New Phenomena of Intergranular Corrosion (IGC) Facilitated by Hydrogen in Stainless Steels

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Abstract This research aims to investigate the distribution of hydrogen and hydrogen-facilitated intergranular corrosion (IGC) in stainless steel, which comprises mainly Σ3 and random grain boundaries. The coherent twin boundaries Σ3, which routinely exhibited excellent corrosion resistance, were observed to be prone to IGC after hydrogen charging. Furthermore, the results demonstrated that the inhomogeneous distribution of absorbed hydrogen finally induced IGC at grain boundaries in both the solution-treated and sensitized specimens. The mechanism of hydrogen-facilitated IGC differs from the conventional chromium-depleted theory. Furthermore, the high-resolution characterizations revealed that hydrogen could deteriorate the passive film of stainless steel, resulting in thinner thickness and more porous morphologies. Hydrogen could also convert components of the passive film which are effective in resisting corrosion into ineffective components. The underlying mechanisms and connections between hydrogen-facilitated pitting and hydrogen-induced destabilization of the passive film were also discussed in detail.