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Stress Corrosion Cracking of Austenitic Stainless Steels: Correlating in-situ crack tip chemistry and crack growth rate measurements

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Abstract: Localized corrosion and stress corrosion cracking (SCC) are potential degradation mechanisms for stainless steels (SS) when exposed to corrosive marine environments. Under stresses (either external or residual), it is possible that localized corrosion features can nucleate a crack and propagate, leading to catastrophic failure. In order to inform upon potential materials degradation in corrosive environments for SS alloys, we present experimental efforts in determining SCC susceptibility for SS304L. *In-situ* crack growth rates (CGR) have been measured in concentrated salt brines at elevated temperatures. In addition to cracking kinetics, *in-situ* crack tip measurements assess the potential controlling nature of crack tip chemistry on crack growth rates. The controlling nature of the external surface is highlighted. By combining both *in-situ* CGR and crack tip chemistry measurements, insights into observed fracture morphologies, testing methodologies, and SCC mechanisms can be made.

Statement of impact: By combining *in-situ* crack tip chemistry measurements with *in-situ* CGR measurements, the dominating factors of the crack tip chemistry can be understood helping to mechanistically understand SCC in austenitic SS. One potential scenario under which chloride-induced SCC of SS304L may pose a risk is the interim storage and the eventual transport of spent nuclear fuel in SS canisters. By detailing the governing mechanisms of SCC in SS systems, more accurate models and effective mitigation strategies can be achieved.

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