Design of advanced anode materials for Lithium ion batteries

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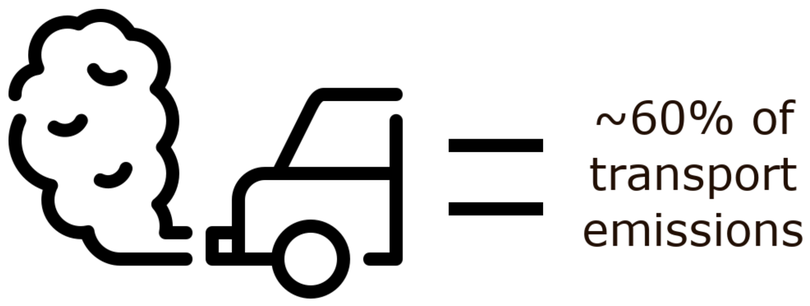
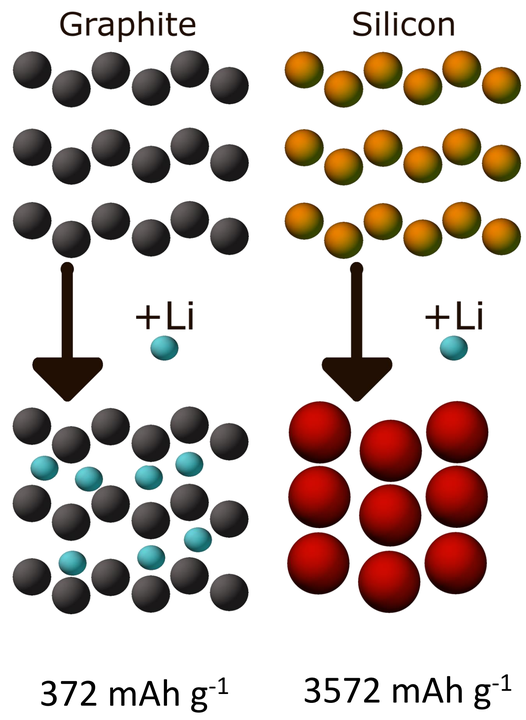
Introduction

Largest Greenhouse gas emitters[1]

- Industrial energy consumption (24.2%)
- Domestic energy consumption (17.5%)
- Agriculture (18.4%)
- **Transport (16.2%)**

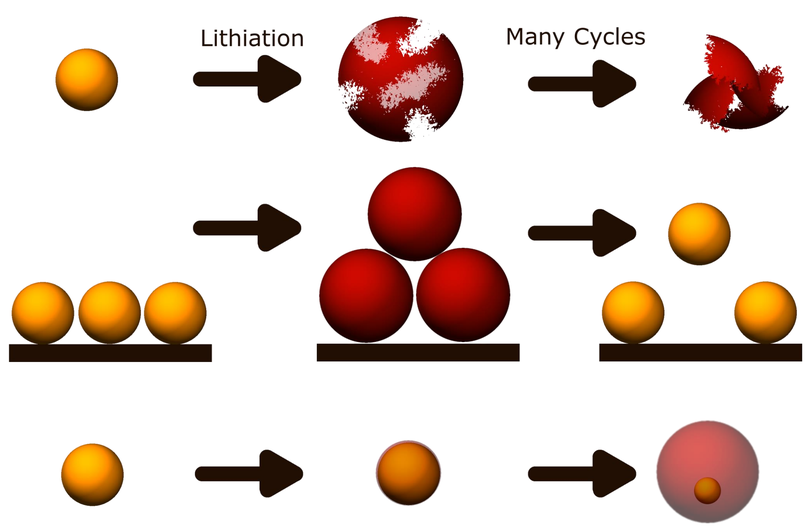
⇒ Electrification of passenger vehicles





Silicon's issues[2]

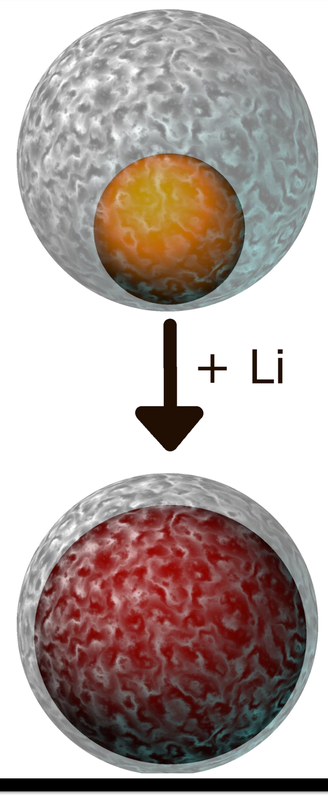
Large volume change:
A) Pulverization
B) Contact loss
C) Excessive solid electrolyte interface (SEI)
⇒ Poor cycle life

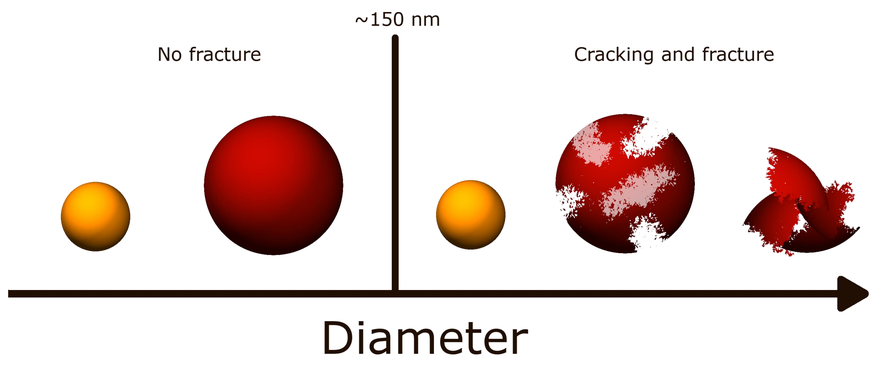


Solving silicon's shortcomings

Preventing common failure mechanisms

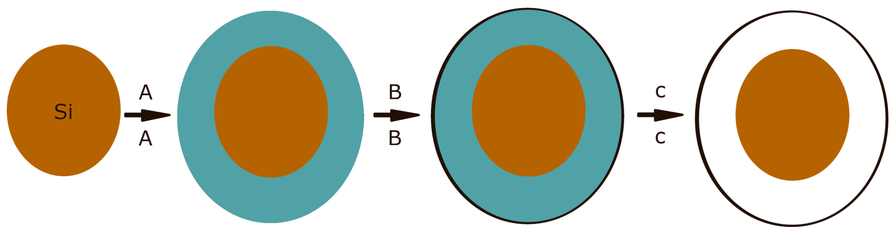
- Pulverization? ⇒ Particle size reduction[3]
- Contact loss? ⇒ Compensate volume expansion
- Excessive SEI formation? ⇒ Artificial SEI





Synthesizing compensation volume and artificial SEI

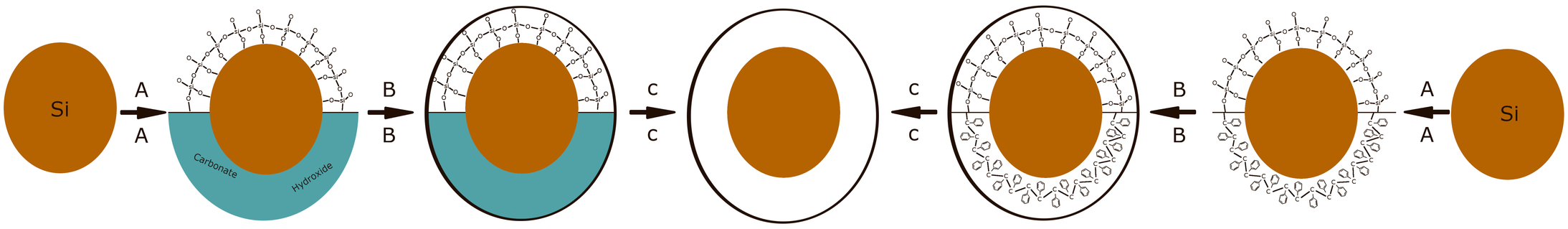
A) Deposition of a sacrificial layer.
B) Deposition of an artificial SEI (or its precursor)
C) Work up: removal of SEI and finalization of artificial SEI
⇒ Yolk-shell type particle



Synthesis methods

Conventional route

A) Stöber generation of silica
B) CVD carbon encapsulation
C) HF leach



Solvothermal route

A) Precipitation of Carbonates or Hydroxides
B) Solvothermal carbonization of monosaccharides
C) Dilute acid leach

Conventional route

A) Stöber silica generation
B) CVD carbon encapsulation
C) HF leach

Polymeric route

A) Polymerization of low coke yield polymer
B) Polymerization of high coke yield polymer
C) Pyrolysis

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