Scanning Probe Microscope for Measuring Mechanical and Electromagnetic Properties of Irradiated Materials

Applicant Name: Pacific Northwest National Laboratory (PNNL)
Project Director/Principal Investigator: Dr. Pradeep Ramuhalli
Major Participants: Dr. Andrew Casella (PNNL), Dr. Charles Henager Jr. (PNNL), Dr. Jonathan Suter (PNNL), Dr. Bradley Johnson (PNNL), Dr. David Blanchard (PNNL)

ABSTRACT:
This proposal seeks support for the acquisition and installation of an advanced, fully equipped commercial off-the-shelf (COTS) AFM with multi-modal measurement capability. This instrument will be used to study irradiated materials, to characterize topographical, mechanical, electrical, and magnetic property changes at nanometer-to-micrometer scales. The standard AFM instrument enables nanometer-scale scanning probe microscopy to measure surface topography. Add-on modules (hardware and/or software) can be used to expand the capabilities of an AFM to allow the measurement of ferromagnetic, ferroelectric, magnetic and nanomechanical properties. This fully equipped AFM will provide: (1) Quantitative mechanical property measurements such as surface topography, elastic moduli, and hardness at nanometer-to-micrometer length scales on irradiated materials; and (2) Quantitative nanometer-scale magnetic and ferroelectric materials measurements. The instrumentation, when located in RPL (a Hazard Category II non-reactor nuclear facility at PNNL), enables new measurement capability that, to our knowledge, does not currently exist within a similar facility, and complements the information that may be obtained using classical microscopy approaches (optical, SEM, TEM) that are currently available at RPL. As such, this new measurement capability will provide the ability for expanded characterization of structural materials, fuels and fuel cladding, as well as sensor materials that have been irradiated, leading to insights into the design of new materials and sensing mechanisms for irradiated materials.