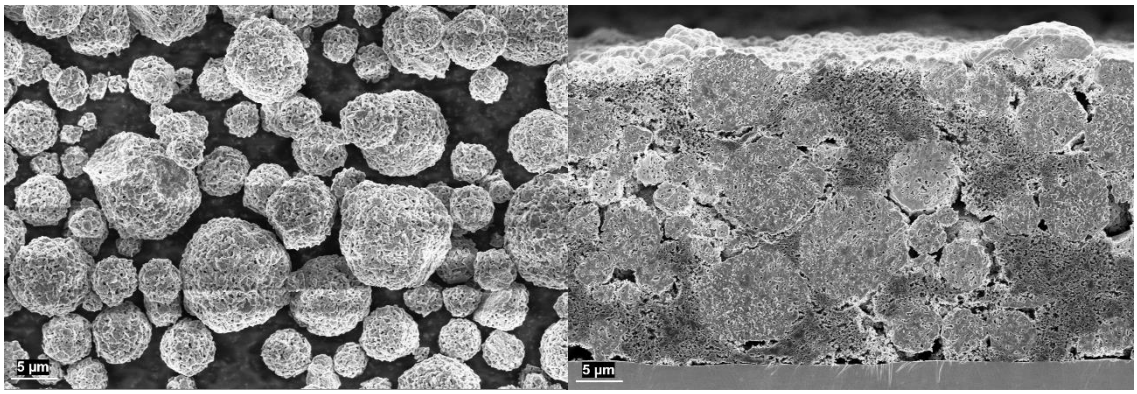
Master thesis

„Synthesis & Optimizing of hierarchically structured layered oxide for Mn based Co-/Ni free Sodium ion battery cathodes “

The cathode material (CAM) is a critical factor determining the performance and cost of a battery. The layered oxide cathodes have garnered the most interests for sodium ion batteries (SiBs) owing to their high theoretical capacity, low material cost and simple synthesis procedures. Depending on the sodium environment and the stacking orders of different oxygen layers, the layered oxide cathode materials are divided into different types. Among them, P2-type materials deliver higher reversible capacity and better rate capability but are low in initial Na-content. Nevertheless, it suffers from capacity fading due to a variety of degradations mechanisms that strongly restricted for their application.

In this work, we will further investigate layered oxide P2-NMCFO ($Na_{7/9}Mn_{2/3}Cu_{2/9}Fe_{1/9}O_2$) with possibly high initial Na content and reduced Mn content by regulating the TM ratio and elemental doping to achieve superior performance in both Half- and full cells. The synthesis of these nano-structured particles involves conventional solid-state reaction/calcination/spray drying processes in a pilot scale. Additionally, comprehensive structural and fundamental electrochemical characterizations of the CAM will be carried out. Ideally, the synthesized materials can be stably cycled and thus enable the characterization of others components in SIBs (anode material, electrolyte etc.).



Your Task:

- Synthesis of Nano-structured CAM particles with standard process in a pilot scale
- Physicochemical characterizations via XRD/SEM/BET/Hg-Porosimetry/PSD etc.
- Crystal structure analysis via Rietveld refinement with software TOPAS
- Electrochemical characterization via galvanostatic cycling and cyclic voltammetry

Experience in the field of synthesis and/or electrochemical characterization of electrode materials is advantageous, but not essential. The ability to work independently on scientific questions and along with the associated experimental and analytical methods is mandatory.

Please note that this work will be conducted at **Campus Nord** and can be started **immediately**.

Interest or question? Please feel free to contact me by email *ruochen.xu@kit.edu*. For applying, please send a short motivation letter, your CV, and your mark sheet.