Effects of Temperature on Corrosion Behaviour of 2205 Duplex Stainless Steel in Carbon Dioxide-Containing Environments

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Temperature plays a decisive role in carbon dioxide corrosion and stainless steel passive film stability. The effects of temperature on the corrosion behaviour of 2205 duplex stainless steel in oil and gas field environments containing carbon dioxide were studied in the range of 30–150 °C by electrochemical analysis, scanning electron microscopy and X-ray photoelectron spectroscopy. The results showed that increasing temperatures increased the amount of corrosion products and the pit area on the material surface. At 150 °C, the surface oxide film broke, and the pit density was highest. As the temperature increased, the hydroxide ion content in the passive film increased, whereas the oxide ion content decreased, and chromium(III) oxide was converted into chromium(III) hydroxide, which has poor corrosion resistance. As the temperature increased, the slopes of the Mott-Schottky curves and the donor and acceptor densities increased. The increase in acceptor density resulted in an increased anion concentration in the electrical double layer in the passive film, accelerating the intrusion of anions into the film. The increase in donor density resulted from the oxidation of iron(II) iron(III) owing to the increased temperature, which thereby increased the oxygen vacancy density in the film.

Keywords: 2205 duplex stainless steel; film; carbon dioxide corrosion; high temperature

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