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Modeling Plasma Surface Interactions in Tungsten through High-Performance Computing BRIAN D. WIRTH[1], Department of Nuclear Engineering, University of Tennessee — The plasma facing components of future tokamak-based fusion power plants arguably represent the single greatest materials engineering challenge of all time. Fortunately, recent innovations in computational modeling, increasingly powerful high performance computing platforms and improved experimental characterization tools provide the opportunity to develop self-consistent, experimentally validated models of materials performance in the fusion energy environment. This presentation will describe the challenges of modeling plasma facing components in a fusion materials environment, opportunities to utilize high performance computing and then focus on recent progress to investigate the surface evolution of tungsten exposed to low-energy He/H plasmas. These results identify the mechanisms of tungsten surface morphology changes during 100 eV He plasma exposure as a function of temperature and initial tungsten microstructure. The results demonstrate that He clusters create self-interstitial defect clusters in W by a trap mutation process, followed by the migration of these defects to the surface that forms adatom layers on the tungsten surface. As the helium clusters grow into nanometer bubbles, their proximity to the surface and extremely high gas pressures leads to rupture the surface. Helium bubble bursting induces additional surface damage and tungsten mass loss.

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