Karlsruhe Institute of Technology

Institut für Angewandte Materialien

Master thesis

# Electrochemical strategy for dendrite suppression in Li-S batteries

Starting date: As soon as possible

A generation shift in Li-based batteries is currently in process where both electrodes will be replaced by substantially more energy dense materials. Li-S batteries are here expected to overtake the market with a battery chemistry optimal for high energy density. Lithium metal is the prime negative electrode material and have for decades been considered the holy grail of future battery technologies. The metal is however prone to grow uncontrollably during cycling forming a highly reactive porous structure. This growth behavior is a serious safety concern as it can lead to long dendritic structures extending through the separate to the positive electrode, causing rapid thermal expansion. Over 4 decades on intense research has produced several advanced strategies to limit the dendrite growth however the problem remains an unacceptable safety concern hindering the commercialization of next generation Li-based battery technologies such as Li-S.
Recently, we created a simple electrochemical nucleation procedure that can control the Li metal growth and force flat layers to reversible deposit and dissolve during battery cycling. The procedure is based on the principle of separating nucleation and growth during Li metal deposition by applying a high energy pulse that can effectively seed the entire metal electrode surface. This exciting new development opens up the possibility to produce Li-S batteries with significantly improved cycling stability.
Therefore, we are looking for a master thesis project which will apply this new nucleation procedure in Li-S full cells 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 Li metal using scanning electron microscopy
- Electrochemical characterization of electrode materials

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)**
**Dr. Fabian Jeschull (fabian.jeschull@kit.edu)**