Erosion and Passivation of Borated 254 SMO Stainless Steel in Simulated Flue Gas Desulfurization Solution

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Grain boundary erosion and passivation of 254 SMO stainless steel with and without boron were investigated in a medium of simulated flue gas desulfurization (FGD) solution. Electrochemical measurements were carried out using potentiodynamic polarization, electrochemical impedance spectroscopy, and Mott-Schottky analysis to determine the significance of boron addition at different temperatures. After potentiodynamic polarization, microstructures and grain boundary erosion were evaluated at 60 °C using scanning electron microscopy (SEM). It was found that the dissolution/erosion of grain boundary is much lower when boron is added. Energy-dispersive X-ray spectroscopy was carried out after SEM to determine the reason of grain boundary erosion of nonborated 254 SMO and compared the passive regions of polarization tests at 60 °C. Experimental results show that the addition of boron significantly hindered the corrosion rate, pits initiation sites, and passive film dissolution. Deconvolution of peaks obtained from X-ray photoelectron spectroscopy (XPS) and their depth profiles after 60 °C passivation confirmed that boron not only stopped the corrosion behavior but also increased the stability and repassivation ability of passive film.

Keywords: Superaustenitic stainless steel; grain boundary erosion; boron effect; corrosion resistance; passive film composition

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