



Bachelor/Master Thesis

“Impact of carbonaceous compositing on ZnMn_2O_4 anode in Na ion battery”

Starting date: as soon as possible

Lithium ion batteries (LIBs) have achieved tremendous success because of their appealing properties such as high working voltage and high capacity and energy. However, considering the limited lithium resources, the sodium-ion batteries (SIBs) offer convincing advantages due to their abundant availability. The spinel ZnMn_2O_4 has been investigated as conversion anode in LIBs and SIBs [1, 2]. However, in SIBs, the redox reaction is limited by the poor electronic conductivity of ZnMn_2O_4 , leading to a low capacity. Therefore, tailoring the morphology of ZnMn_2O_4 and compositing with carbonaceous materials, such as graphene wrapping and carbon coating, is important to improve its performance in SIBs.

The aim of this master project is to investigate the impact of carbonaceous compositing on the energy storage mechanism in SIBs fundamentally on phase transition, metal oxidation state changing, SEI composition and electrode morphology in dependence on the electrochemical cycling. Based on these investigations, we will derive strategies to improve the rate capability and cycle stability of ZnMn_2O_4 anode in SIBs.

Your tasks will include for example:

- Synthesis of ZnMn_2O_4 and its carbonaceous composite
- Morphological, structural and chemical characterization of the electrode materials
- Electrochemical characterization of the electrode materials
- *In-situ* and *ex-situ* XRD characterization of phase transition
- the SEI and electrode morphology characterization using *ex-situ* XPS and SEM

Ideally, you have a background in chemistry, chemical engineering, material science or similar and have an interest in electrochemical analysis.

We will discuss the final outline of the project together and can adjust the experimental plan according to your level.

If you are interested in this topic or would like to have more information, please contact **Dr. Sonia Dsoke** (sonia.dsoke@kit.edu) or **Zijian Zhao** (zijian.zhao2@partner.kit.edu)

References

- [1] J.G. Kim, S.H. Lee, Y. Kim, W.B. Kim, Fabrication of Free-Standing ZnMn_2O_4 Mesoscale Tubular Arrays for Lithium-Ion Anodes with Highly Reversible Lithium Storage Properties, *ACS Appl. Mater. Interfaces*. 5 (2013) 11321–11328.
- [2] B. Chandra Sekhar, P. Packiyalakshmi, N. Kalaiselvi, Custom designed ZnMn_2O_4 /nitrogen doped graphene composite anode validated for sodium ion battery application, *RSC Adv.* 7 (2017) 20057–20061.