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6.35 Qualification of implanted depth markers for erosion and deposition studies in fusion experiments

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A novel method for measuring erosion of high-Z plasma facing components (PFCs) has been developed using bulk materials implanted with a single isotope a few microns deep or shallower from the surface. Changes to the depth of the implanted isotope, measured by particle-induced gamma emission, indicate erosion/deposition at the surface of the PFC. In addition to applicability in ex situ analysis, implanted depth markers can be deployed for an Accelerator-based In situ Materials Surveillance (AIMS) diagnostic, which enables shot-by-shot analysis of the inner wall in fusion energy experiments. This work describes the characterization of the implanted layer, as well as assessment of its viability in terms of thermal stability and the retention of bulk properties of the PFC surface layer traversed by the implanting beam. Implantation temperatures from 300 to 700 C and sample baking from 120 to 1000 C for 1 to 24 hours were studied. A synthetic diagnostic developed to assess measurement sensitivity and aid in interpreting experimental data shows excellent agreement between simulated and experimental measurements. The experiments, combined with the synthetic diagnostic, show erosion/deposition sensitivities of ˜ 40 nm for high-Z PFCs.

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