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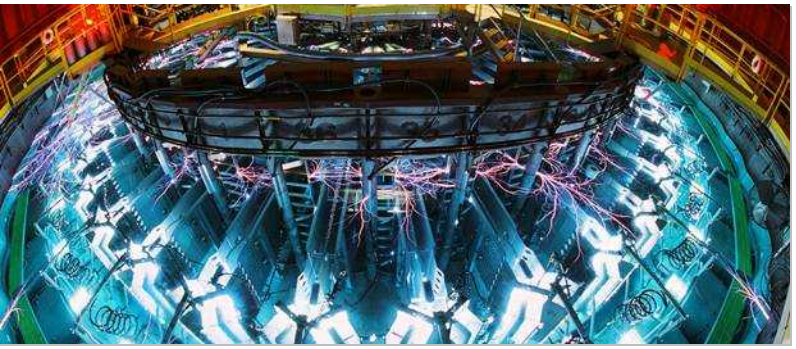
Silicon Anode Gas Generation Questions



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U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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ICL During Formation in Model System

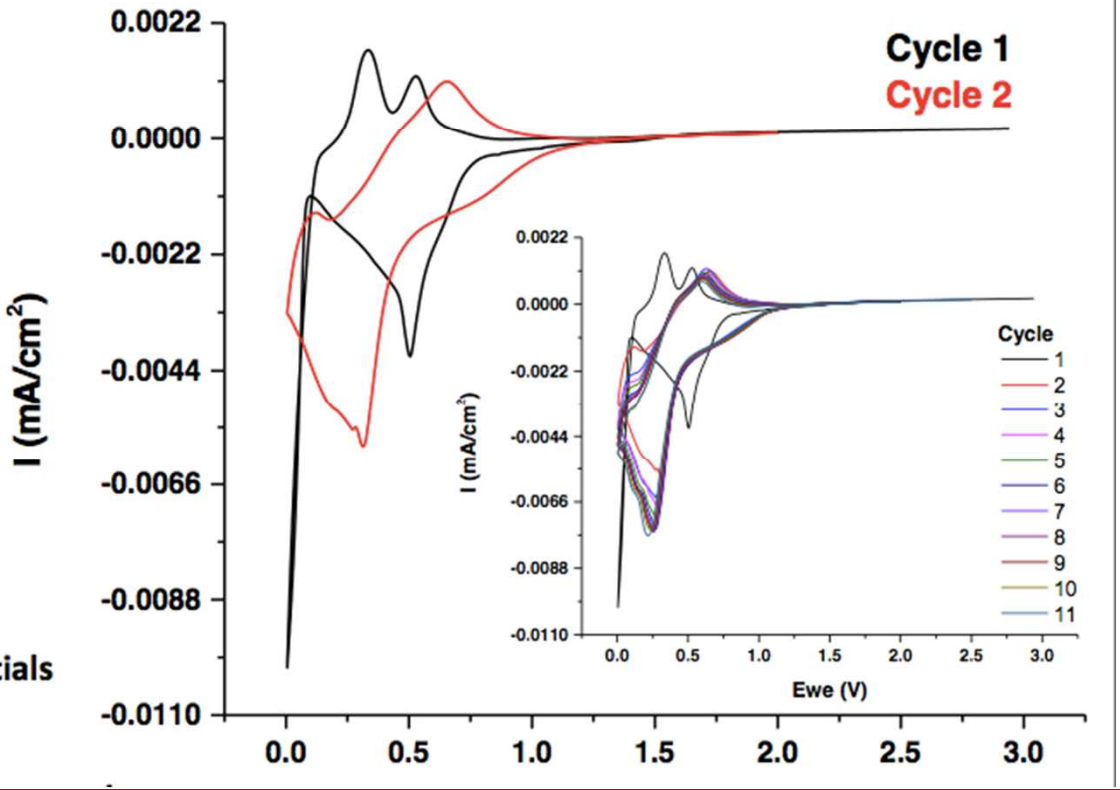
Electrolyte: EC:DEC 3:7 (wt%) 30 wt% FEC, 1.2 M $LiPF_6$
Scan rate: 0.2 mV/s
cut off voltage: 2 V – 0.005 V
Cycle #: 11
Sample area: ~0.33 cm^2

Charge consumption
[mC/cm^2]

Cycle 1	
total	-90.53
cathodic	-112.34
anodic	21.81
2-0.29 V	-64.07
0.29-0.2 V	-45.51
0.2-2V	18.96

No surface passivation.
Reduction shifted to lower potentials

Possible scenarios:



Significant losses observed during formation cycling in model systems (copper and silicon). Electrochemical reduction of binder/electrolyte? Can this be correlated to gas generation seen in full electrode ensembles?

Abuse Response of Silicon Anodes

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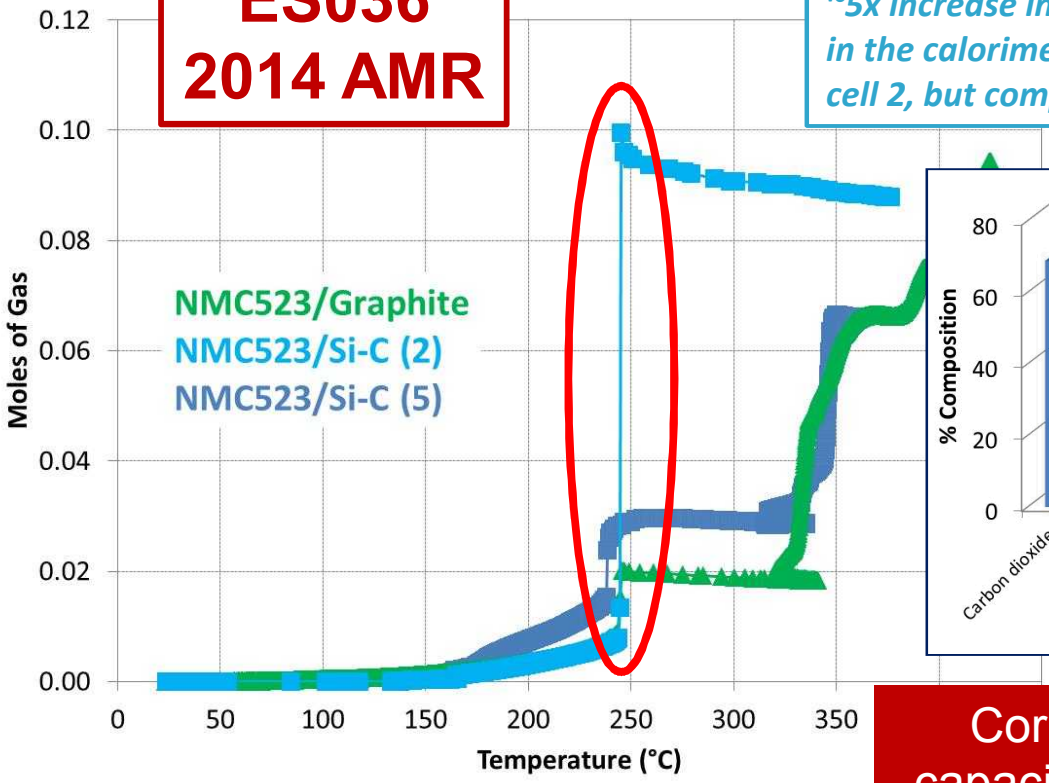
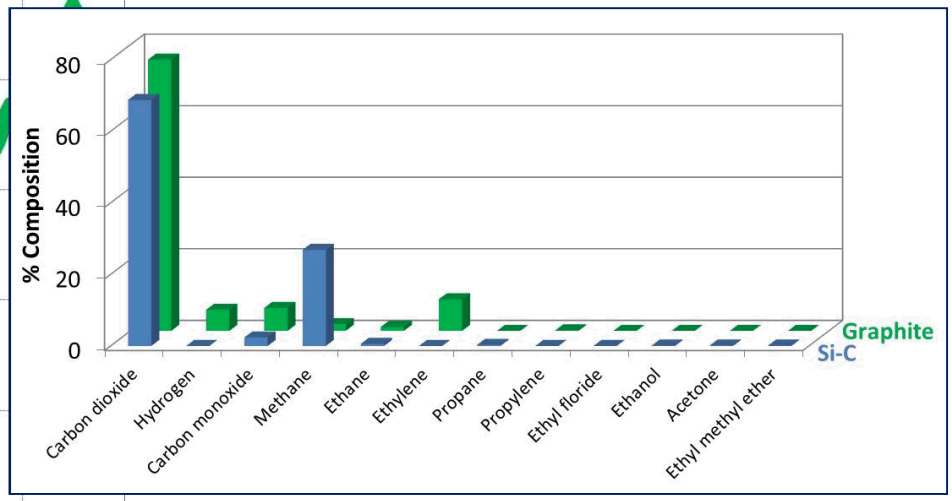
ES036
2014 AMR

~5x increase in the amount of gas generated in the calorimeter during thermal runaway of cell 2, but comparable gas generation for cell 5



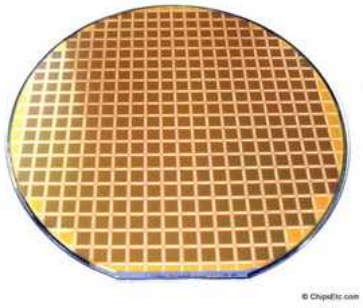


Correlation with observed irreversible capacity loss for model Si based systems?

Difference in gas generation attributed to the differences in surface reactivity and surface products generated at the anode/electrolyte interface

Approach

1. Spin-coat binder and carbon phases on both Cu and p-Si wafer substrates.
2. Carry out electrochemical measurements of model thin-film electrodes in baseline electrolyte(s).
3. Ex situ evaluations for gas generation using DSC/TGA and grab samples during electrochemical and abuse evaluations.
4. Perform similar treatment for electrode ensembles to determine correlation between model system and industry relevant electrodes.



Understand relationship between model system and multi-particle ensemble behavior?