization of medical implants (such as scaffolds, stents, and bioglass), visualization of hydrogels, monitoring of drying processes (e.g., in concrete), flow and pH measurements, and tracking diffusion processes (e.g., of water, lithium, and sodium). When combined with micro-CT, MRI offers complementary material characterization.

The facility’s 7-tesla Bruker BioSpec system accommodates samples up to 6.7 cm in diameter, while the 14-tesla Bruker Avance Neo microimaging system, designed for smaller samples up to 4 cm in diameter, delivers enhanced signal-to-noise ratio (SNR) and improved resolution. This performance is further elevated by the use of the system’s unique cryo-probe, which provides an approximate threefold increase in SNR. The two SkyScan micro-CT systems (models 1176 and 1276) can achieve resolutions in the low micrometer range, ideal for applications such as bone density measurements.

In this presentation, we will showcase ongoing collaborative projects with faculty from various departments and highlight specific MRI techniques that can support new research endeavors.