

Bioengineering Seminar, College of Engineering, University of Toledo

Atomic Force Microscopy (AFM) is Histology

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Where: SSOE Seminar Room, 1027 Nitschke Hall

Time: 11:30 am – 12:30 pm

AFM is a scanning probe microscopy technique which enables high resolution imaging, nanoscale force measurements and manipulation of nanoparticles and biomolecules. Although AFM is widely used for in-vitro samples involving purified proteins, nanoparticles and cells, limited studies exist on analysis of tissue sections using AFM. We demonstrate here how AFM can provide novel insights into the structural features and components of tissues using sections routinely used for histology.

One of my major research areas is to understand the collagen fibril structure and its regulation at the molecular level. In particular we are studying how the collagen receptors, discoidin domain receptors (DDR1 and DDR2) interact with collagen type 1. We have elucidated that by binding to collagen DDRs inhibit the fibrillogenesis and native structure of collagen fibrils. Using AFM we demonstrate how the depth of D-periodic structure of collagen fibrils is altered in aortic tissue sections from the DDR1 knockout mice, consistent with our in-vitro studies. In addition abnormal collagen fibrils with reduced depth of D-periods were found in mouse models of abdominal aortic aneurysm, which coincided with upregulation of DDRs. Our ongoing work aims to elucidate the functional consequences of altered collagen fibril structures.

In another study we employ the AFM based technique, namely magnetic force microscopy (MFM) to map magnetic iron deposits in rodent tissue sections. Our results demonstrate that ferritin(iron) rich lysosomes can be detected using MFM at a resolution comparable to transmission electron microscopy (TEM). We also demonstrate the development of a novel indirect MFM technique for high-throughput analysis of iron deposits.

Bio:

Dr. Gunjan Agarwal received her PhD in Biophysics from the Tata Institute of Fundamental Research, Mumbai, India and came to the US for her post-doctoral research at the Albert Einstein College of Medicine, Bronx, NY. After a brief period at Procter and Gamble Pharmaceuticals, Mason OH and at the Air Force Research Lab, Dayton, she joined the Ohio State University (OSU) in 2003, as an Assistant Professor, in Biomedical Engineering (BME) and Internal Medicine. She was currently an Associate Professor in BME. Her major research interest is to understand extracellular matrix (ECM) regulation at the cellular and molecular scale and its manifestations in vascular and bone diseases. She extensively employs atomic force microscopy (AFM), electron microscopy and fluorescence microscopy alongwith biochemical assays for her research. Another vector of her research is to develop novel biomedical applications of AFM, such as magnetic force microscopy to detect nanoscale magnetic domains in biological samples. Her research has been funded by the NSF, NIH and American Heart Association as well as the NSEC, MRSEC and IMR at OSU. In addition, she has served as the PI for two NIH shared instrument grants on AFM and directed the AFM core facility at OSU for several years.