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CorWiz a Platform for Exploring Corrosion Data and Accessing Corrosion Models

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Abstract. Corrosion is a major cause of material degradation and failure in various industries and applications. Damage caused by corrosion causes billions in damage each year and is a major cause of infrastructure degradation. Besides that, corrosion mechanisms, countermeasures and effects are generally not good understood. The platform **CorWiz** will provide an easily accessible way to corrosion research and data.

Research data on corrosion mechanisms, rates, and prevention methods are essential for developing effective solutions and improving the performance and reliability of materials. However, corrosion research data are often scattered, inconsistent, or inaccessible, limiting their reuse and impact. Providing a more straightforward way to access available data and models has thus a significant impact on the research field and application areas.

In the following we present the components of the minimum viable platform focusing on stainless steel corrosion.

Keywords: Corrosion, Platform, Data-management, Corrosion-Modeling, Stainless-Steel corrosion

1. Introduction

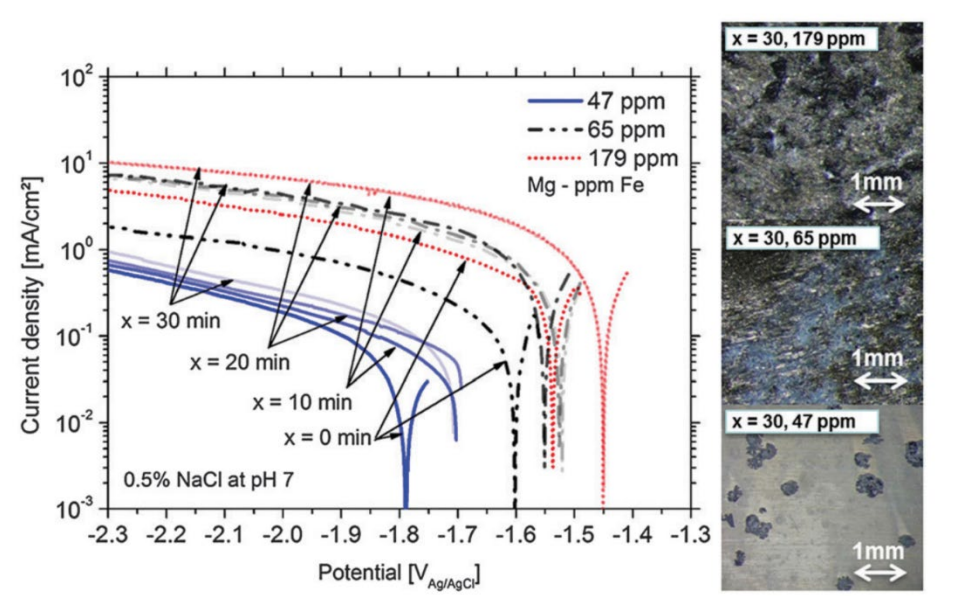

Figure 1: Example corrosion data from measurement [1]

Stainless steel is one of the most used materials in industrial applications due to its excellent corrosion resistance properties. However, stainless steel can still be susceptible to corrosion under certain conditions. Corrosion in stainless steel occurs when the protective layer of chromium oxide on the surface of the metal is damaged or removed, allowing oxygen and moisture to interact with the underlying metal. This can result in various forms of corrosion, such as pitting, crevice corrosion, or stress corrosion cracking, which can compromise the integrity of the material and impact its performance. Therefore, it is important to understand the causes and prevention methods of stainless-steel corrosion to ensure its long-term durability and reliability.

The envisioned platform builds upon existing technologies including Kadi4mat, Plotly and others to provide access to corrosion data and models using an intuitive web interface. While allowing the data to be used interoperable through a consistent metadata schema. Available data can be freely downloaded from the repository, while the platform can also be used to analyze data on the platform for processing and visualization.

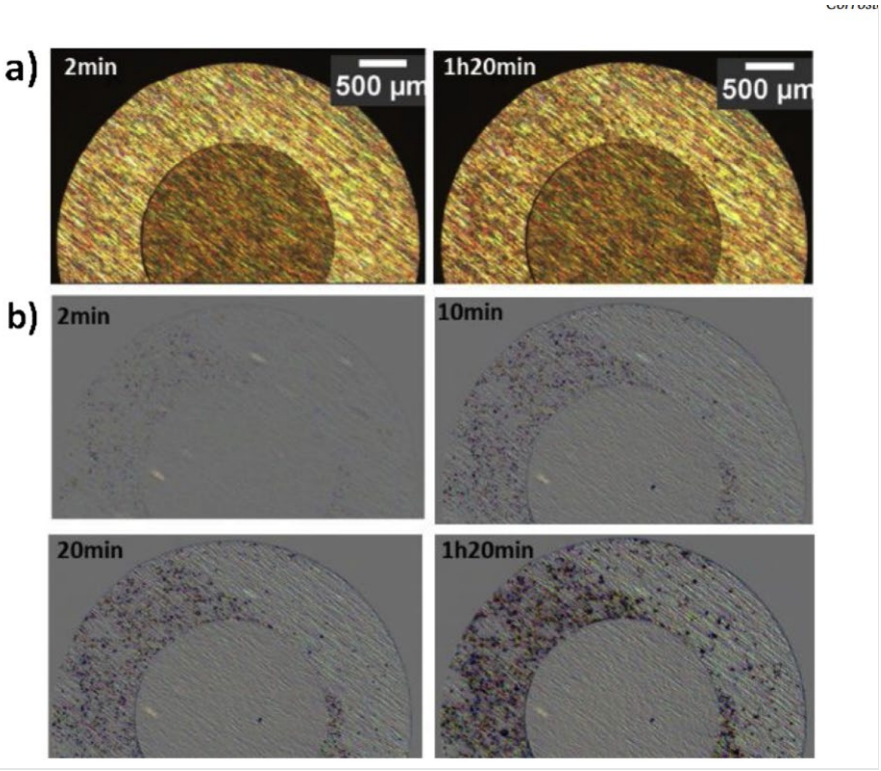

Figure 2: Optical images (a), and difference images by DVIT (b) over AA2024-Ti sample during immersion in 0.05 M NaCl. [2]

2. Data sources

Corrosion research data can be obtained from various sources depending on the objectives and scope of the study. And vary widely in the form of data ranging from electrostatic measurements (see Fig. 1), optical measurements (see Fig. 2) over to simulations (see Fig. 3). Some of the common data sources are:

- Laboratory experiments: These involve conducting controlled tests on materials or structures under simulated environmental conditions to measure their corrosion rates, mechanisms, and effects. The type of data obtained from laboratory experiments can include electrochemical measurements, weight loss measurements, surface analysis techniques, mechanical testing, etc.

- Field studies: These involve monitoring and evaluating the performance of materials or structures exposed to natural or service environments over a period of time. The type of data obtained from field studies can include visual inspection, non-destructive testing, corrosion coupons, sensors and probes, etc.

- Literature review: This involves collecting and analyzing existing information from published sources such as journals, books, reports, standards, etc. The type of data obtained from literature review can include theoretical models, empirical equations, statistical analysis, case studies, best practices, etc.

- Data repositories: These involve accessing and using online databases that store and share corrosion research data from various sources and domains. The type of data obtained from data repositories can include metadata (such as authorship, date, location), raw data (such as numerical values), processed data (such as graphs), derived data (such as indicators), etc.

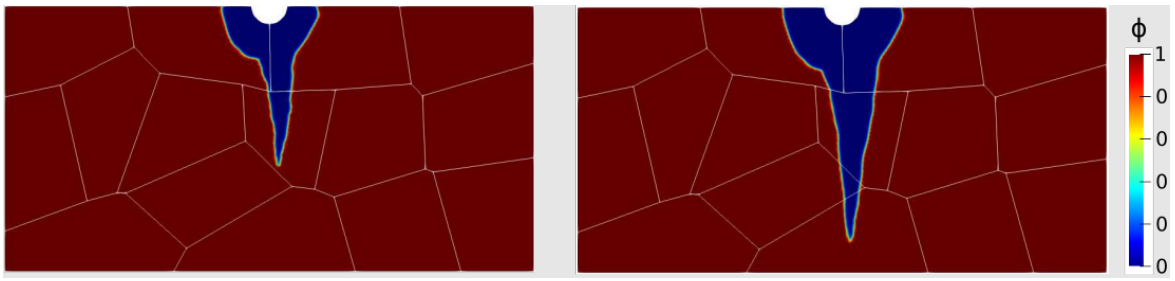

Figure 3: Evolution of the phase field in a pitting corrosion process of aluminium. [3]

3. CorWiz

CorWiz (see Fig. 4) is a platform that helps engineers and researchers access public corrosion data. Users can explore corrosion data using various filters, charts, and maps, and gain insights into the corrosion behavior of different materials and environments. Moreover, the web application enables users to explore and use corrosion models that can predict the corrosion rate, life cycle cost, and risk of failure of various structures and components. In the first phase of **CorWiz** we will limit ourselves to stainless steels and lab measurements of mass loss due to corrosion.

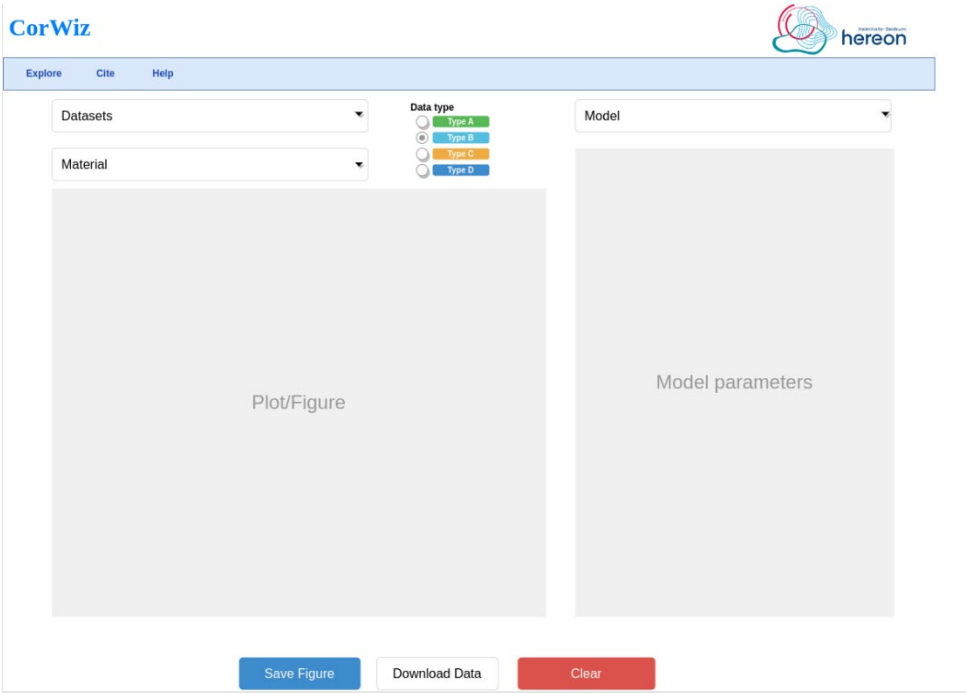

Figure 4: Mock Up of the Web Interface

4. Backend

Kadi4mat is a software tool that allows users to analyze and visualize corrosion data from various sources. It can handle different types of corrosion measurements, such as electrochemical impedance spectroscopy (EIS), potentiodynamic polarization (PDP), and weight loss (WL). Kadi4mat also provides features for data preprocessing, curve fitting, parameter extraction, and statistical analysis. Kadi4mat is used to store and process data to be presented on the **CorWiz**.

5. Conclusion

The minimal viable platform implemented during this first phase of **CorWiz** will demonstrate the impact of Research data management (RDM) and application of FAIR principles in corrosion research. Which will allow us to build upon and extend to further materials, more complex models and workflows.

Competing Interests

The authors declare that they have no competing interests.

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References

1. D. Hoeche et al., “The effect of iron re-deposition on the corrosion of impurity-containing magnesium”, Phys. Chem. Chem. Phys., 2016, 18, 1279, doi: 10.1039/C5CP05577F.
2. D. Snihirova et al., “Galvanic corrosion of Ti6Al4V -AA2024 joints in aircraft environment: Modelling and experimental validation”, Corrosion Science Volume 157, 2019, Pages 70-78, doi: 10.1016/j.corsci.2019.04.036.
3. C. Kandekar et al., “A partitioned computational framework for damage evolution in stresscorrosion cracking utilizing phase-field", Proceedings in Applied Mathematics & Mechanics, 2023, doi: 10.1002/pamm.202200211.