Electrochemical and Corrosion Behavior of 316L Stainless Steel in a CO₂-SO₂-H₂O Mixture

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Although steel corrosion in a SO₂-containing atmospheric environment has been extensively investigated, its electrochemical behavior still needs to be addressed, especially when it coexists with CO₂ in a carbon capture, utilization and storage system. In this work, electrochemical experiments with 316L stainless steel corrosion in a CO₂-saturated solution were conducted by adding different amounts of SO₂ to a solution at 25 °C under different pH conditions. The effect of SO₂ on the cathodic reactions of 316L stainless steel corrosion in a CO₂-saturated solution was investigated by electrochemical methods, including potentiodynamic sweep, linear polarization resistance and electrochemical impedance spectroscopy. The results showed that the presence of SO₂ increased the cathodic limiting current and corrosion rates of 316L stainless steel at the same pH. There was a “second-wave” phenomenon that appeared before the second limiting current and this new “wave” was demonstrated to be related to the direct reduction of both hydrate of SO₂ and bisulfite on the steel surface.

Keywords: CCUS; CO₂; SO₂; cathodic reaction; 316L stainless steel

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