# High Resolution Scanning Acoustic Microscopy System for High Throughput Characterization of Materials and Nuclear fuels

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**ABSTRACT:**

The objective of this NEUP infrastructure project is to acquire a state-of-the-art high resolution scanning acoustic microscopy system along with accessory sample synthesis and potentiostat setups to enhance North Carolina State University (NCSU)'s educational and research capabilities in high throughput characterization of nuclear fuels, sensor materials, cladding materials, reactor structural materials and 3D printed materials. This effort directly supports DOE Office of Nuclear Energy (NE)'s R&D priorities to develop advanced materials and nuclear fuels for innovative nuclear energy applications. The requested equipment will be used for: (1) the research related to nuclear science and engineering programs of interest to DOE NE R&D mission; and (2) the learning of undergraduate and graduate students of nuclear engineering. It will be shared with other internal and external researchers who are interested in nuclear energy studies, and holds great potential to serve as a NSUF Partner Facility to support the broader nuclear energy community. As such the proposed infrastructure improvement will significantly enhance the testing capabilities at NCSU for supporting critical DOE mission-oriented research while training next-generation workforce for national laboratories and nuclear industry.

Through the use of advanced frequency-dependent sonic wave sensing technique to detect changes in acoustic impedances of materials, the proposed scanning acoustic microscopy system offers a unique high sensitivity nondestructive characterization capability with largely accelerated measurement time, thus enabling high throughput inspection of defects within materials and fuels of nuclear energy systems. Its high penetration capability can effectively reveal material microdefects, such as cracks, voids, delaminations and porosity. The system's ability to produce images on a layer-by-layer basis allows high resolution 3D tomography imaging. The accessory sputtering and potentiostat setups will be able to conduct rapid sample synthesis and quick electrochemical impedance spectroscopy measurements for performing complementary controlled experiments. The proposed acoustic-sensing-based high throughput characterization platform is not presently available at NCSU or within the NSUF facility network. To this end, the requested equipment acquisition represents a timely addition to NCSU's infrastructure to complement the existing structural and mechanical characterization equipment. Such infrastructure enhancement would not only improve the testing capabilities of NCSU's nuclear engineering program for supporting nuclear energy research and teaching/learning missions, but also have the potential to serve the broader nuclear energy community by expanding the material examination capabilities of NSUF network. The team's professional expertise will ensure the successful implementation of this infrastructure project. NCSU has all the necessary facilities and resources to support the installation and operation of the requested equipment.