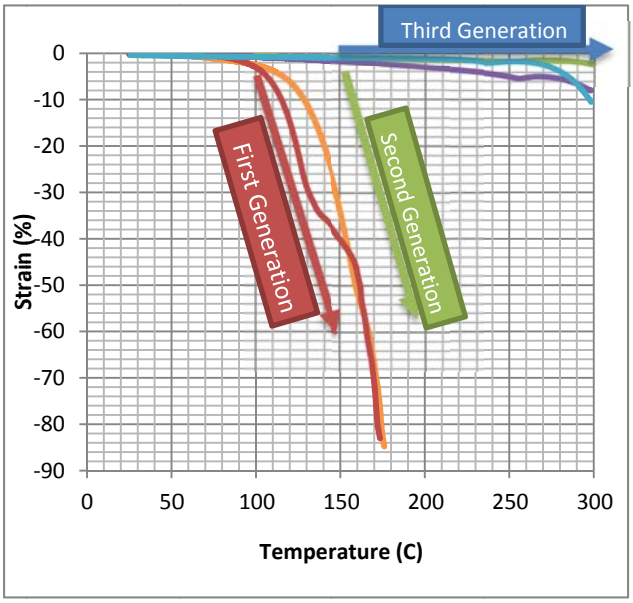
JMU Chemistry and Biochemistry Seminar
Friday, February 3, 2017
3:35pm in ISAT 159

3rd Generation Separators: Using Thermally Stable Separators to Turn the Aluminum Current Collector into a Fuse

ABSTRACT

Samsung's problem with the batteries in the Galaxy Note 7 helped to emphasize the importance of safety in lithium ion batteries, an emphasis that will only be compounded when Wh turn to KWh in electric vehicles. But a solution is at hand in improved battery separators. First generation separators are bare polyolefin films that shrink between 100 – 150 C. Second generation separators have a ceramic coating that improves the shrinkage temperature to between 150 – 200 C. Third generation separators have inherent thermal stability and do not shrink until at least 300 C.

These inherently stable separators completely change the paradigm in certain safety situations.



- Hot Box: In hot box tests at temperatures over 170 C, the third generation cells endure far longer without cell failure, while the cells with first and second generation separators fail when the cell surface temperature reaches ~160 C.
- Nail Penetration: The cells with first and second generation separators experience a voltage drop to zero volts, indicating a hard short between the electrodes, when the nail is driven in. With third generation separators, the voltage drops by ~100 mV, and then slowly recovers.

Cell autopsies of nail penetrated cells showed significant cracking and shrinking of the separator around the nail hole with first and second generation separators. With 3rd generation separators, there was no shrinkage, but charring on some layers. SEMs of cross sections of the layered structure show significant buildup of alumina at the aluminum current collectors near the nail. The alumina broke the circuit, acting like a fuse and allowing the cell to continue functioning with the nail in the cell. When the nail was removed, the cell discharged ~2/3 of the original capacity, and was able to be cycled.