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2018 American Nuclear Society Student Conference

Development of an Experimental Routine for Electrochemical and Laser-Induced Breakdown Spectroscopy Composition Measurements of LiCl-KCl Eutectic Salts

While nuclear power has continued to play a role in the world's electrical energy generation, used nuclear fuel (UNF) has become an increasing concern for both those in the nuclear industry and those not. While some desire to pursue a once-through fuel cycle ending in a geological repository, another solution to the problem of UNF is nuclear fuel reprocessing, a process which extracts the still fissile and fertile material which can then be reused in a nuclear reactor. Nuclear fuel reprocessing would allow for a closed fuel cycle, which when combined with advanced reactors could help to develop the declining nuclear infrastructure. One possible method for the treatment of UNF is known as 'pyroprocessing technology.' Pyroprocessing or pyrochemical technology uses a method of electrorefining used nuclear fuel in molten chloride salts to extract rare earths and actinides from UNF. This method has the ability to treat both oxide and metal fuel, extract plutonium in the presence of uranium, and separate other minor actinides used in nuclear fuel at high temperatures creating a system with a strong resistance to nuclear proliferation. The keystone step within the pyroprocessing system is an electrorefining process, where most of the U in the UNF is selectively collected on a solid cathode in eutectic lithium chloride-potassium chloride (LiCl-KCl) molten salt at high temperatures.