GEC15-2015-000257

Abstract for an Invited Paper
for the GEC15 Meeting of
the American Physical Society

Interactions of Deuterium Plasma with Lithiated and Boronized Surfaces in NSTX-U[1]

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The main research goal of the presented research has been to understand the changes in surface composition and chemistry at the nanoscopic temporal and spatial scales for long pulse Plasma Facing Components (PFCs) and link these to the overall machine performance of the National Spherical Torus Experiment Upgrade (NSTX-U). A study is presented of the lithium surface science, with atomic spatial and temporal resolutions. The dynamic surface responds and evolves in a mixed material environments (D, Li, C, B, O, Mo, W) with impingement of plasma particles in the energy range below 100 eV. The results, obtained by quantum-classical molecular dynamics, include microstructure changes, erosion, surface chemistry, deuterium implantation and permeation. Main objectives of the research are i) a comparison of Li and B deposition on carbon, ii) the role of oxygen and other impurities e.g. boron, carbon in the lithium performance, and iii) how this performance will change when lithium is applied to a high-Z refractory metal substrate (Mo, W). In addition to predicting and understanding the phenomenology of the processes, we will show plasma induced erosion of PFCs, including chemical and physical sputtering yields at various temperatures (300-700K) as well as deuterium uptake/recycling.

[1]This work is supported by the U.S. Department of Energy Office of Science, Office of Fusion Energy Science, Award Number DE-SC0013752