Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Analysis of Helium Segregation on Surfaces of Plasma-Exposed Tungsten DIMITRIOS MAROUDAS, LIN HU, University of Massachusetts, Amherst, KARL HAMMOND, University of Missouri, Columbia, BRIAN WIRTH, University of Tennessee, Knoxville — We report a systematic theoretical and atomic-scale computational study of implanted helium segregation on surfaces of tungsten, which is considered as a plasma facing component in nuclear fusion reactors. We employ a hierarchy of atomic-scale simulations, including molecular statics to understand the origin of helium surface segregation, targeted molecular-dynamics (MD) simulations of near-surface cluster reactions, and large-scale MD simulations of implanted helium evolution in plasma-exposed tungsten. We find that small, mobile helium clusters (of 1-7 He atoms) in the near-surface region are attracted to the surface due to an elastic interaction force. This thermodynamic driving force induces drift fluxes of these mobile clusters toward the surface, facilitating helium segregation. Moreover, the clusters' drift toward the surface enables cluster reactions, most importantly trap mutation, at rates much higher than in the bulk material. This cluster dynamics has significant effects on the surface morphology, near-surface defect structures, and the amount of helium retained in the material upon plasma exposure.

Lin Hu
University of Massachusetts, Amherst

Date submitted: 22 Jul 2015 Electronic form version 1.4