NEUP Nuclear Energy University Program
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Ultrafast elemental depth profiling to enable high-throughput characterization of nuclear materials and fuels

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ABSTRACT:

We propose to acquire a pulsed radio frequency glow discharge optical emission spectrometer (GD-OES), with the capability of ultrafast elemental depth profiling, to install and test the instrument, and to demonstrate its applications in high-throughput characterization of nuclear materials. The objectives of our proposed research are to build at Missouri University of Science and Technology (Missouri S&T) the capability of ultrafast elemental depth profiling, establish this capability as a regular tool for high-throughput compositional characterization of nuclear materials and fuels, enhance the nuclear research and education at Missouri S&T, and ultimately join the Nuclear Science User Facilities (NSUF) as a partner facility, contributing to enhancing the characterization capabilities of NSUF.

The mission of the Office of Nuclear Energy of Department of Energy (DOE-NE) to extend the life of current nuclear reactors and develop and deploy the next-generation reactors calls for rapid development and qualification of nuclear materials, which in turn requires high-throughput characterization of nuclear materials. There is a critical need for a high-throughput characterization technique that meanwhile has high sensitivity and accuracy. There is also an urgent need for a technique that can provide efficient depth profiling of nuclear materials. GD-OES is a technique that has combined advantages of high throughput, high sensitivity/accuracy, and ability to perform depth profiling. It has been widely used for characterizing materials for many non-nuclear applications. However, there has been limited applications of this technique in the nuclear field. There is a critical need to expand the capability of GD-OES to the nuclear materials community especially universities.

Missouri S&T currently has many different capabilities for materials characterization. The development of GD-OES will complement the existing facilities at Missouri S&T, and significantly improve the university's high-throughput characterization capabilities. More broadly, the development of GD-OES for nuclear materials and fuels characterization could contribute to improving the research capabilities of the whole nuclear materials community, through NSUF. Furthermore, this project will contribute to training graduate and undergraduate students for the next-generation workforce of national labs and nuclear industry. Missouri S&T's very well established NE program (established in the late 1950's) has made very significant contributions to providing workforce for the nuclear field.