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THE EFFECT OF BULK COMPOSITION ON SWELLING AND RADIATION-INDUCED SEGREGATION IN AUSTENITIC ALLOYS

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Changes in bulk composition are known to affect both radiation-induced segregation and microstructural development, including void swelling in austenitic stainless steels. Judicious choices of major element or impurity element concentrations can be used to reduce grain boundary chromium depletion, thus reducing susceptibility to environmental cracking. Variations in composition can also produce materials with increased resistance to void swelling. In this work, select solutes have been added to an Fe-18Cr-8Ni alloy (bulk composition corresponding to 304 stainless steel) to identify the effect of composition on microstructural and microchemical development. Fe-18Cr-40Ni is analyzed to study the effect of bulk diffusivity increases, Fe-16Cr-13Ni to isolate the effect of major elements in improving both swelling resistance and intergranular cracking resistance in 316 stainless steel, and Fe-18Cr-8Ni+Zr to determine the effect of an oversized element on enhancing point defect recombination. Following irradiation with high energy protons, the microstructure of irradiated samples is investigated to determine the void size distribution and dislocation microstructure. The swelling calculated from the void distribution is compared to the swelling in the Fe-18Cr-8Ni alloy to determine the effect of composition change on void swelling. For each of the alloys, grain boundary composition is also measured to determine the effect of composition change on grain boundary segregation, and to relate microchemical changes to swelling resistance.

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