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Electronic Properties and Corrosion Resistance of Passive Films on Austenitic and Duplex Stainless Steels

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Abstract

Passive films were grown at constant potential in acidic (pH 2) and alkaline (pH 13) solutions on chromium, AISI 304L, AISI 316L and Duplex stainless steels. Passive films on chromium grow following a high field mechanism considering the presence of dissolution phenomena. According to the photoelectrochemical characterization, passive films on Cr have a bandgap of 3.4 eV when formed in acidic solution, and of 2.4 eV when formed in alkaline solution due to the formation of $Cr(OH)_3$. These films result to be poorly stable against anodic dissolution due to a very anodic flat band potential. Conversely, impedance and photoelectrochemical measurements proved that passive films on stainless steels are chromium rich oxide n-type semiconductors with a very high polarization resistance. Their band gap depends on the pH of the passivation solution and the SS composition.