Measurement of Irradiated Pyroprocessing Samples via Laser Induced Breakdown Spectroscopy

PI: Supathorn Phongikaroon – University of Idaho

Collaborators: Richard Russo – Lawrence Berkeley National Laboratory

Michael Glazoff – Idaho National Laboratory

Sergy Rashkeev – Idaho National Laboratory

Jeffrey Giglio – Idaho National Laboratory

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ABSTRACT

The primary objective of this research is to develop an applied technology to remotely measure and analyze the real time or *near* real time concentrations of spent nuclear fuel (SNF) dissolute in electrorefiners. Here, Laser Induced Breakdown Spectroscopy (LIBS), in SNF pyroprocessing facilities will be investigated. The LIBS is an elemental analysis method, which is based on the emission from plasma generated by focusing a laser beam into the medium. This technology has been reported to be applicable in the media of solids, liquids (includes molten metals), and gases for detecting elements of special nuclear materials. The advantages of applying the technology for pyroprocessing facilities are: (1) Rapid real-time elemental analysis—one measurement/laser pulse, or average spectra from multiple laser pulses for greater accuracy in < 2 minutes; (2) Direct detection of elements and impurities in the system with low detection limits—element specific, ranging from 2-1000 ppm for most elements; and (3) Near non-destructive elemental analysis method (about 1 □g material). One important challenge to overcome is achieving high-resolution spectral analysis to quantitatively analyze all important fission products and actinides. Although a promising femtosecond LIBS has been developed and proven to be successful at detecting Group I metal dopants (e.g. Na and K), it has not been conventionally applied to the pyroprocessing technology. Another important challenge is related to accessibility of molten salt, which is heated in a heavily insulated, remotely operated furnace in a high radiation environment with an argon atmosphere. The project aims to address these challenges. If successful, follow-on work would be focused on engineering design and demonstration in an actual hot cell environment at the national laboratories.