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Cluster dynamics modeling of He accumulation kinetics in W exposed to low-energy He plasma exposure SOPHIE BLONDEL, ORAU, DIMITRIOS MAROUDAS, LIN HU, University of Massachusetts, KARL HAMMOND, University of Missouri, BRIAN WIRTH, University of Tennessee, PSI SCIDAC COLLABORATION — We report a hierarchical multi-scale modeling study of implanted helium segregation to surfaces of tungsten, considered as a plasma facing component in nuclear fusion reactors. We employ a hierarchy of atomic-scale simulations based on a reliable interatomic interaction potential, including molecular-statics and molecular dynamics simulations to understand the origin of helium surface segregation. The near-surface cluster dynamics found in these simulations have significant effects on the surface morphology, near-surface defect structures, and the amount of helium retained in the material upon plasma exposure. We integrate the findings of such atomic-scale simulations into a properly parameterized and validated spatially-dependent, continuum-scale reaction-diffusion cluster dynamics model, capable of predicting implanted helium evolution, surface segregation, and its near-surface effects in tungsten. This cluster-dynamics model sets the stage for development of fully atomistically informed coarse-grained models for computationally efficient simulation predictions, toward optimal design of plasma facing components.

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