COMPREHENDING NANO-SCALE CORROSION BEHAVIOR USING MULTI- LAYERED PERCEPTRON FOR REGRESSION

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ABSTRACT

- Corrosion impact almost 3.4% of global GDP.
- Complexity and lack of understanding of nucleation process of corrosion.
- Ongoing research suggests crystal features and orientation and electrochemical behavior associated with corrosion.
- Integrated data obtained from scanning electrochemical cell microscopy (SECCM) and electron backscatter diffraction (EBSD) experiment.
- Proposed work exploits multi-layered perceptron (MLP) for regression based deep learning (DL) approach on integrated data to develop a model.
- Developed model can predict corrosion behavior with satisfying accuracy.
- Demonstrate that the behavior are related not only to the grain orientation but also to irregularities of grain surface.

RESEARCH GAP

- Recent research shows a close relationship between crystal orientation and electrochemical properties.
- Potential of zero charge (PZC) has been seen to correlate with the local grain crystal orientation.
- Although the relationship was observed, is the orientation information enough to predict the nano-scale electro-chemical behavior?
- Or are there other features that also play role in the corrosion behavior?

CONTRIBUTION

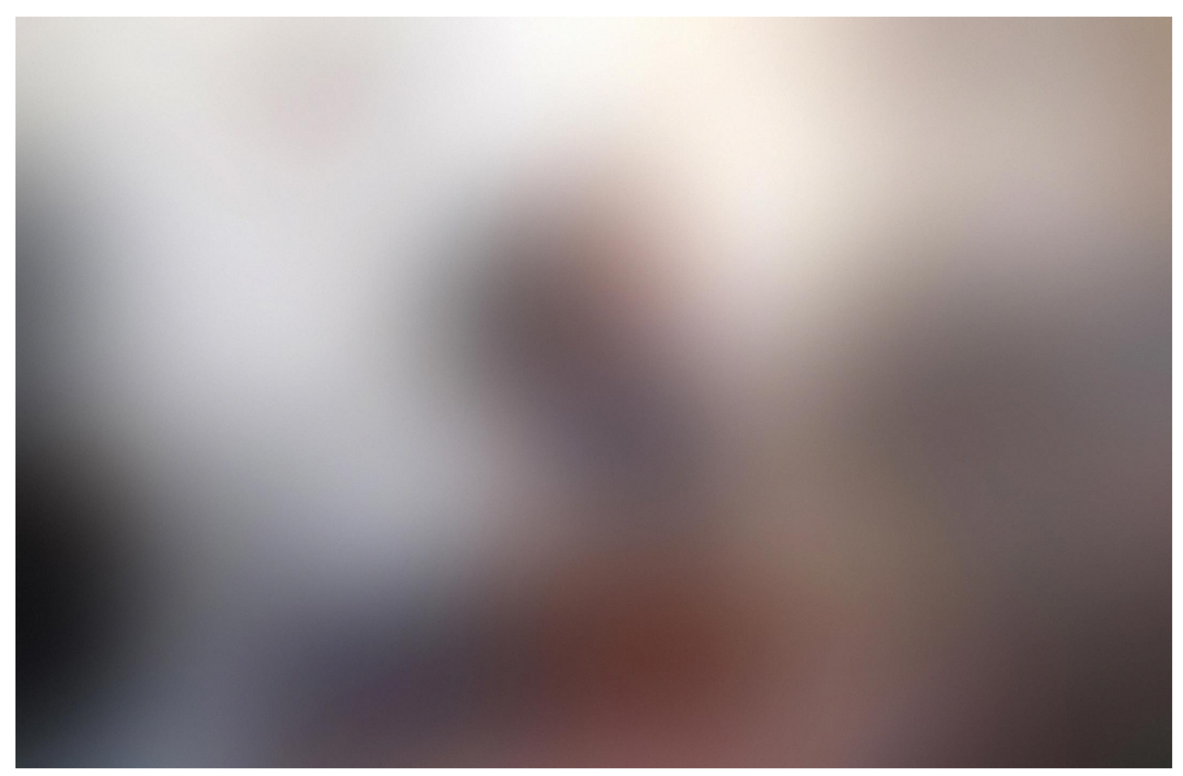
- Image processing-based approach for SECCM and EBSD data integration.
- Development of MLP-Regression model that predicts the corrosion behavior of grains of silver.

HIGHLIGHTS

- **Use of EBSD and SECCM data in the deep learning model.**
- **Regression model based on deep learning axiom that can predict the electrochemical behavior based on the grain orientation and surface features.**

METHODOLOGY

- Image processing-based matching SECCM datapoints with EBSD orientation and grain information.
- Three-layer neural network with limited memory Broyden Fletcher Goldfarb Shanno quasi-Newton algorithm (LBFGS) solver to minimize loss function.
- Developed MLP structure consists of 55, 55, 2 nodes on first, second and third layer, respectively.
- Input features used
  - Position coordinate (XYZ of every datapoint from SECCM experiment)
  - Euler angle (Orientation feature obtained from EBSD)
  - Z gradient with respect to both X and Y
  - Current at pitting condition



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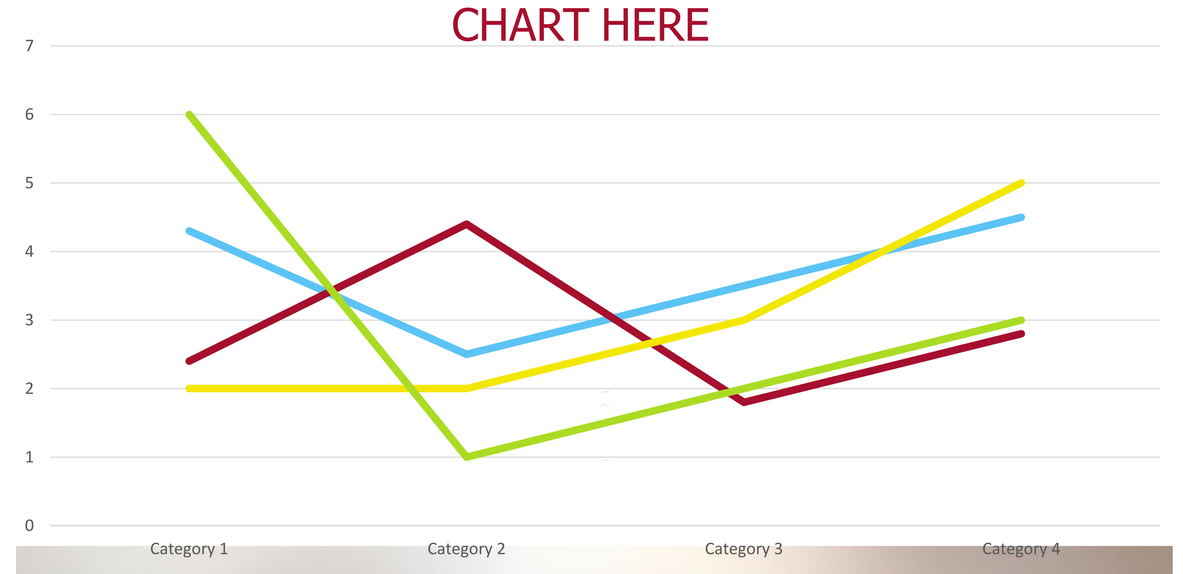

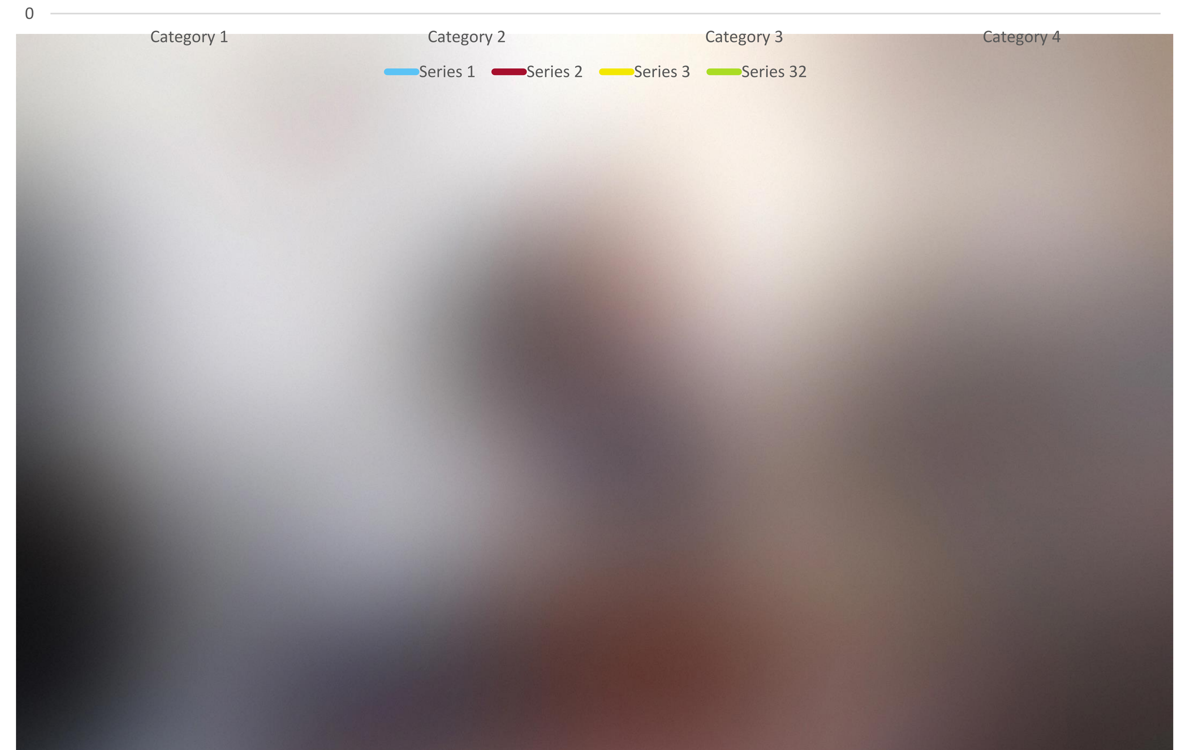

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MLP BASED REGRESSION MODEL

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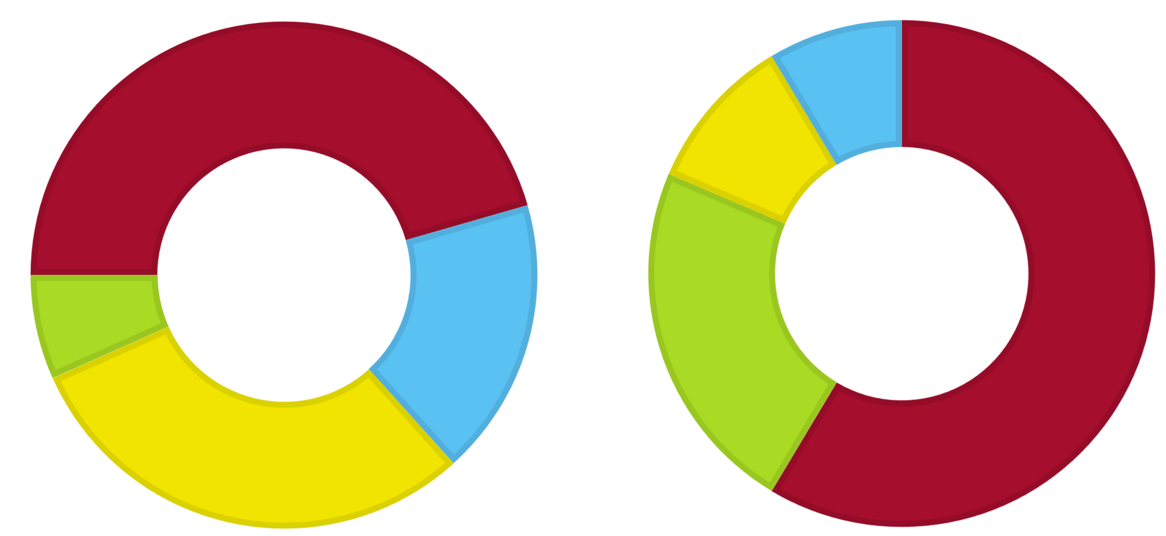

RESULTS

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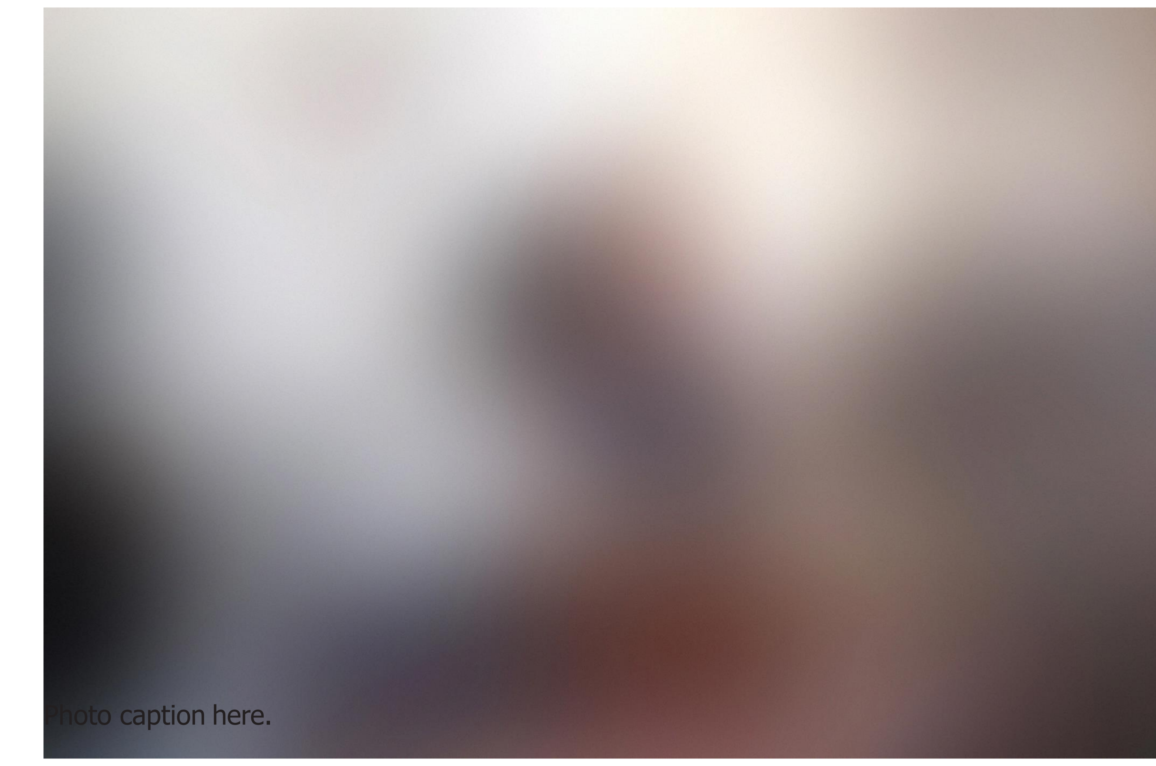

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CONCLUSION AND FUTURE WORK

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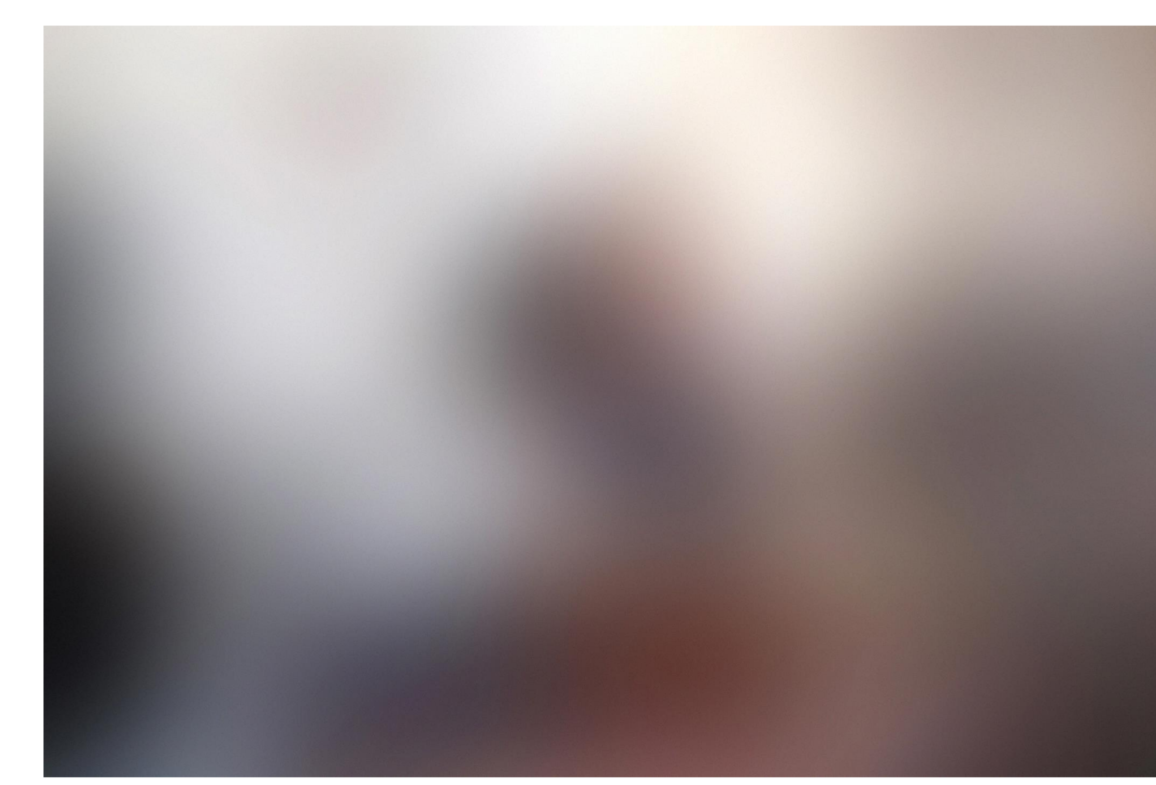

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