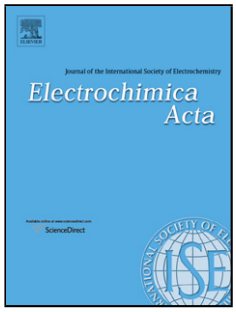

Title: *In situ* SR-XRD study of $FeCO_3$ precipitation kinetics onto carbon steel in CO_2-containing environments: The influence of brine Ph

Authors: D. Burkle, R. De Motte, W. Taleb, A. Kleppe, T. Comyn, S.M. Vargas, A. Neville, R. Barker

PII: S0013-4686(17)32009-1
DOI: https://doi.org/10.1016/j.electacta.2017.09.138
Reference: EA 30337

To appear in: *Electrochimica Acta*

Received date: 14-4-2017
Revised date: 21-9-2017
Accepted date: 22-9-2017

Please cite this article as: D.Burkle, R.De Motte, W.Taleb, A.Kleppe, T.Comyn, S.M.Vargas, A.Neville, R.Barker, In situ SR-XRD study of FeCO3 precipitation kinetics onto carbon steel in CO2-containing environments: The influence of brine Ph, Electrochimica Acta https://doi.org/10.1016/j.electacta.2017.09.138

In situ SR-XRD study of $FeCO_3$ precipitation kinetics onto carbon steel in CO_2-containing environments: The influence of brine pH

D. Burkle,[a*] R. De Motte,[a] W. Taleb,[a] A. Kleppe,[b] T. Comyn,[c] S. M. Vargas,[d] A. Neville,[a] and R. Barker[a]

[a]Institute of Functional Surfaces, School of Mechanical Engineering, University of Leeds, Leeds, LS2 9JT, United Kingdom.
[b]Diamond Light Source Ltd, Diamond House, Didcot, Oxfordshire, OX11 ODE United Kingdom.
[c]Ionix Advanced Technologies, 3M Buckley Innovation Centre, Firth Street, Huddersfield, HD1 3BD, United Kingdom.
[d]BP America, Inc., Houston, Texas 77079, United States of America.

[*]**Corresponding Author**

ABSTRACT

The growth of iron carbonate ($FeCO_3$) on the internal walls of carbon steel pipelines used for oil and gas transportation can reduce internal corrosion significantly. Solution pH can be considered as one of the most influential factors with regards to the kinetics, morphology and protection afforded by $FeCO_3$ films. This paper presents results from a recently developed *in situ* Synchrotron Radiation-X-ray Diffraction (SR-XRD) flow cell integrated with electrochemistry for corrosion measurements. The cell was used to follow the nucleation and growth kinetics of corrosion products on X65 carbon steel surfaces in a carbon dioxide (CO_2)-saturated 3.5 wt.% NaCl brine at 80°C and a flow rate of 0.1 m/s over a range of solution pH values (6.3, 6.8 and 7). In all conditions, $FeCO_3$ was identified as the only crystalline phase to form. Electrochemical results coupled with post-test surface analysis indicate that at higher pH, larger portions of the surface become covered faster with thinner, more protective films consisting of smaller, denser and more compact crystals. The comparison between XRD main peak area intensities and $FeCO_3$ surface coverage, mass and volume indicates a qualitative relationship between these parameters at each pH, providing valuable information on the kinetics of film growth.