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In-situ measurements of surface structure and composition evolution during high-flux plasma exposure[1] ROBERT KOLASINSKI, CHUN-SHANG WONG, RYAN HOOD, JOSH WHALEY, Sandia National Laboratories — In-situ analysis of surfaces during high-flux plasma exposure represents a long-standing challenge in the study of plasma-material interactions. While post-mortem microscopy can provide excellent detail on how the material itself has been modified, in-situ techniques can provide information on dynamic effects. In this study, we demonstrate how spectroscopic ellipsometry and low energy ion beam analysis can be applied to real-time characterization of surfaces during low energy, high-flux He and D implantation. Here we report on three applications: (a) growth of He-induced nanostructure on W plasma-facing surfaces, (b) effects of N and B impurities on W surface morphology and composition, and (c) removal of oxides from super-permeable membranes used for pumping and separation of H isotopes from plasma exhaust. In-situ spectroscopic ellipsometry was found to be extremely sensitive to nm-scale changes surface morphology induced by plasma exposure, capturing the early stages of W nanostructure growth and providing insight into the erosion of thin oxides. Low energy ion beam analysis was used to complement these results by providing information on the composition of the first few nm of the exposed interface.

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