

Propositions

accompanying the dissertation

Data-driven Study of Atmospheric Corrosion under Multi-droplet Conditions

An End-to-end Experimental-computational Multi-modal Framework for Electrolyte-resolved Corrosion Kinetics Investigation

by

Keer ZHANG

1. (Chapter 1&2) Predicting atmospheric corrosion without explicitly modeling the electrolyte is just like forecasting the weather based solely on the season: statistically plausible, but physically groundless.
This proposition pertains to this dissertation
2. (Chapter 3&4) In multi-droplet environments, larger droplets exhibit a significantly higher probability of developing optically detectable corrosion products, and the accumulation of corrosion products primarily within or near the droplet footprint confirms that the Evans-type (differential aeration) mechanism governs the corrosion kinetics in discontinuous electrolyte layers.
This proposition pertains to this dissertation
3. (Chapter 3&4) The integration of electrical resistance sensing, computer vision, and machine learning transforms optical observation of droplet populations from a qualitative tool into a quantitative predictor of corrosion kinetics.
This proposition pertains to this dissertation
4. (Chapter 5) Surface roughness influences corrosion kinetics not only by increasing surface area but by fundamentally altering the dynamics of the electrolyte population through pinning and coalescence.
This proposition pertains to this dissertation
5. Artificial Intelligence for Sciences (AI4S) must evolve from a “Black Box” oracle into a “White Box” lens that aware the governing laws hidden within high-dimensional data.
6. The evolution in AI4S does not reduce the need for domain experts; rather, it increases the penalty for misunderstanding the underlying physics.

7. True transferability in predictive modeling remains elusive as long as experimental standards prioritize reproducibility over environmental reality.
8. The reproducibility crisis in materials science is usually not a methodology problem, but a data accessibility problem.
9. Transitioning from academia to industry after a PhD is not a compromise but a translation, which appreciates personal adaptability as much as institutional support.
10. Debugging a computer vision model that looks at rust is the only time where seeing “corrosion” on the screen is a sign of success rather than hardware failure.

These propositions are regarded as opposable and defensible, and have been approved as such by the promotor Prof. dr. ir. J.M.C. Mol and the copromotor Dr. Y. Gonzalez-Garcia.