

## SVET measurements combined with in-situ scratch approaches

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Accelerated corrosion testing based on the introduction of surface defects is an increasing necessity for the modern development of protective coating systems [1].

A few methods for the in-situ introduction of defects during conventional corrosion testing have been proposed [1,2]. In parallel, local assessment of corrosion (and inhibition) processes from defects produced ex-situ (before exposure to an electrolyte) have been widely considered in the literature. The understanding of the protection mechanisms often requires the evaluation of the dissolution, release, and transport of inhibitor species to a coating defect [3].

Nonetheless, considerable time-lapses often exist between the moment of surface scribing and the start of localized electrochemistry testing. It is reasonable to assume that the corrosion mechanism of defects temporarily exposed to air before contact with the corrosive solution certainly differs from those produced on a surface already immersed. In this context, the existing localized approaches are barely capable of capturing the inhibitive action during early-stage scratching, thus losing information of inhibition kinetics that are quite sensitive to the local environment.

Therefore, aiming at overcoming these limitations, this study proposes SVET measurements combined with in-situ scratch approaches. A commercial Berkovich indenter, assembled with epoxy resin to a metallic screw beam, was fixed in a manual micromanipulator positioned on a tilting base placed right next to the SVET cell. Two sets of spatially resolved experiments were carried out on bare hot-dip galvanized steel (HDG) specimens exposed to 0.05 M NaCl.

In the first one, scratches produced ex-situ were compared to defects created in-situ on the immersed surfaces. Through the in-loco scratch approach, it was possible to detect an extra 20 min of activity related to the early-stage corrosion of the defect. The second test consisted of imposing multiple in-situ scratching operations at the same locations of surfaces exposed either to NaCl or NaCl + Na<sub>2</sub>MoO<sub>4</sub> (inhibitor). This experimental design allowed the assessment of inhibition kinetic aspects provided by molybdate. Moreover, it allowed the evaluation of the dynamic response of the inhibitor upon repetitive creation of active surfaces.

The novel experimental approach here described allowed more detailed insights into the kinetics of corrosion/inhibition processes of scribed HDG and could be particularly useful for the investigation of self-healing systems.

[1] W. Kautek, G. Daminelli, *Electrochim. Acta.* 48 (2003) 3249–3255.

[2] G.T. Burstein, R.C. Newman, *Electrochim. Acta.* 25 (1980) 1009–1013.

[3] M.E. McMahan, R.J. Santucci, C.F. Glover, B. Kannan, Z.R. Walsh, J.R. Scully, *Front. Mater.* 6 (2019) 1–24.