## Vita

Candidate's name: Steven Robert Curtis McWilliams

Universities Attended:
University of New Brunswick (2016)
Bachelor of Science

University of New Brunswick (2020)
Master of Science

**Publications/Conference Presentations:**

Hakimian, A., McWilliams, S.R.C. and Ignaszak, A. "ZnO Synthesized Using Bipolar Electrochemistry: Structure and Activity". *Materials* (2019), 12(3), p. 535.

McWilliams, S.R.C.; Flynn, C.D.; McWilliams, J.; Arnold, D.C.; Wahyuono, R. A.; Undisz, A.; Rettenmayr, M.; Ignaszak, A. 2019. "Nanostructured Cu2O Synthesized via Bipolar Electrochemistry." *Nanomaterials* 9, no. 12: 1781.

McWilliams, S.R.C.; Ignaszak, A. (June 2018) "Synthesis of Cuprous Oxide (Cu2O): A Wireless Bipolar Electrochemical Approach" at CCCE 2019, Quebec, QC, Canada (Oral presentation).

McWilliams, S.R.C.; Ignaszak, A. (June 2018) "Synthesis of Cuprous Oxide (Cu2O): A Wireless Bipolar Electrochemical Approach" at ChemCon2018, Halifax, NS, Canada (Oral presentation).

# Nanostructured Cuprous Oxide Synthesized by Bipolar Electrochemistry

UNIVERSITY OF NEW BRUNSWICK

THESIS DEFENCE AND EXAMINATION

in Partial Fulfillment

of the Requirement for the Degree of
Master of Science

by

**Steven R. C. McWilliams**

in the Department of Chemistry

U.N.B., Fredericton, N.B.

**Wednesday, March 18th, 2020**
**10:30 a.m.**

Toole Hall, Room 3

Examining Committee

| | |
|---|---|
| Dr. Anna Ignaszak | Supervisor |
| Dr. Adam C. Dyker | Internal Examiner |
| Dr. Igor Mastikhin | Int-Ext Examiner |
| Dr. John Neville | Chair of Oral Examination |

## Abstract

This thesis covers the development of and groundwork for an environmentally benign approach for the fabrication of cuprous oxide (Cu2O). By controlling the conditions that are applied to the reaction, the successful synthesis of uniform shapes and sizes of Cu2O particles were achieved. The advantage of this approach over other existing synthesis methods lies in its potential ability to generate non-stoichiometric oxides, which demonstrate different photoelectrochemical and optical properties as compared to a control sample. Furthermore, with varying reaction conditions, there was a slight improvement of the carrier concentration, absorption of light, and photocurrent generation. Scanning electron microscope (SEM)/Transmission electron microscope (TEM) showed that the structures appear to be built from substructures. Data from X-ray powder diffraction (XRD) determined that the nanoparticles are cubic in shape and the product is phase pure. Evidence provided by illuminating the sample under open circuit potential (OCP) conditions indicate that the Cu2O produced is a P-type semi-conductor.