Dynamics and morphology of solid electrolyte interphase (SEI)

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Phys. Chem. Chem. Phys., 2016,**18**, 17810-17814

DOI: 10.1039/C6CP02816K

Received 27 Apr 2016, Accepted 13 Jun 2016

First published online 13 Jun 2016

We develop a novel theory for the continuous electrochemical formation of porous films to study the solid electrolyte interphase (SEI) on lithium ion battery anodes. Existing SEI studies model a homogeneous morphology and a single relevant transport mechanism. Our approach, in contrast, is based on two transport mechanisms and enables us to track SEI porosity in a spatially resolved way. SEI thickness evolution agrees with existing studies and is validated with experiments. This consistent approach is unprecedented in SEI modeling. We predict a non-zero SEI porosity and the dependence of morphology on transport properties. Additionally, we capture dual-layer chemistry and morphology. Analytic expressions which describe the parameter dependence of all key properties are derived and discussed.