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Experimental characterization of intergranular fracture of irradiated austenitic stainless steels

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Austenitic stainless steels are used in the nuclear industry to make the internals parts of Pressurized Water Reactors (PWR) such as baffle and former plates. Numerous Baffle-to-Former Bolts (BFB) intergranular failures have been reported as a result of Irradiation Assisted Stress Corrosion Cracking (IASCC) phenomenon. In order to predict the cracking of the grain boundary through a micro-mechanical approach, it is necessary to determine the intragranular mechanical behavior of the steel and the grain boundary strength.

Micro-compression tests of non-irradiated and proton irradiated 304L micro-pillars will be performed to collect experimental data on the mechanical behavior at the single crystal scale. Based on these experiments and data available in the literature, numerical simulations will be set up to calibrate the parameters of crystal plasticity constitutive equations as a function of irradiation dose and temperature.

To obtain the cracking resistance of the grain boundary, experimental bending tests on micro-cantilevers containing a grain boundary will be carried out on non-irradiated and proton irradiated pre-oxidized 304L steel. Numerical simulations of these experiments will be performed to evaluate failure stresses of the grain boundary as a function of oxidation time, irradiation and grain boundary type.

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