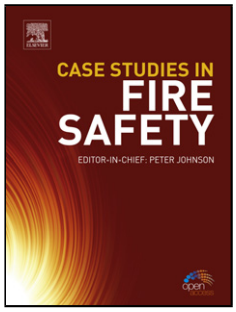

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Local supersaturation and the growth of protective scales during CO_2 corrosion of steel: effect of pH and solution flow.

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Highlights

- Kinetics of formation of protective siderite scale during CO_2 corrosion elucidated
- Observed current is sum of crystallisation and dissolution as carbonato complex
- Initial amorphous film controls crystallisation kinetics and dissolution rate
- Crystal nucleation independent of hydrodynamics
- Hydrodynamics controls dissolution and crystal growth differently

Abstract

By correlating *in-situ* synchrotron X-ray diffraction measurements with electrochemical measurements using a rotating disc electrode, we demonstrate the critical dependence on the local supersaturation of the kinetics of formation of a protective crystalline scale on the surface of carbon steel during CO_2 corrosion in brine at elevated temperature. We show that the total current is the sum of a current due to dissolution of iron and a current due to growth of a crystalline layer. We show that the dissolution current and the surface supersaturation are controlled by the thickness of an initially-formed amorphous layer. As in earlier work at room temperature, we infer that the