Silicon (Si) is a potential material for high capacity negative electrodes due to its theoretical capacity (~4200 mAh g\(^{-1}\)) that is over 10 times higher than that of conventional graphite-based materials (~370 mAh g\(^{-1}\)).

The limiting issue with Si negative electrodes is their short cycle life due to mechanical failure resulting from large volume changes during lithiation (>300%).

We have previously demonstrated improvement in cycling stability with Si microparticles using a self-healing polymer (SHP) binder. Using spatial control, high areal capacity and long cycle life have been achieved. [1, 2]

Varying the concentration of tri-functionalized starting material allows for facile control of the crosslinking density. (Figure 3)

Hydrogen bonding groups at condensation sites give additional dynamic crosslinks between chains.

To make electrodes, Si microparticles were dispersed in ethanol by sonication and drop-cast onto Cu foil. Smooth Si electrodes with controlled Si mass loading were obtained after drying and calendaring.

The Si electrodes were heated to approximately 100°C and coated with the SHP/carbon black (CB) composite using a doctor blade technique.

Coin cells with Si-SHP/CB and lithium electrodes were assembled under argon atmosphere (Figure 2).

Crosslinking Effects in Self-Healing Binder for Silicon Electrodes

Jeffrey Lopez, Zheng Chen, Chao Wang, Sean Andrews, Yi Cu, and Zhenan Bao

Crosslinking of Polymer Binder

Self-Healing Binder

Cell Fabrication and Polymer Design

Silicon for High-Capacity Batteries

Crosslinking of Polymer Electrodes