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Development of a novel in-situ accelerator-based surface diagnostic for Alcator C-Mod[1] ZACH HARTWIG, DENNIS WHYTE, Massachusetts Institute of Technology — Boundary science in magnetic fusion devices is severely hindered by a dearth of in-situ diagnosis of the surfaces of Plasma Facing Components (PFC). The customary laboratory surface diagnostic, nuclear scattering using MeV-range ions, is being adapted to the Alcator C-Mod tokamak. The design features toroidally and poloidally resolved measurements of PFC surface element and isotope compositions on a shot-to-shot basis with 1 cm spatial resolution and sub-micron depth resolution. Several novel design features are described. An RF quadrupole accelerator supplies a high-current 0.93 MeV deuteron ion beam for injection into C-Mod between discharges. The ion beam is steered to a large fraction of the PFC surfaces by applying tokamak toroidal and poloidal fields. The deuterons have high Q, large nuclear-reaction cross-sections with most low-Z isotopes; the resulting high-energy gammas and neutrons are then detected for quantitative analysis of the surface compositions. Numerical modeling of these processes towards PFC measurements of interest are described, including boron film depth, deuterium fuel retention, isotope tracing for transport studies and PFC net erosion.

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