

Novel Approaches to Corrosion Analysis through Data-Driven Computer Vision and Reflective Microscopy

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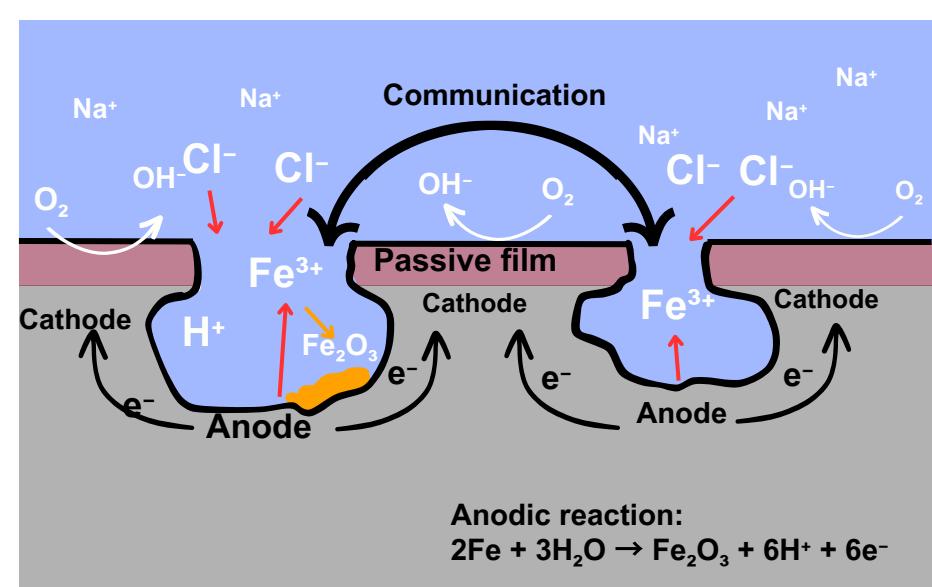
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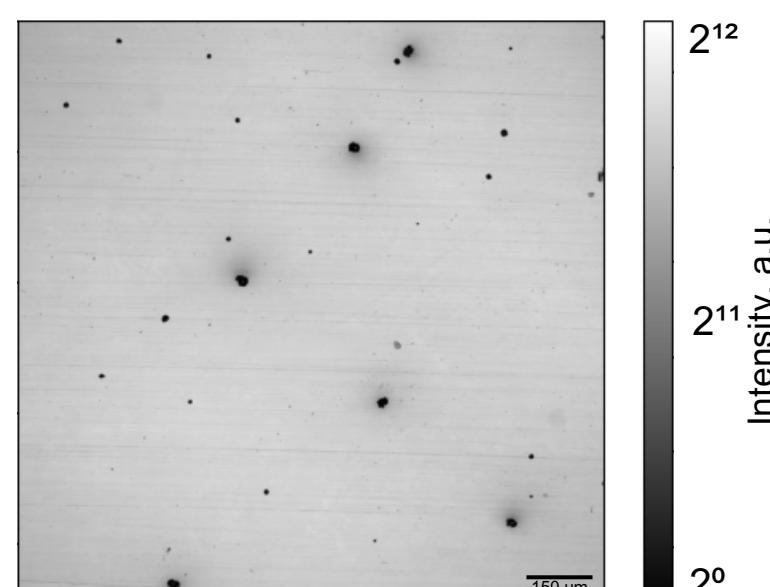


Source codes,
original data & more

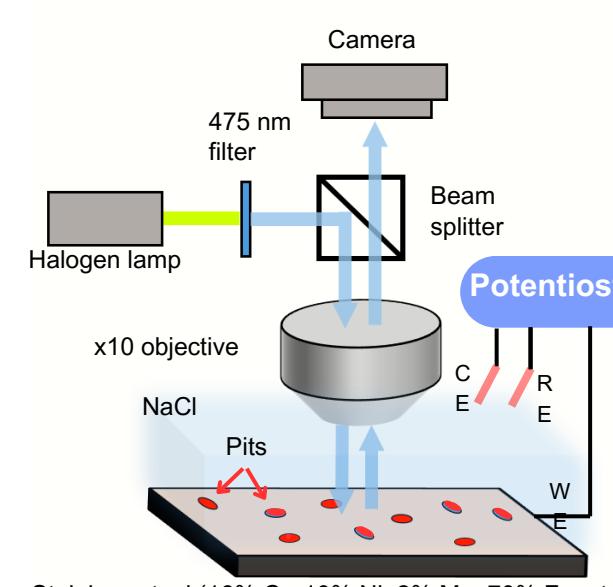
Methods : Multimodal Approach to Pitting Communication Studies



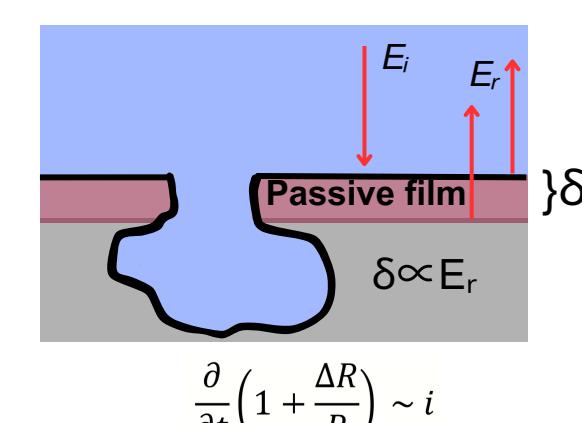
Scheme of pits growth and communication



Optical microscopy view of pitting corrosion on a steel surface during the experiment



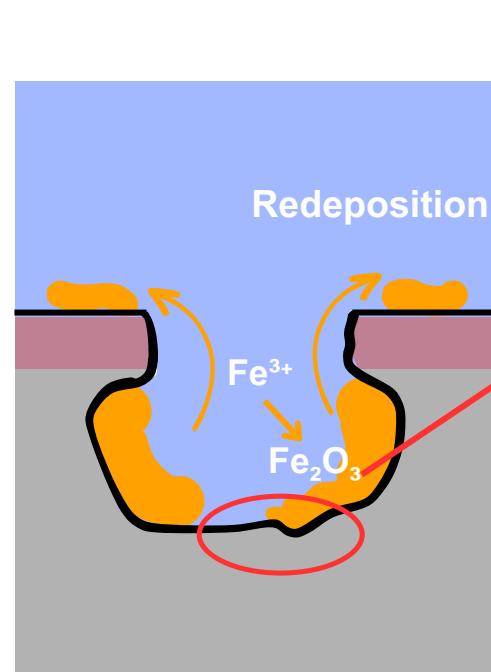
Scheme of the setup¹



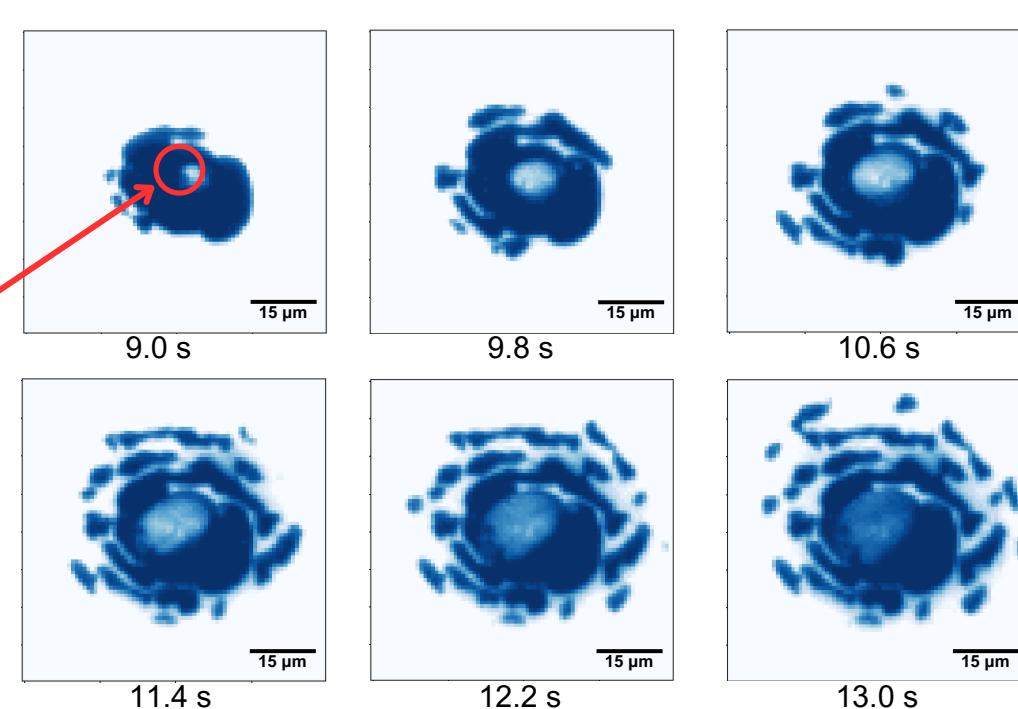
Change in reflected light intensity is proportional to the electrical current

Reflective microscopy was coupled with chronoamperometry (1.6 V vs Ag/AgCl)

Single Pit Dynamics: Redeposition Insights

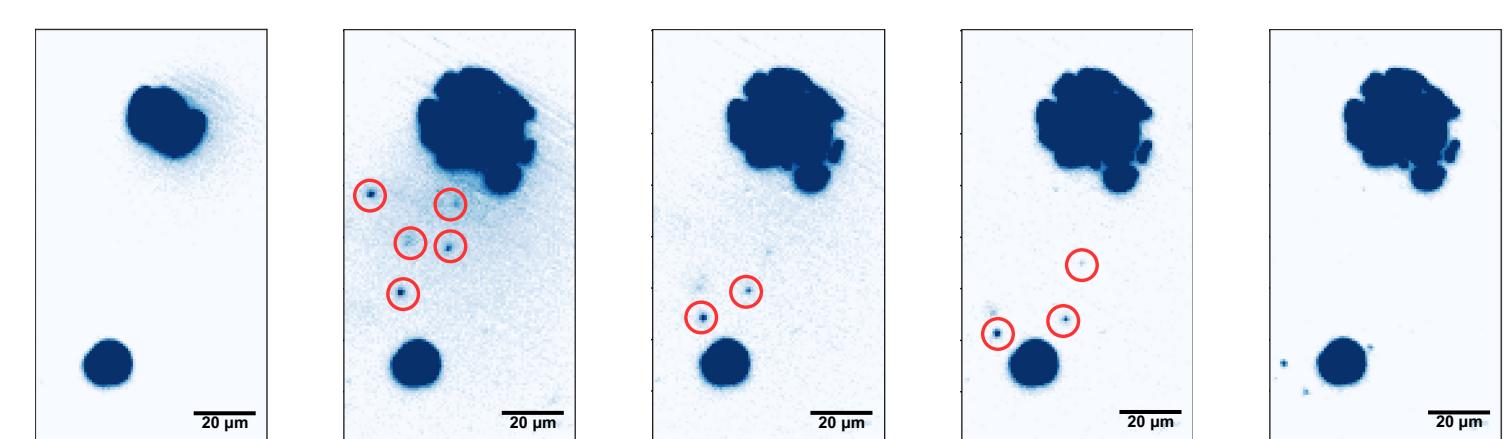


Scheme of Insoluble Corrosion Products Redeposition inside single pit

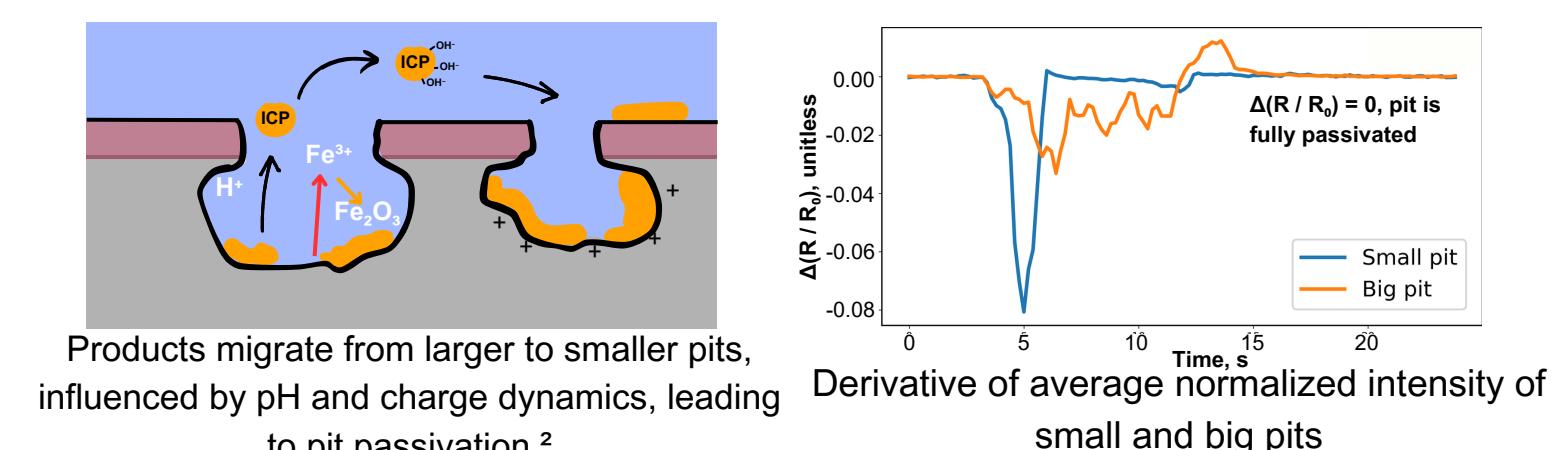
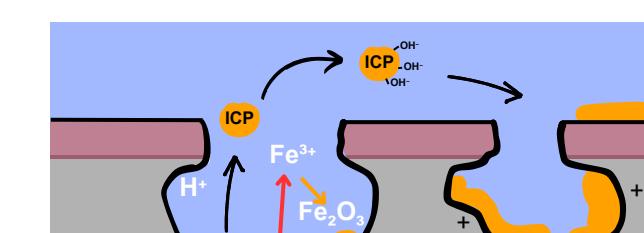


Sequential images of a corrosion pit: from the bright appearance of pure metal, darkening with passivation, to the surrounding deposition of corrosion products

Adjacent Pits: A Dance of Decay

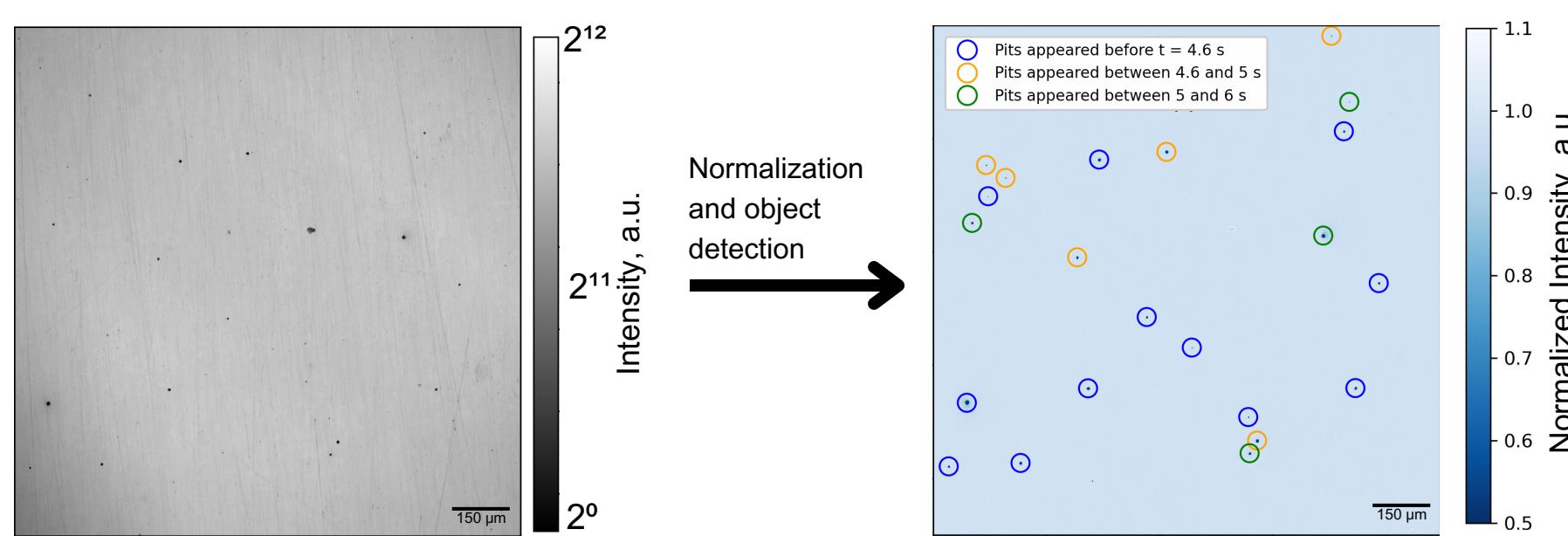


Sequential images showcasing two active pits. Corrosion products are observed migrating from the larger pit towards the smaller one, evidencing the dynamic interplay of pit interactions

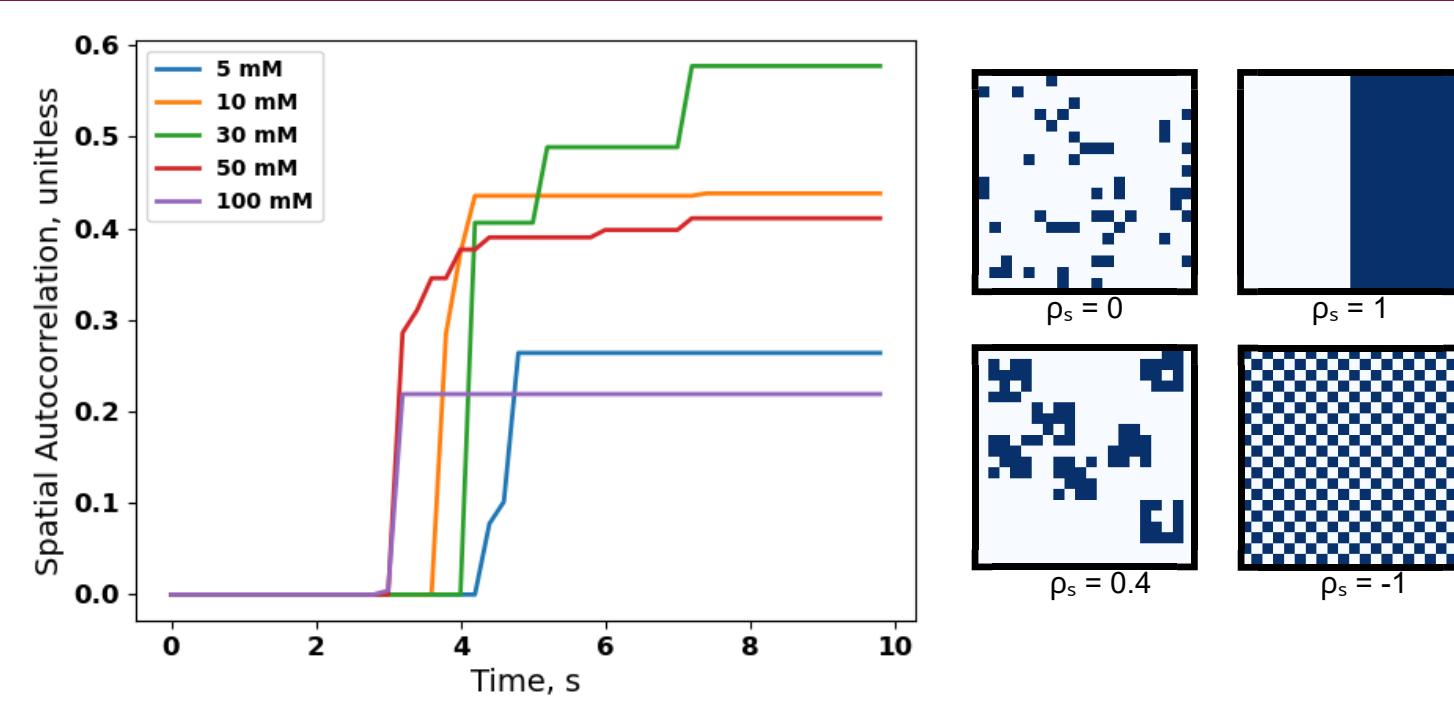


Products migrate from larger to smaller pits, influenced by pH and charge dynamics, leading to pit passivation²

Proximity Matters: Understanding the Spatial Distribution of Corrosion Pits



Original optical microscopy image (left) and normalized image (right): initial random distribution and subsequent clustering of emerging pits over time



Temporal progression of spatial autocorrelation (SA).³ SA consistently increases over time, the values remain unaffected by the NaCl concentration

Conclusions

- A novel approach to investigate pit communication during steel pitting corrosion was established, utilizing optical microscopy and computer vision
- Pit communication significantly influences overall reactivity, underscoring its practical relevance and the need for developing respective physical models

Acknowledgements & References

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¹ Godefroy L, Makogon A, Derouich S, Kanoufi F, Shkirskiy V. Anal. Chem., 95, 26, 9999–10007, 2023

² Ansari, T.Q., Luo, J.L. & Shi, S.Q. npj Mater Degrad 3, 28, 2019

³ Thompson E.S. et al., Journal of Colloid and Interface Science, 513, 2018