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Characterising the SEI of lithium-mediated electrochemical nitrogen reduction via in operando X-Ray Radiography

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To combat climate change, many industries are trying to reduce their greenhouse gas emissions via clean fuels such as hydrogen. However, hydrogen gas is not energy dense, so finding efficient methods of storing hydrogen is critical. Nitrogen reduction to ammonia is a promising form of hydrogen storage because of ammonia's increased relative energy density and pre-existing transport infrastructure. Due to the energy-intensive nature of the traditional Haber-Bosch process to produce ammonia, alternatives like electrochemical nitrogen reduction are being explored. Reduction in organic media via a lithium mediator (LiNRR) has been shown to be a viable alternative process, with some systems optimised for high efficiency, and others for sustained production.1,2

LiNRR utilises much of the same electrolytes as Li batteries, so understanding the solid electrolyte interphase (SEI) is key to optimising conditions for high faradaic efficiency and ammonia yield. To better understand SEI formation, in operando X-Ray radiography was done on electrochemical LiNRR experiments with select conditions. Subsequent image processing using ImageJ and Noise2Void (N2V)3 was able to give us useful information on SEI growth and gas evolution rates as the experiments progressed. Radiography images were then corroborated with ex situ SEM-EDX maps. Future experiments using other types of imaging, such as neutron radiography, may provide even greater insight on how the SEI builds over time.

References

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Topics

Chemistry and Crystallography

Primary author(s) : EZRA, Laela (Monash University)

Co-author(s) : WEIR-LAVELLE, Callum; HODGETTS, Rebecca (Monash University); Dr RUSKE, Florian (Helmholtz Zentrum Berlin); Prof. SIMONOV, Alexandr; Prof. RISSE, Sebastian (Helmholtz Zentrum Berlin)

Presenter(s) : EZRA, Laela (Monash University)

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