Grain Boundary Structure Effects on Intergranular Stress Corrosion Cracking of Alloy X-750

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Abstract

It is well known that the properties and behavior of grain boundaries are strongly affected by local chemistry and atomic structure. This paper focuses on the mesoscale description of grain boundary structure (i.e., the five crystallographic degrees-of-freedom) and correlations with intergranular stress corrosion cracking observed in Alloy X-750. Orientation imaging microscopy, coupled with serial polishing, is used to reveal mesoscale structure and the connectivity of the grain boundary network. The propensity for cracking is correlated with the coincident site lattice (CSL) classification of grain boundary geometry, coupled with information about the orientation of the grain boundary plane. The data is interpreted to show that low-CSL boundaries (defined by the more restrictive Palumbo-Aust criterion), low-angle boundaries, and general boundaries with plane normals well off the principal stress axis, have low vulnerability to cracking.