Salt-induced iron corrosion under evaporating sessile droplets of aqueous sodium chloride solutions

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Repetitive drying and condensation of droplets from aqueous saline solutions deposited on a stainless steel substrate undergo the phenomenon of pitting corrosion. Our experimental work aims to investigate the corrosion process induced by evaporation of sessile droplets from aqueous sodium chloride solutions on planar iron surfaces.

The spatial distribution of the salt inside the evaporating sessile droplet is influenced by the initial salt concentration in the droplet bulk [2], and we studied how it is correlated to the localization of the anodic and cathodic reactions at the electrolyte-metal interface over the footprint droplet area.

At low salt concentration we found the inverse of the classical well-accepted Evans model: the anode area is established near the three-phase contact line region. Increasing salt concentration leads to a more uniform pitted sessile droplet: we observed locally anodic and cathodic areas over the droplet surface at the metal-electrolyte interface, where local variations in chloride concentrations occur.

In addition, the presence of corrosion products and some pits demonstrate that corrosion takes place, if the salt concentration reaches a threshold value. This is experimentally determined by an optical set-up, allowing also to measure liquid flow inside the droplet

[1] P. Takhistov and H.-C. Chang. Complex Stain Morphologies. Industrial & Engineering Chemistry Research, 41:6256–6269, 2002.