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Development of a Microspot Fast Neutron Irradiation Platform for Examining the Correlation Between Local Neutron Damage and Graphite Microstructure

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ABSTRACT

This project proposes to utilize a small-spot, cyclotron-based, fast neutron irradiation platform to produce highly localized damage in the microstructure of graphite. Post-irradiation analysis, combining microscopy, spectroscopy, and electrical and mechanical testing, will provide information as to how high doses of localized damage affect this microstructure and lead to changes in the physical characteristics of graphite. The majority of this work will be accomplished on-site at a university reactor facility. The university team is comprised of a new investigator with expertise in materials characterization, a plasma physicist, and a nuclear engineer. This team is collaborating with two graphite experts from the DOE national laboratory system. The major objective of this study is to resolve the mechanisms of fast-neutron damage on graphite microstructure, whether it be the more classically accepted Wigner Effect [1], or the ab initio predicted void/boulder structure, i.e., the ruck-tuck-fold [2]. The formation of one structure over the other will lead to pronounced differences in physical characteristics such as thermal and electrical conductivity, thermo-mechanical creep, and other properties.