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Towards stable artificial SEI protecting metal anodes in metal-sulfur batteries

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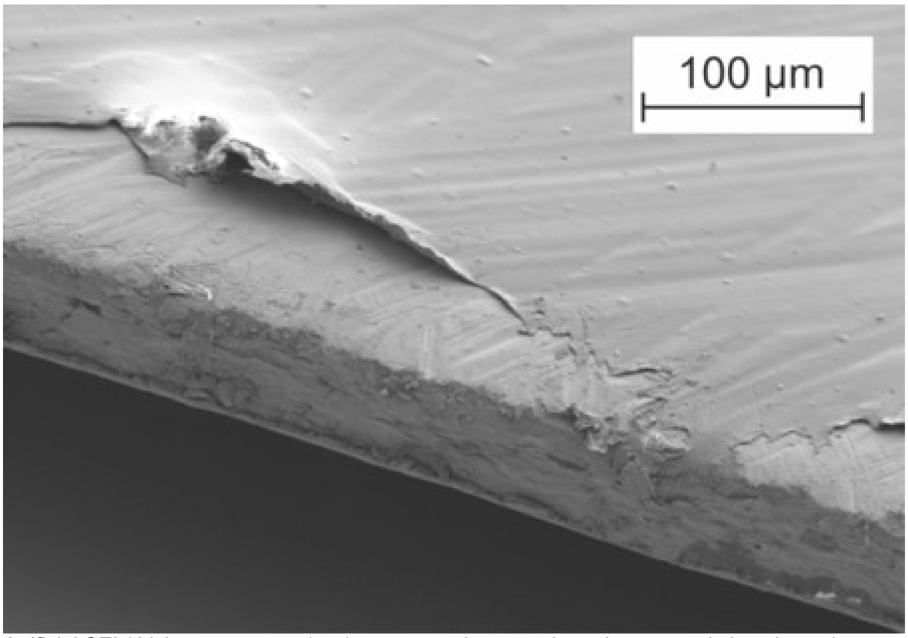
Metal sulfur batteries (Me-S) are widely perceived as prospective candidate for post-lithium ion technology offering high energy density and low cost of raw materials. However, the application of metal anodes like lithium or magnesium is accompanied with several challenges. This mainly concern the solid electrolyte interphase (SEI), which has to meet several demands: The SEI should be thin, homogenous, electrochemically stable and mechanically elastic as well as ionically conductive and electronically insulating. Furthermore, it should enable uniform stripping/plating and prevent dendrite formation. An ideal layer hinders excessive continuous electrolyte decomposition and inhibits the reaction of polysulfide species at the anode surface. However, an *in-situ* formed SEI usually does not feature these ideal characteristics due to ongoing parasitic reduction reactions resulting in overconsumption of the electrolyte and promoted growth of dendrites. In addition, its thickness and inhomogeneity has an adverse effect on important properties such as ionic conductivity.[1]

To address named requirements, in this study, lithium and magnesium metal anodes were coated with an artificial *ex-situ* SEI layer combining desired porperties.[2] Various sulfonate ($-SO_3^-$) based ionomers were applied, which exhibit high ionic conductivity and large cation transfer number.[3][4] Their chemical composition and morphology was examined *ante* and *post mortem* using SEM-EDX and FTIR spectroscopy. Electrochemical properties were investigated by galvanostatic cycling and electrochemical impedance spectroscopy in symmetrical cells as well as Me-S full cells. In both, the Mg-S and Li-S system, the artificial SEI provokes an improved cycling stability and capacity retention, though still non-uniform stripping/plating and localized reaction sites were observed.



Artificial SEI (thickness approx. 1µm) on magnesium metal anode prepared via spincoating.

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