
Enhancement of Material Characterization Capabilities at North Carolina State University for Supporting Nuclear Energy Related Studies

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Program: Infrastructure

ABSTRACT:

The objective of this project is to enhance research and educational infrastructure of Nuclear Engineering Program of North Carolina State University (NCSU) in material characterization/examination for supporting nuclear energy related studies. Through the NEUP infrastructure program, we propose to acquire a high spatial resolution ($<10\mu\text{m}$) photoluminescence and Raman spectroscopy and mapping system to characterize nuclear fuel, cladding materials and nuclear sensor materials, along with a floating zone furnace and accessories for sample preparation and thermal treatment. The major outcome of this project will be an advanced optical characterization platform at NCSU that enables essential optical testing for developing materials related to nuclear energy applications. The optical tests through use of the requested equipment will effectively complement mechanical tests and corrosion tests, thus offering complete material examination/characterization capabilities at NCSU's nuclear engineering department.

The proposed photoluminescence and Raman system will feature high spatial resolution ($<10\mu\text{m}$) spectroscopy and mapping measurements. The system will share the same con-focal microscopy configuration for seamless switching between photoluminescence and Raman measurements on the same sample. Presently, there is no such dedicated optical characterization capability available in the nuclear energy community. With the requested floating zone furnace, targeted microstructures of alloys, compounds and composites can be more precisely controlled due to the availability of ultra-high temperature gradient at the floating zone region, thus enabling better sample preparation and thermal treatment. 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. The project team is highly experienced in relevant technical areas involving material characterization, optical testing, nuclear sensor development, sample preparation and thermal treatment. The team members' 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.

The proposed infrastructure improvement will significantly enhance the materials examination/characterization capabilities of NCSU's Nuclear Engineering Department for training next-generation workforce of national labs and nuclear industry and conducting critical DOE mission-oriented research. It will have a vital and lasting impact on expanding the research and training capabilities of DOE Office of Nuclear Energy and could serve the broader nuclear energy community through NSUF. NCSU is highly supportive of such efforts and is committed to provide \$40,000 cost share to this infrastructure project to acquire the requested equipment for nuclear energy studies.