Synergistic Corrosion Mechanism of Cl^- and SO_3^{2-} on 2507 Duplex Stainless Steel

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Abstract The synergistic corrosion mechanism of Cl^- and SO_3^{2-} on 2507 duplex stainless steel during seawater desulfurization was investigated using simulation calculations, heat treatment, electrochemical test, SEM, EDS, XRD and XPS. Metallographic observations revealed that the microstructure comsisted of ferrite and austenite phases after solid solution treatment at 1050 °C for 60 min. The electrochemical tests indicated that the hydrolysis of SO_3^{2-} increased the pH of the simulated artificial seawater and inhibited the oxygen depolarization process at the cathode. Moreover, SO_3^{2-} and metal ions formed metal sulphates, reducing the shielding performance of the passivation film and thus promoting corrosion in the presence of Cl^-. Corrosion morphology observation revealed that the corrosion type of 2507 duplex stainless steel in simulated artificial seawater with different concentrations of SO_3^{2-} is selective pitting corrosion, with pitting holes preferentially nucleating and growing in the ferrite region. As the concentration of SO_3^{2-} increases, the number and size of pitting holes increased.

Keywords seawater desulfurization; 2507 duplex stainless steel; SO_3^{2-}; Cl^-; passive film; synergetic corrosion