Lithium-Schwefel-Hochenergie Akkumulatoren mit reversiblen Matrix-interkalierten Schwefelkathoden

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The successful design of Li-S batteries with high energy density has the challenging perspective to significantly boost the development of environmentally friendly automotive technology. Li-S batteries will triple the energy density of existing Li-oxide batteries combined with high reversibility of fast charging-discharging cycles and lifetime of thouthands of cycles. Understanding of interaction between the isolated sulphur and carbon matrix is required to obtain fundamental knowledge about function and reliability of Li – S batteries. Meanwhile, the distribution of sulphur atoms and their form (clusters films or particles) plays a keynote role. Here, the electrochemical transfer through the current conductive structures to isolated sulphur molecules, which have to be reduced, and its reversibility are of interest. The process of formation of solvation shell around Li-polysulphide in the ionic-conductive solvent, transition state to crystallisation of sulphide and determination (calculation) of corresponding energy are very important as well. Moreover, it is very important to investigate adhesion mechanism of electrochemically active components to the current conductive electrode structures to achieve better mechanisms then merely mechanical contact.

Based on detailed investigations of novel cathode materials with nano-containers for electrochemical active materials, we plan to develop hierarchically structured carbon electrodes on micro- and nano-scale leading to high-energy density Li-S batteries. In our multidisciplinary consortium polymer engineers will develop the new polymer-based cathode materials, electro-chemists will optimise the electrochemical performance and physicists try to understand basic principles both from experimental as well as from theoretical viewpoint. Application aspects will be introduced by close contact with a leading battery producing company. New materials development routes will be combined with dedicated instrumentation to reveal structural and electro-chemical aspects at different levels, absolute elemental composition, depth profiling and electronic oxidation states as well as simulation of charging and discharging.