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Engineering & Scientific Consulting

## Samuel B. Madden, Ph.D., P.E.

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### Professional Profile

Dr. Madden's expertise is in corrosion science and electrochemistry. Dr. Madden has conducted research and failure analysis involving general corrosion, localized corrosion, environmentally assisted cracking, hydrogen embrittlement, and galvanic corrosion. His research has included the use of AC and DC techniques to evaluate the electrochemical behavior of metals and coatings. Dr. Madden has experience with mechanical testing techniques, fractography, metallurgical analysis, and microscopy as well as glass and silicon fracture analysis. He has experience in the failure analysis of microelectronics (i.e. solder ball void analysis and trace characterization), batteries (i.e. Li-ion, NiCd), and medical devices. Dr. Madden has participated in the failure analysis of large scale petrochemical infrastructure and conducted failure analysis inspections for litigation matters.

Dr. Madden has extensive experience with material and analytical surface science characterization techniques including scanning electron microscopy (SEM), electron dispersive spectroscopy (EDS), X-ray diffraction (XRD), Raman spectroscopy, and Rutherford backscatter electron spectroscopy (RBS). Dr. Madden is also skilled in computed tomography (CT) and 3D volume metrology. He has experience with diffusible hydrogen concentration studies in steels, including barnacle electrode and permeation method analysis.

Dr. Madden's doctoral research involved the investigation of crack-tip chemistry and its relationship to the repassivation of high strength aluminum alloys assisted by corrosion inhibitors.

### Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, University of Virginia, 2014

B.S., Physics, Union College, 2007

2nd Place, Milton Levy Award for Corrosion Science, NACE Corrosion Conference, La Quinta, CA, 2011

### Licenses and Certifications

Licensed Professional Engineer, Metallurgical, Texas, #134267

### Prior Experience

Graduate Research Assistant, University of Virginia, 2008-2014

Graduate Teaching Assistant, University of Virginia, 2010-2014

## Professional Affiliations

The Electrochemical Society (2010-present)

National Association of Corrosion Engineers — NACE (2009-present)

ASTM International (2015-present)

Sigma Xi, National Scientific Research Society

Sigma Pi Sigma, National Physics Honor Society

## Publications

Reitman, M. T. F., Dimitriou, M. D., Vargas, J. R., & Madden, S. B. (2020). Why is service life prediction of polymers and plastics exposed to outdoor weathering important? An industrial perspective. In C. C. White, M. E. Nichols, & J. E. Pickett (Eds.), *Service Life Prediction of Polymers and Coatings* (pp. 19-32). William Andrew Publishing. <https://doi.org/10.1016/B978-0-12-818367-0.00002-3>

Cain T, Madden SB, Birbilis N, Scully JR. Evidence of the enrichment of transition metal elements on corroding magnesium surfaces using Rutherford backscattering spectrometry. *Journal of the Electrochemical Society*,= 2015; 162:C228.

Madden SB, Scully JR. Inhibition of AA2024-T351 corrosion using permanganate. *Journal of the Electrochemical Society*, 2014; 161:C162.

Madden SB, Moosbauer DJ, Scully JR. Effects of chromate and molybdate ions on scratch repassivation behavior of precipitation hardened aluminum alloys. *ECS Transactions*, 2013; 50:57.

Madden SB, Scully JR. Investigation of permanganate as an environmentally friendly inhibitor of corrosion on aluminum 2024-T351. *Conference Proceedings, NACE DoD*, 2011, Palm Springs, CA, July 2011.

## Presentations

King AD, Bland LG, Madden SB, Cain T, Birbilis N, Scully JR. Electrochemical measurement of magnesium corrosion rates: A combined impedance, mass-loss and hydrogen collection study. *RTS, NACE*, San Antonio, TX, 2014.

Madden SB, Scully JR. The effects of chromate and molybdate anionic inhibitors on the scratch repassivation behavior of precipitation age hardened Al alloys. *Symposium Honoring Professor Clive Clayton*, ECS Conference, San Francisco, CA, 2013.

Madden SB, Scully JR. Effects of chromate and molybdate ions on scratch repassivation behavior of precipitation hardened aluminum alloys. *Hydrogen Interactions with Materials, ECS PRiME*, Waikiki, HI, 2012.

Madden SB, Scully JR. Inhibitor assisted regrowth of protective oxides over freshly scratched AA2024-T351 and AA7075-T6 electrodes. *University Corrosion Collaboration Meeting*, University of Virginia, Charlottesville, VA, 2012.

Madden SB, Scully JR. Mechanism of protection of selected chromate-free single inhibitors and inhibitor combinations Full immersion and droplet. *University Corrosion Collaboration Meeting*, University of Southern Mississippi, Hattiesburg, MS, 2012.

Madden SB, Scully JR. Investigation of permanganate as an environmentally friendly inhibitor of corrosion

on aluminum 2024-T351. NACE DoD Corrosion Conference, Palm Springs, CA, 2011.

Madden SB, Scully JR. Investigation of selected inhibitor combinations as an environmentally friendly corrosion inhibitor strategy for AA2024. University Corrosion Collaboration Meeting, US Air Force Academy, Colorado Springs, CO, 2011.

Madden SB, Scully JR. Permanganate and permanganate inhibitor combinations as environmentally friendly corrosion inhibitor replacements for AA2024-T351. NACE Corrosion Conference 2011, Houston, TX, 2011.

Madden SB, Scully JR. Investigation of permanganate as an environmentally friendly corrosion inhibitor strategy for AA2024. University Corrosion Collaboration Meeting, The Ohio State University, Columbus, OH, 2010.

## Project Experience

Conducted electrochemical analysis of aqueous corrosion inhibitors for high strength aluminum alloys. This included the development of techniques used to examine the repassivation of depassivated electrodes to study the effects of corrosion inhibitors on hydrogen uptake and embrittlement.

Participated in the failure analysis of line pipe steel used in ocean water including electrochemical measurements of hydrogen diffusion, hydrogen concentration and in-situ measurements of hydrogen embrittlement.

## Peer Reviewer

Electrochimica Acta

Journal of the Electrochemical Society

Corrosion Journal