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Automated Characterization of Uranium-Molybdenum Fuel Microstructures

Understanding the performance of nuclear fuel materials under irradiation is critical to the development of new nuclear fuels. The Reduced Enrichment for Research and Test Reactors program aims to convert research and test reactor fuels from high enrichment (> 20 wt% uranium-235) to low enrichment (< 20 wt% uranium-235) in order to meet nuclear non-proliferation goals. Many of the research reactors still fueled with highly enriched uranium have fissile atom density requirements too high to be met by existing low enriched uranium fuels, thus requiring the development of new fuels. Idaho National Laboratory conducts extensive research on uranium-molybdenum fuels, which possess high uranium atom densities. In order to ensure the safe and economic operation of nuclear fuels, it is necessary to be able to predict their behavior and life-time during irradiation. An accurate description of a fuel's behavior, however, involves a multitude of disciplines including chemistry, nuclear and solid state physics, metallurgy, ceramics, and applied mechanics. The strong interrelationship between these disciplines has led the nuclear industry to develop computational fuel performance codes capable of predicting the behavior of nuclear fuels during irradiation. Fuel designers and safety personnel rely heavily on this type of code since the cost of code development is minimal in comparison with the costs of an unexpected fuel failure. The development and validation of these codes is highly reliant on data from in-core experiments. The aim of this research is to assist in the evaluation of uranium-molybdenum fuels through the use of automated image processing techniques in order to provide accurate collection of data for use in fuel qualification and code development.