

# **M.Tech. Thesis Research Progress Report**

## **A High-performance aqueous symmetric sodium-ion battery using NASICON-structured $\text{Na}_3\text{V}_2(\text{PO}_4)_3$**

My project work focuses on the latest progress in NASICON advanced electrode materials for SIBs. It also details research in binders and additives and their effects on the SIB system. It further highlights the optimization of organic electrolytes and ionic liquid based electrolytes for utilization in SIBs. The mechanisms of sodium ion storage, transport, and solid electrolyte interphase formation are also discussed to better understand the behavior of ions and battery materials during de/intercalation.

### **Objective:**

- $\text{Na}_3\text{V}_2\text{P}_{3-x}\text{Si}_x\text{O}_{12}$  (NVP) has been considered as a very promising electrode material for both cathode and anode in sodium-ion batteries (SIBs) due to its typical NASICON structure, which provides an open and three-dimensional (3D) framework for  $\text{Na}^+$  migration.
- Synthesis and optimization of different powder composite for the positive electrode.
- Fabrication and electrochemical analysis of the NVPS cathode material for sodium ion batteries.
- Electrochemical analysis of NVPS powder material.

### **Methodology:**

- Among the various cathodes  $\text{Na}_3\text{V}_2\text{P}_{3-x}\text{Si}_x\text{O}_{12}$  (NVPs) is a typical sodium super ionic conductor (NASICON) compound is very popular for its high  $\text{Na}^+$  mobility and structural stability.
- $\text{NH}_4\text{VO}_3$ ,  $\text{NH}_4\text{H}_2\text{PO}_4 \cdot 2\text{H}_2\text{O}$ ,  $\text{Na}_2\text{CO}_3$  and Citric acid as chelating agent in stoichiometric amounts were dissolved in distilled water with continuous stirring at room temperature.

- Structural and morphological characterization of the as-prepared materials using different tools; FESEM, XRD, TGA, etc.
- Symmetric cell fabrication in inert gas environment by using glove box.

### **Remaining Experimental Part:**

- Electrochemical analysis of the as-prepared materials in three-electrode setup.
- Analysis of the full cell performance in the two electrode set up.

Due to this pandemic situation I left my workplace without completing my work. So, I want to make you aware of my current work situation in the same sequencing manner.

I left my current workplace on 18th March 2020. (Department of material science and engineering, IIT Kanpur) (Reason, Due to this coronavirus pandemic situation my lab and hostel both are closed.)

I completed my synthesis and fabrication part regarding Sodium Ion Batteries but the cell testing, Cyclic Voltametry (C.V.) and Galvanic Charge discharge, part are still remaining. (Almost 60% part of my thesis project work is complete).

So, I must want to go back for completing my project work because the remaining Sodium ion batteries cell testing part is most important part (Output) of my thesis work.

I ensure you after the condition is normalizing i am trying to complete my work as soon as possible.