Contribution submission to the conference Berlin 2024

The role of the SEI for lithium whiskers in lithium metal batteries — •Martin Werres[1,2], Arnulf Latz[1,2,3], and Birger Horstmann[1,2,3] — [1]Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Ulm, Deutschland — [2]Helmholtz Institut Ulm (HIU), Ulm, Deutschland — [3]Universität Ulm, Ulm, Deutschland

Lithium metal (Li) batteries are promising due to their high specific energy. However, safety concerns and non-optimal cycle stability hold back Li anodes paired with liquid electrolytes.[1] A major challenge is the growth of Li whiskers. Li whiskers come with cycling inefficiencies, e.g., enhanced formation of isolated Li.[2] Understanding why Li whiskers emerge can help find design rules for safer Li batteries. We study plating/stripping of Li under the aspect of the mechanical properties of Li and the role of the covering solid-electrolyte interphase (SEI).[3] We consider a Li nucleus covered by SEI, which grows continuously during plating. Once the stress in the SEI exceeds a threshold, the SEI breaks. Due to the softness of Li and significant creep under the expected stress conditions, Li can extrude through the hole in the SEI. We model this by approximating Li as a Herschel-Bulkley liquid. Our predicted shapes and growth rates are consistent with the experimental observation of Li whiskers. We deduce that the SEI is the most important design parameter to achieve safe Li batteries.

[1] B. Horstmann et al., Energy Environ. Sci. 2021, 14(10), 5289-5314. [2] M. Werres et al., ACS Nano 2023, 17(11), 10218-10228. [3] L. von Kolzenberg et al., Phys. Chem. Chem. Phys. 2022, 24(31), 18469-18476.

Part: KFM
Type: Vortrag;Talk
Topic: Focus: Battery Materials: Lithium-ion and Post-Lithium cells and their materials
Keywords: modeling; battery; lithium; whisker; SEI
Email: martin.werres@dlr.de