Using *in operando* pulse EPR to investigate metallic lithium anodes in rechargeable batteries

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Li-ion battery technology is key for the mobility reorientation towards electric vehicles in upcoming years.[1] Two main factors of battery performance are the capacity, which determines range, and the charging time. To enhance both, various electrode materials, cell characteristics, and charging protocols have to be tested under realistic operating conditions. A tenfold increase in specific capacity might be achieved by using lithium metal anodes instead of commercially used graphite.[2] However, irregularly deposited lithium upon charging still poses a safety issue leading to degradation or short-circuiting. Here, we demonstrate the application of pulse electron paramagnetic resonance (EPR) as a non-invasive technique to monitor electrochemically deposited lithium metal.[3] *In operando* pulse EPR is shown to be capable of monitoring batteries under fast-charging conditions with sampling intervals of 100 ms. This sampling rate is sufficient to observe dynamic effects of deposited lithium. When using an electrochemical pulse charging scheme, dynamic morphology changes are detected that evolve for several seconds after fresh lithium was deposited.

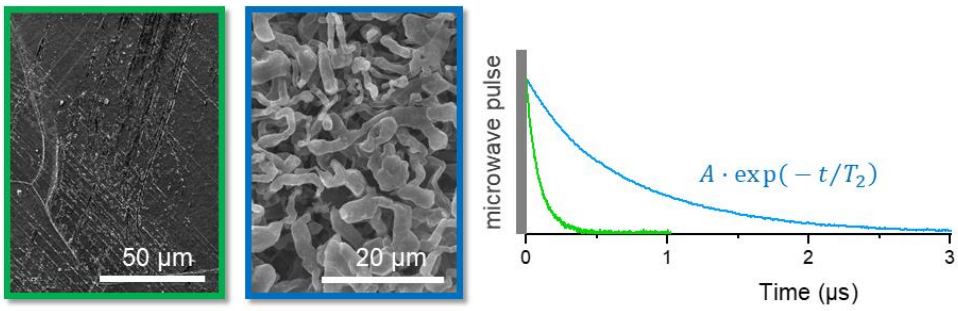

Figure: Electron microscopy images of pristine lithium metal anode (green frame) and electrochemically deposited microstructured lithium (blue frame). The lithium metal morphology gives rise to pulse EPR responses with characteristic relaxation times, which can be used to monitor transient morphology changes.

References

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