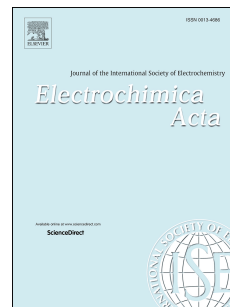


# Accepted Manuscript

Electrochemical aspects of copper atmospheric corrosion in the presence of sodium chloride

E.J. Schindelholz, H. Cong, C.F. Jove-Colon, S. Li, J.A. Ohlhausen, H.K. Moffat



PII: S0013-4686(18)30953-8

DOI: [10.1016/j.electacta.2018.04.184](https://doi.org/10.1016/j.electacta.2018.04.184)

Reference: EA 31751

To appear in: *Electrochimica Acta*

Received Date: 8 March 2018

Revised Date: 24 April 2018

Accepted Date: 24 April 2018

Please cite this article as: E.J. Schindelholz, H. Cong, C.F. Jove-Colon, S. Li, J.A. Ohlhausen, H.K. Moffat, Electrochemical aspects of copper atmospheric corrosion in the presence of sodium chloride, *Electrochimica Acta* (2018), doi: 10.1016/j.electacta.2018.04.184.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

**Electrochemical Aspects of Copper Atmospheric Corrosion in the Presence of Sodium Chloride**E.J. Schindelholz<sup>1\*</sup>, H. Cong<sup>4</sup>, C.F. Jove-Colon<sup>2</sup>, S. Li<sup>4</sup>, J.A. Ohlhausen<sup>1</sup>, H.K. Moffat<sup>3</sup><sup>1</sup>Materials Science and Engineering, <sup>2</sup>Geosciences Engineering, <sup>3</sup>Engineering Sciences, Sandia National Laboratories, Albuquerque, NM, 87185, USA<sup>4</sup>Department of Chemical and Biomolecular Engineering, Corrosion Engineering Program, The University of Akron, Akron, OH, 44325, USA

\*Corresponding

Abstract

This study describes the evolving state of electrolyte and corrosion processes associated with sodium chloride on copper at the initial stage of corrosion and the critical implications of this behavior on controlling kinetics and damage distributions. Sodium chloride droplets were placed on copper in humid conditions and the resulting electrolyte properties, corrosion products and damage were characterized over time using time-lapse imaging, micro Raman spectroscopy, TOF-SIMS and optical profilometry. Within minutes of NaCl droplet placement, NaOH-rich films resultant from oxygen reduction advanced stepwise from the droplets, leaving behind concentric trenching attack patterns suggestive of moving anode-cathode pairs at the alkaline film front. Corrosion attack under these spreading alkaline films was up to 10x greater than under the original NaCl drops. Furthermore, solid  $\text{Cu}_2\text{Cl}(\text{OH})_3$  shells formed over the surface of the NaCl drops within hours of exposure. Thermodynamic modeling along with immersed electrochemical experiments in simulated droplet and films electrolytes were used to rationalize this behavior and build a description of the rapidly evolving corroding system.

1. Introduction

The corrosion of copper in saline atmospheric environments, such as marine sites, has been a subject of study dating back over a century. This attention is reflective of the aggressive corrosive nature of sodium chloride, a primary component of sea salt, and the wide use of copper in applications ranging from electronics to architecture in these environments. Several aspects of copper corrosion phenomena in high chloride environments are well known. For example, the patina that forms on copper in the presence of high chloride typically and primarily consists of cuprite ( $\text{Cu}_2\text{O}$ ), tenorite ( $\text{CuO}$ ) and nantokite

Download English Version:

<https://daneshyari.com/en/article/6602832>

Download Persian Version:

<https://daneshyari.com/article/6602832>

[Daneshyari.com](https://daneshyari.com)