**Molecular Dynamics and Phase-field Study of Anisotropic Grain Growth Behavior in UO2**

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UO2 is the primary nuclear fuel in light water reactors. The fuel performance while in-reactor can be significantly affected by the fuel’s grain growth behavior. Using a combination of molecular dynamics and phase-field simulations, we have systematically investigated microstructural evolution in UO2 as influenced by anisotropic grain boundary (GB) properties. Molecular dynamics simulations are conducted to study the misorientation- and rotation-axis-dependent anisotropy in GB energy and GB mobility in UO2. Our results show that GB mobility has a strong anisotropy, while GB energy is not sensitive to these two GB characters. In general, the GBs with a <111> rotation axis have higher mobility than other rotation axes. Phase-field simulations are performed to elucidate the effect of anisotropic GB mobility on grain growth behavior at the mesoscale.