Intergrowth Structural Cathode Materials

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Introduction

Sodium-ion batteries are a promising alternative for large scale lithium batteries. Sodium is of interest because of its similar properties to lithium, low cost and abundance in the Earth's crust[1]. The cathode material can be manipulated to form favorable crystal structures that enhance the batteries electrochemical performance. Doping the cathode material with different elements as well as exposing it to a range of temperatures can affect the crystal structure. These structures (O-type and P-type) can mix to form an intergrowth structure that provides stability and capacity in the cathode material.

Methods/ Materials

Co- Precipitation

Calcination & Lamination

Coin cell Assembly

Results

SEM

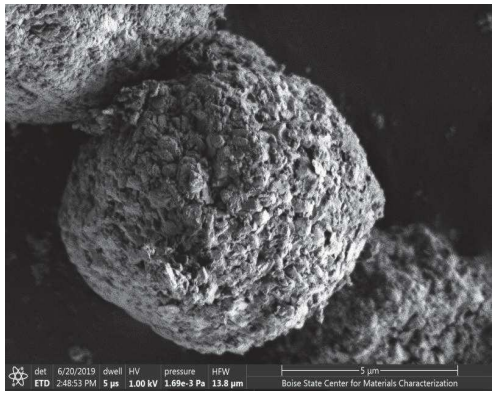

Figure 1. Scanning Electron Microscopy image showing cathode material before doping.

XRD

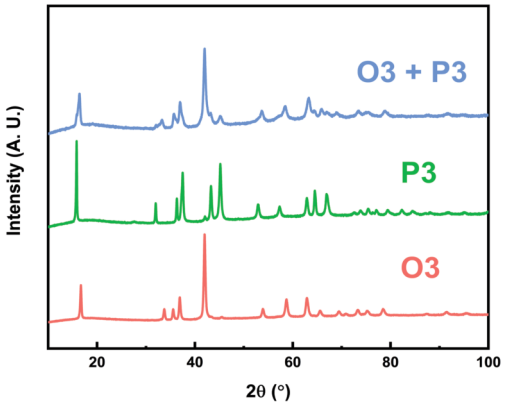

Figure 2. X-Ray diffraction graph depicting the different peaks created by an O phase and P phase.

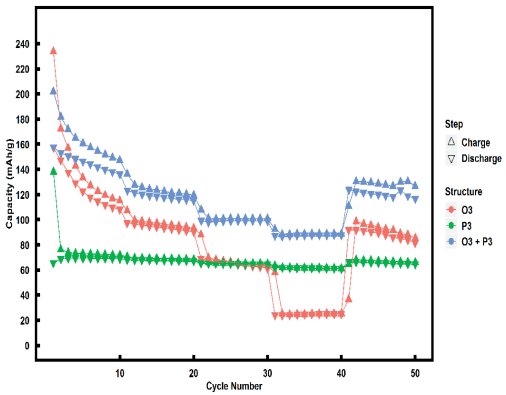

Figure 3. Electrochemical results showing capacity vs. cycle number at different currents. Data collected from 2-4 V.

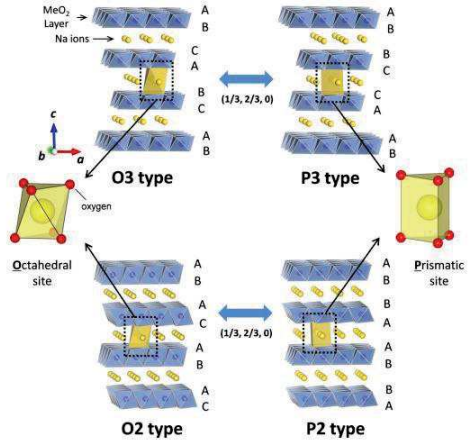

Figure 4. Image explaining the different types of layered oxide structures[1].

Summary

-Smooth, ball like structures in the cathode material are more favorable for electrochemical performance

-P-type provide fast charging while O-type provide large storage capability

-A mixture of P and O type intergrowth phases results in better battery performance.

Future Work
- Modified heating and doping methods
- Use TEM for characterization

References

1. Research Development on Sodium-Ion Batteries. Naoaki Yabuuchi, Kei Kubota, Mouad Dahbi, and Shinichi Komaba. Chemical Reviews 2014 114 (23), Publication Date:November 12, 2014

Acknowledgements

The authors would like to thank the National Science Foundation via the REU Site: Materials for Society at Boise State University (DMR 1658076) , Boise State University and The Department of Energy for helping conduct this research.