Measurement of Nanoscale Material Properties of Irradiated Lithium Aluminate

S.L. Riechers[1], B. R. Johnson[1], and W. Jiang[1]

[1]Pacific Northwest National Laboratory, Richland, WA, USA

Lithium aluminate, specifically ^{6}Li-enriched γ-$LiAlO_2$ is an important material used as a solid breeder material for tritium production and has potential uses in neutron dosimeters and fusion reactor designs. Under neutron irradiation ^{3}H and ^{4}He particles are emitted at 2.75 and 2.05 MeV producing point defects in the $LiAlO_2$ lattice. The accumulation of defects and gas species affect the mechanical stability, thermal properties, and tritium migration. Recent studies have revealed the formation of $LiAl_5O_8$ precipitates and Li accumulation at grain boundaries and void spaces after irradiation. In order to better understand these decomposition behaviors and their implications for bulk material properties it is important to probe the material properties of nanoscale features and individual crystal grains in relation to irradiation induced changes. While material properties such as hardness and thermal conductivity of the bulk material may be readily measured it is difficult to probe local material properties. However, by utilizing atomic force microscopy nanoscale hardness and thermal conductivity of $LiAlO_2$ both before and after ion implantation have be measured. In addition, correlative SEM/EBSD has been utilized to determine the phase and grain boundaries of those same local features allowing for a more complete understanding of the structure-property relationship. These preliminary findings demonstrate a powerful tool for furthering our fundamental understanding of material properties of irradiated materials and for the development of a mechanistic material performance model.