

**UMSAEP (UM–UWC) ACADEMIC EXCHANGE PROGRAM PROJECT REPORT FOR  
28 AUGUST – 28 OCTOBER 2022**

**Project Title:** Understanding the relationship between Crystal Chemistry and Electrochemical Properties of  $\text{Na}_2\text{MnSiO}_4$  and  $\text{Li}_2\text{MnSiO}_4$  Nanomaterials in Secondary Na/Li ion Batteries.

**Report Submitted by:** Dr. Miranda Ndipingwi  
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**UWC Supervisor:** Professor Emmanuel Iwuoha  
DSI/NRF South African Research Chair for Nano Electrochemistry & Sensor Technology  
Director, Sensor Lab (University of the Western Cape Sensor Laboratories)

**UM Host:** Dr. Amitava Choudhury  
Associate Professor, Department of Chemistry, Missouri University

## Background

The exchange visit to the Missouri University of Science and Technology was originally planned for 2020. However, due to the COVID-19 pandemic and passport issues, the visit finally happened from the 28<sup>th</sup> of August – the 28<sup>th</sup> of October 2022, thanks to Prof Uphoff and Prof Iwuoha's great support. This represented the start of a productive research collaboration between SensorLab (University of the Western Cape Sensor Laboratories) with extensive expertise in nanomaterials synthesis and electrochemistry led by Prof Iwuoha and the Inorganic Solid State and Materials Group at Missouri S&T, with wide experience in solid state synthesis alongside single and powder X-ray crystallography, headed by Dr. Choudhury.

The main goal of the project was the fabrication and testing of cathode materials for lithium and sodium ion secondary batteries. The development and adoption of battery energy storage systems has become a global trend, due to the energy needs and climate commitments of many countries worldwide. Most especially, South Africa is currently facing massive load shedding which is severely affecting its social and economic activities. Cost effective and efficient batteries such as lithium and sodium ion batteries to store the energy produced by renewables and fed into the grid will play a huge role in reducing the huge shortfall in electricity supply and contribute towards enabling long term energy security.

## Project objectives

The original project objectives are listed below.

Synthesis of pristine and doped nanomaterials of  $\text{Na}_2\text{MnSiQ}$ , and  $\text{Li}_2\text{MnSiQ}$  and their coated composites with  $\text{V}_2\text{O}_5$  as cathode materials

Crystal structure refinement studies and electrochemical characterization of synthesized materials

Fabrication of Na/Li ion coin cells and galvanostatic charge/discharge studies of the pristine and nanocomposite cathode materials

The original project objectives were slightly altered by replacing the silicate nanomaterials ( $\text{Na}_2\text{MnSiQ}$  and  $\text{Li}_2\text{MnSiQ}$ ) with the highly sought after superionic conducting solid

Research activities and outcomes

August 30, 2022– September 9, 2022

Figure 1: Simulated pattern of MN 7 and powder X ray diffraction patterns of MN 7, MN 14

### Benefits of the exchange visit

The exchange visit to Missouri S&T was my first visit to USA and I gained international exposure and experiences that will be very useful in enhancing my research skills and development as well as those of my colleagues at SensorLab,

