Soteria Battery Innovation Group

Challenge: Lithium Battery Fires are Expensive

The Dreamliner Debacle Has Already Cost Boeing $600 Million

Tim Hepher, Alwyn Scott, Reuters
Apr. 18, 2013, 9:37 AM 2,310

BUSINESS NEWS OCTOBER 11, 2016 / 2:04 AM / A YEAR AGO

Note 7 fiasco could burn a $17 billion hole in Samsung accounts

World FOLLOW MASHABLE

Crashed Tesla explodes into a massive fireball

Tesla Adds Titanium Underbody Shield and Aluminum Deflector Plates to Model S

Elon Musk, Chairman, Product Architect & CEO • March 28, 2014

Forbes / Autos

DEC 12, 2011 @ 01:32 PM 18,295 VIEWS

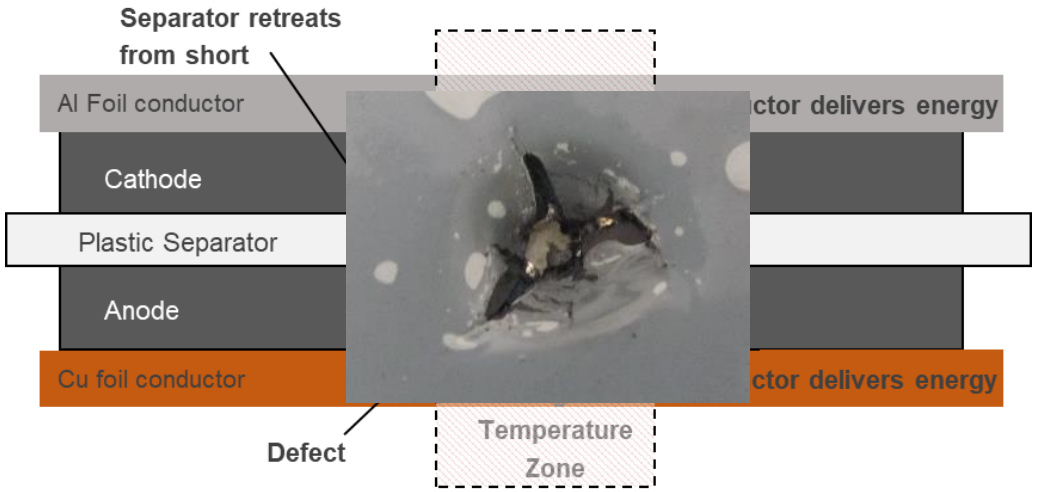
Chevy Volt Battery Fires Threaten All Electric Vehicle Makers, Not Just GM

Amazon stops selling some hoverboards over safety

Brett Molina and Elizabeth Weise, USATODAY 6:02 p.m. EST December 14, 2015




Separator Failure: Fire



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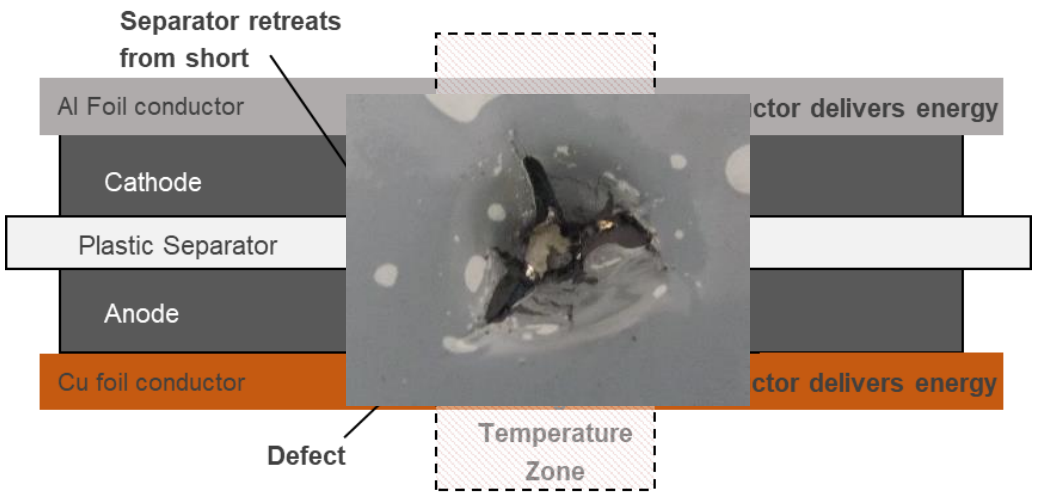
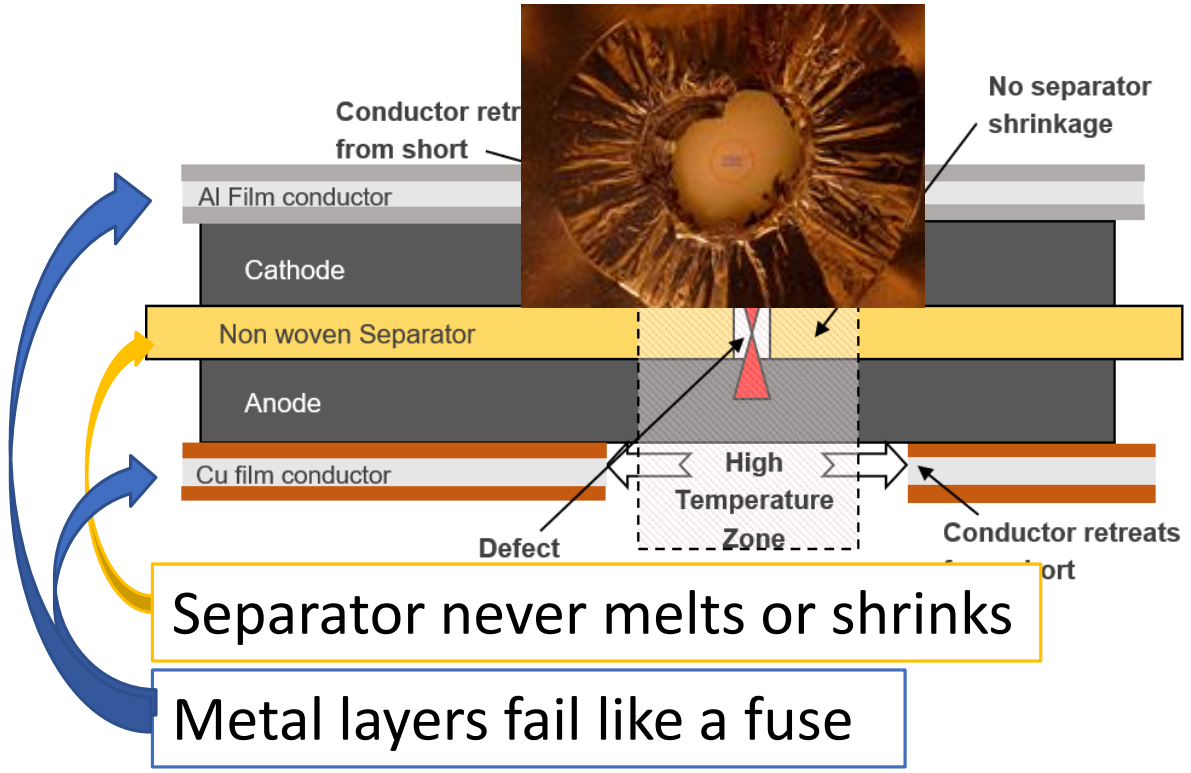
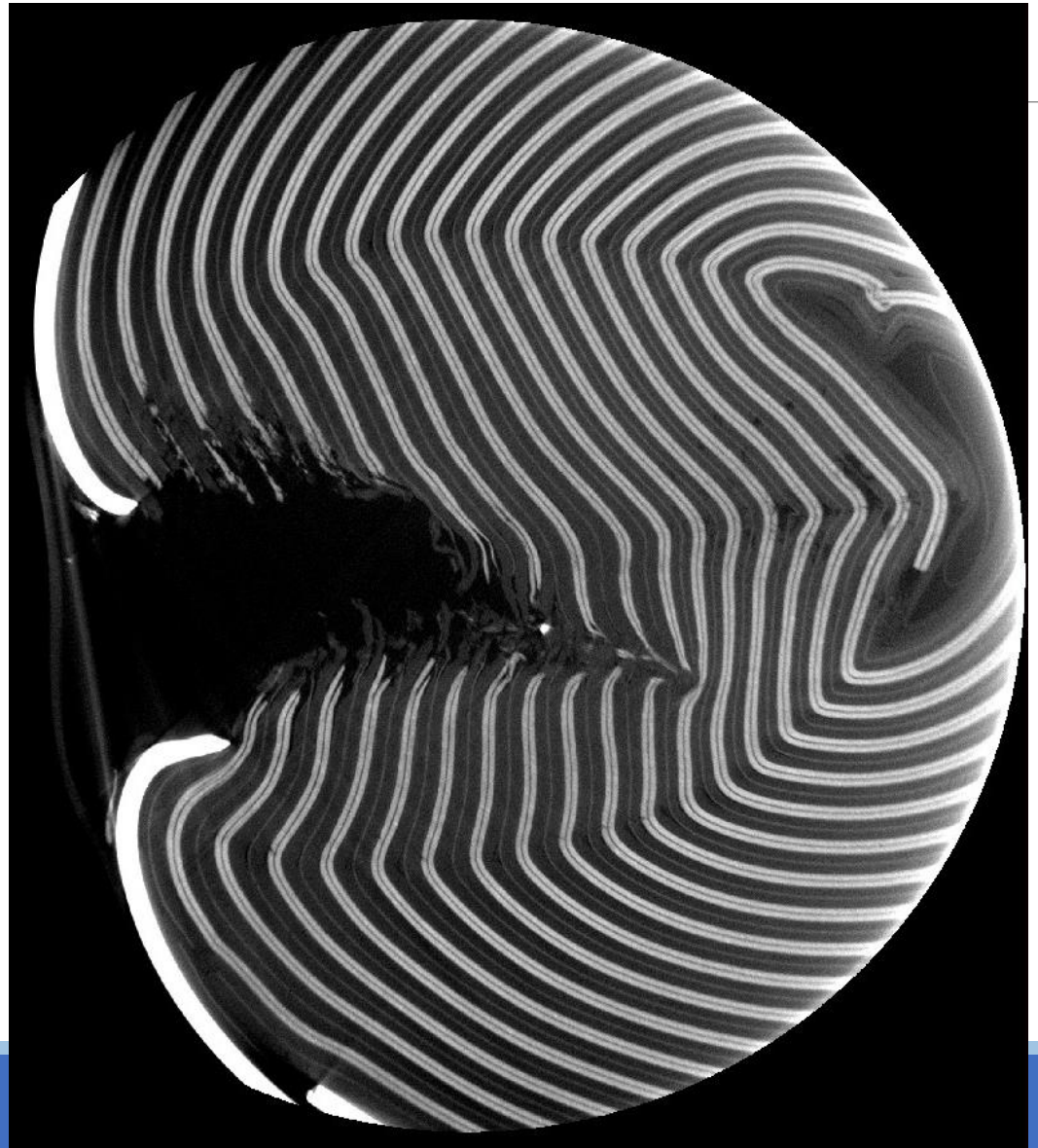
Separator Failure: Fire



Fuse Stops Ignition: No Fire



Run 80 – N05-07 Soteria Al & Cu Collectors (cont.)



Fine focused CT image with 5.5 micron resolution

- Both plastic collectors are visible
  - Cathode is bright layer with thin dark line in middle
  - Anode is dark layer with thin brighter line in middle
- Collector appears missing near nail impingement interface
  - Only active material left dangling
- Nail impingement causes several additional creases in the JR

CT Images from UCL

2.1 Ah Cell – 100 % SOC (4.2 V)
Standard materials
Without ISC device

Do polymer collectors help protect against mechanical induced thermal runaway?

Thermal runaway propagates almost immediately.

Cell type: Li-ion 18650
Capacity: 2.1 Ah
State of charge: 100 % (4.2 V)

Bottom vent: None
Wall thickness: 250 µm
Orientation of cell: Upright (vent at top)
Location of ISCD radially: None
Location of ISCD longitudinally: None
Side of ISCD in image: None

Separator type: Normal
Positive current collector: Normal
Negative current collector: Normal

Location of FOV longitudinally: Middle
Frame dimension (Hor x Ver): 2016 x 1111 pixels
Pixel size: 10 µm

Notice the 'spring-back' as the metal CC's split around the nail.

Run 68

2.1 Ah Cell – 100 % SOC (4.2 V)
Al coated polymer current collector
Without ISC device

Do polymer collectors help protect against mechanical induced thermal runaway?

No thermal runaway propagation.

Notice that there is no ‘spring-back’ as the polymer CC travels with the nail.

Run 72

License to Best Advanced Materials Suppliers & Set Standards

OPEN MARKET APPROACH

To license the Soteria battery technology to the best advanced materials companies

To develop a set of aggressive test standards that highlight the advanced safety performance of the Soteria battery architecture

To get those standards adopted in electronics, electric vehicles, energy storage and the broader lithium ion battery industry

CONSORTIUM MEMBERS

Market Target: 25% Market Penetration in 10 Years (2028)

Current Market

- ~1.5 B m^2 each of separators, current collectors
- 20% CAGR
- 20 B m^2 total in 2028 (10% auto penetration)

25% of market in 10 years

- 5 B m^2/year, ~$5 B of materials
- Separators
  - ~30-40,000 T/y of fiber
  - 2.5 B m^2 ~ 25 machines each @ 100 M m^2/year, +5/year
- Current collectors
  - 17,500 T/year plastic, 12,750 T/year metal
  - 2.5 B m^2 ~ 80 machines each @ 10 M m^2/year, +16/year

Material	Amount	$/y
Separators		
Advanced fibers	7,500 T/y	$225 M
Lyocell	22,500 T/y	$90 M
Lyocell (if pre-fibrillated)	22,500 T/y	$225 M
Micro PET fibers	7,500 T/y	$75 M
Paper Machines	25 machines needed +5/year after	$1B for 25 machines $200M/y after
Current Collectors		
Thin polymer film	17,500 T/y	$125 M
Aluminum wire	3,750 T/y	$19 M
Metallization Machine (AL)	40 machines needed +8/year after	$10 M for 40 machines $20M/y after
Copper Wire	9,000 T/y	$135 M
Metallization Machine (CU)	40 machines needed +8/year after	$400M for 40 machines $80M/y after

This is the motivation for supply chain partners to support us through membership fees.

An Open Consortium

THE CONSORTIUM IS

Dedicated to improving lithium ion battery safety

- Any cell that passes the certification can use the mark, regardless of material

Doing shared R&D, with each company playing it's natural role

- Reducing parallel efforts by sharing the R&D burden

A network for sharing information for companies with common goals

A way to get IP from small, innovative companies to large, stable, licensed manufacturers

THE CONSORTIUM IS NOT

A monopoly

- Anybody can join as an Adopter/Associate/Licensee
- Global, non-exclusive licenses for a broad supply chain
- No raw material & equipment purchase restrictions
- Ongoing royalty rate only partially offsets material cost savings, resulting in a net cost-down

An IP trap

- No grant backs of IP required
- Member developments belongs to that member
- Nobody is locked into using Soteria IP

Licenses & Material Purchase within SBIG

Material Purchases

- All member agreements contain a clause that material that is covered by SBIG patents will only be purchased from members who have a license to those patents.
- The licensees have no restrictions on who they buy their equipment and raw materials from, or who they subcontract for partial/full manufacture.

Licenses

- Each covers only current collector or separator.
- Global, nonexclusive, non-sublicensable, limited transfer rights, perpetual until last patent expires.
- Require membership. Fee disappears once royalties exceed fee.
- Economic terms: 5% royalty, dropping to 3% with (total) volume. “Meaningful” up front fee is $600,000 for first license, goes up by 25% for each successive license (for each technology)

In a cell, royalty is 3% of about 15% of the cell cost, or 0.45%.
At $100/kWh, would be $45 on a 100 kWh EV.

Technology Member Company Participation

Materials Members →Test your materials in these structures, and adapt them (or choose best of existing products) to help licensees improve the eventual performance	**Potential Licensees** →Work to develop uniquely positioned products leveraging your company strengths to offer a differentiated product within the architecture →When ready, buy license and offer unique and improved product offering	**Cell Manufacturers** →Test the prototypes and give feedback to help with optimization →When ready, launch new products using materials
Equipment/Process Members →Prove and improve the manufacturability of the materials to optimize performance, uniformity & yield		**Test/Development Labs** →Help develop aggressive safety standards →Become qualification lab for use of architecture/brand

Soteria goal is for each company to develop a unique product offering within this total architecture

Soteria™

Awards: Most Fundable and Innostars

Entrepreneur Magazine Most Fundable Companies
➔#1 out of 2500 applicants
➔published Entrepreneur Magazine Oct 24

Innostars (by US China Innovation Alliance)
➔#1 Advanced Materials

Entrepreneur MAGAZINE

PEPPERDINE GRAZIADIO

InnoSTARS

US CHINA Innovation Alliance

Soteria™

Thank you!