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# 8.2 In-situ surface diagnostics for magnetic fusion

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Important plasma-surface processes in burning plasmas include erosion due to physical and chemical sputtering, material redeposition and transport, mechanical failure, and other unique topics such as fuel recycling, tungsten fuzz formation, tritium retention, all of which are wall-material dependent and highly dynamic. It is also anticipated that better understanding through in-situ measurements will lead to better plasma performance and plasma-facing material development. Although a suite of surface diagnostics exists for material science, chemistry and others, very few of them can be directly applied to in-situ surface diagnostics due to the hostile environment of burning plasmas and the presence of tesla magnetic fields. Fusion neutrons only make the problem more challenging. Here we review the existing fusion surface diagnostics, as well as current status of surface measurements that can potentially be adapted to in-situ monitoring or characterization of particle flux, species identification, erosion rate, particle recycling, energy flux, and their temporal evolutions. Examples from several fusion devices and plasma experiments will be given. New opportunities for in-situ diagnostics associated with novel material interrogation techniques will be emphasized.

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