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A Combined Approach to Reducing Sensitization in Austenitic Stainless Steel

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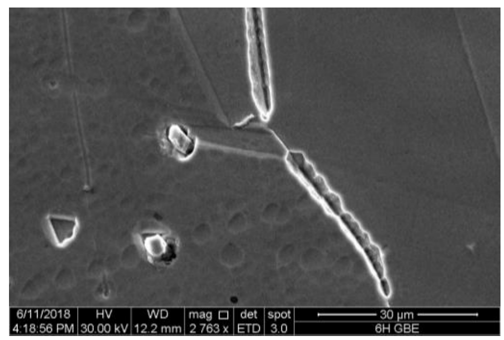
Abstract

Austenitic stainless steels contain appreciable amounts of chromium and nickel and are used in a wide array of applications, from cookware and food handling equipment to heat exchangers and chemical processing tanks, due to their excellent corrosion resistance and good formability. When exposed to elevated temperatures during welding, heat treating, or in service, many austenitic stainless steels can experience sensitization, wherein carbide particles form and deplete the grain boundaries of chromium, leaving them vulnerable to corrosion.

Grain boundary engineering (GBE) is a field of study established in the 1980s that involves controlled deformation and annealing of metals to deliberately alter the grain boundary structure in beneficial ways. The main goal of GBE is to lower the interfacial energy of the grain boundaries, often by creating particular coincident site lattices (CSLs). GBE has been studied along with many other techniques, such as controlling carbon content and adding stable carbide formers such as Ti or Nb, to reduce the severity of sensitization of 304 steel, but still the problem of sensitization persists, partly due to one-sided approaches.



SEM Image of a twin boundary inhibiting intergranular corrosion where it meets a regular grain boundary.

This work aims to examine the relationship between GBE, carbon content, delta-ferrite content, and the nucleation and growth mechanics of carbides in 304 stainless steel to better understand how to reduce or completely prevent sensitization in this material.

Biography

Erin Connelly is a PhD student working under Dr. Druschitz at the Kroehling Advanced Materials Foundry, planning to graduate in December 2019. They graduated from Virginia Tech in 2014 with a B.S. and in 2015 with an M.S., both degrees in MSE and focused on metal casting and corrosion, fields they have continued to study as a PhD student. They presented their Master's thesis on Al-Ga sacrificial anodes at NACE Corrosion 2016 in Vancouver.