Solid Electrolyte Interphase (SEI)
- Film formation on graphite anode
  - Reduction product of electrolyte
  - SEI slows down further electrolyte reduction
  - Continued capacity fade / Increase in impedance
- Challenges in Experiment and Theory
  - Complex chemical composition
  - SEI morphology: porosity / dual-layer structure
  - Limiting transport process

Experiment
- Graphite vs. Li/Li⁺
- Electrolyte: EC:DEC 3:7 wt.-%. 1 M LiPF₆
- Additive: Fluoroethylene carbonate (FEC), 2 wt.-%

Results:
Fourier Transform Infrared Spectroscopy

Cyclovoltammetry

Conclusion:
- VC is reduced earlier than the electrolyte (CV)
- A stable film on the anode side is formed
- Further electrolyte decomposition is prevented
  Homogeneity of SEI-layer verified with space-resolved FTIR

Modeling Scheme
- 1D mesoscopic continuum model on electrode surface
  - Simple SEI chemistry: LiₓCO₃
  - Electrolyte conductivity in nanopores \( \sigma_{eff} = \epsilon^\theta \sigma \) with large empirical Bruggemann coefficient \( \beta \)

Specific Surface Area of porous SEI
- Elementary cubes of size \( a_0^3 \) filled with probability \( \epsilon_{SEI} \)

Simulation and Discussion
- Numerical stability
  - Front width scales with \( a_0 \)
- Thickness growth with \( \sqrt{t} \) due to electron conductivity \( \sigma \approx 10^{-12} \) S/m

Constant porosity \( \epsilon \) due to balance with electrolyte transport \( (\beta \approx 10) \)

Literature