Karlsruhe Institute of Technology

Institut für Angewandte Materialien

Master thesis

Electrochemical synthesis and characterization of sodium metal batteries

Starting date: As soon as possible

Li-ion batteries (LIBs) found in practically all consumer electronics and are quickly being deployed in electric vehicles to meet the growing demand for portable electrical devices and mobility. There is however a finite amount of elements and materials needed to produce LIBs meaning the technology cannot meet the growing need for electrochemical energy storage. This calls for alternative battery technologies based on more abundant elements that can be produced in large quantities. Sodium-ion batteries (SIBs) are the ideal candidates based on the abundance of Na and its close physiochemical properties to Li allowing use of LIB technology advances. Over the last two decades, considerable research has been devoted to realize SIBs as a commercially viable battery technology. The main roadblock is the lack of high energy density anode materials since graphite is incompatible with Na-ion insertion. The ideal solution would be to use sodium metal itself as it enables optimal energy density for both current and next-generation sodium batteries. Safe use of Na metal anodes is however currently not possible since the metal is, like Li, prone to grow dendritically.

Recently we established an electrochemical strategy to control Li metal anodes and achieve reversible 2D growth. Given the similar properties of Na and Li, we will now transfer these advances to Na metal anodes. The master thesis will be included in a large project to develop the necessary electrochemical tools to control Na metal anodes and create safe and efficient sodium metal batteries.

Therefore, we are looking for a master thesis project which will apply this new nucleation procedure on Na metal anodes and characterize its battery performance.
The project will mainly include:

- Electrochemical metal deposition and dissolution
- Battery assembly and performance analysis
- Battery cycling using an adapted Li nucleation protocol
- Morphology analysis of Na metal using scanning electron microscopy

The work will primarily take place at Campus South, in the MZE lab.

We are looking for curious and engaged students with a background in chemistry, chemical engineering, materials science or similar. Experience in electrochemistry or battery research is highly meriting.

If this project sounds interesting and you would like to hear more, then please contact
Dr. David Rehnlund (David.rehnlund@kit.edu)