SEPION TECHNOLOGIES

WORLD MATERIALS FORUM

What More Can Your Separator Do for You?

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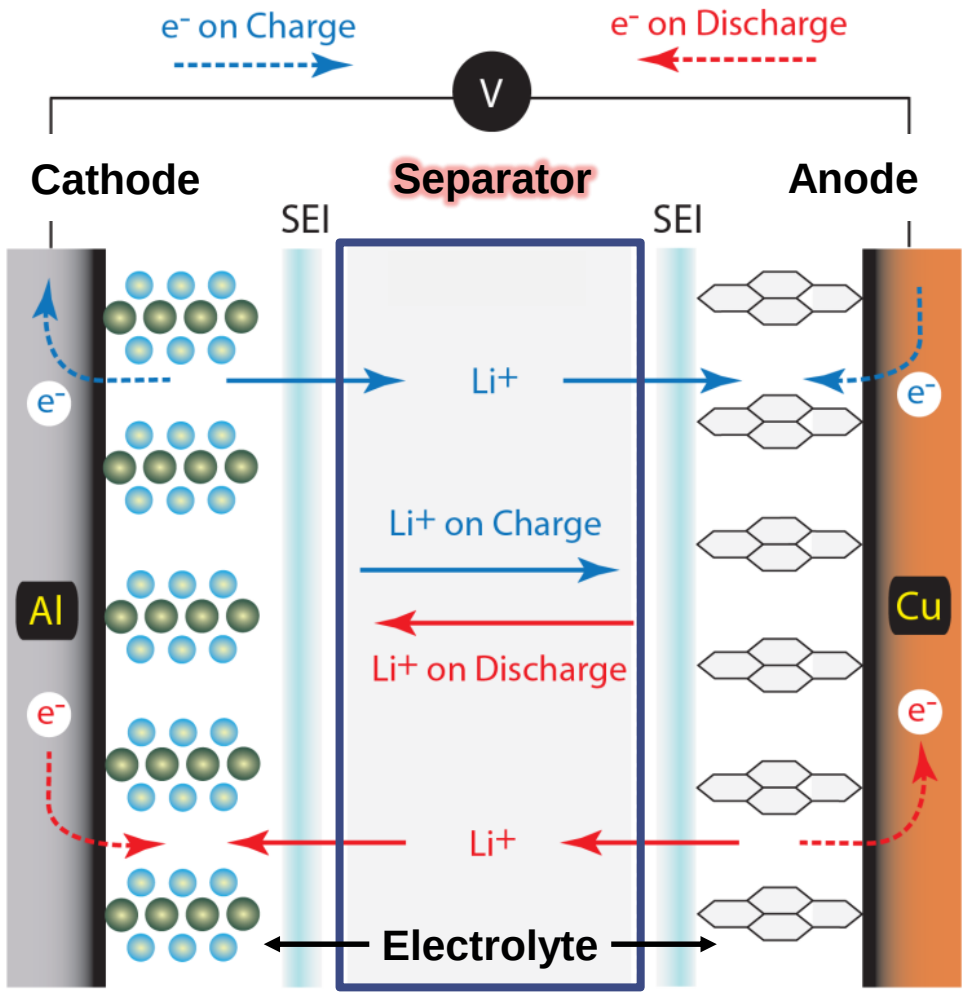
Separator: A Key Element to Overall Cell Performance

Critical for power, safety, and manufacturing throughput



Hitachi Chemical

Safety

- Electrically insulating
- Mechanically strong
- Thick

Power

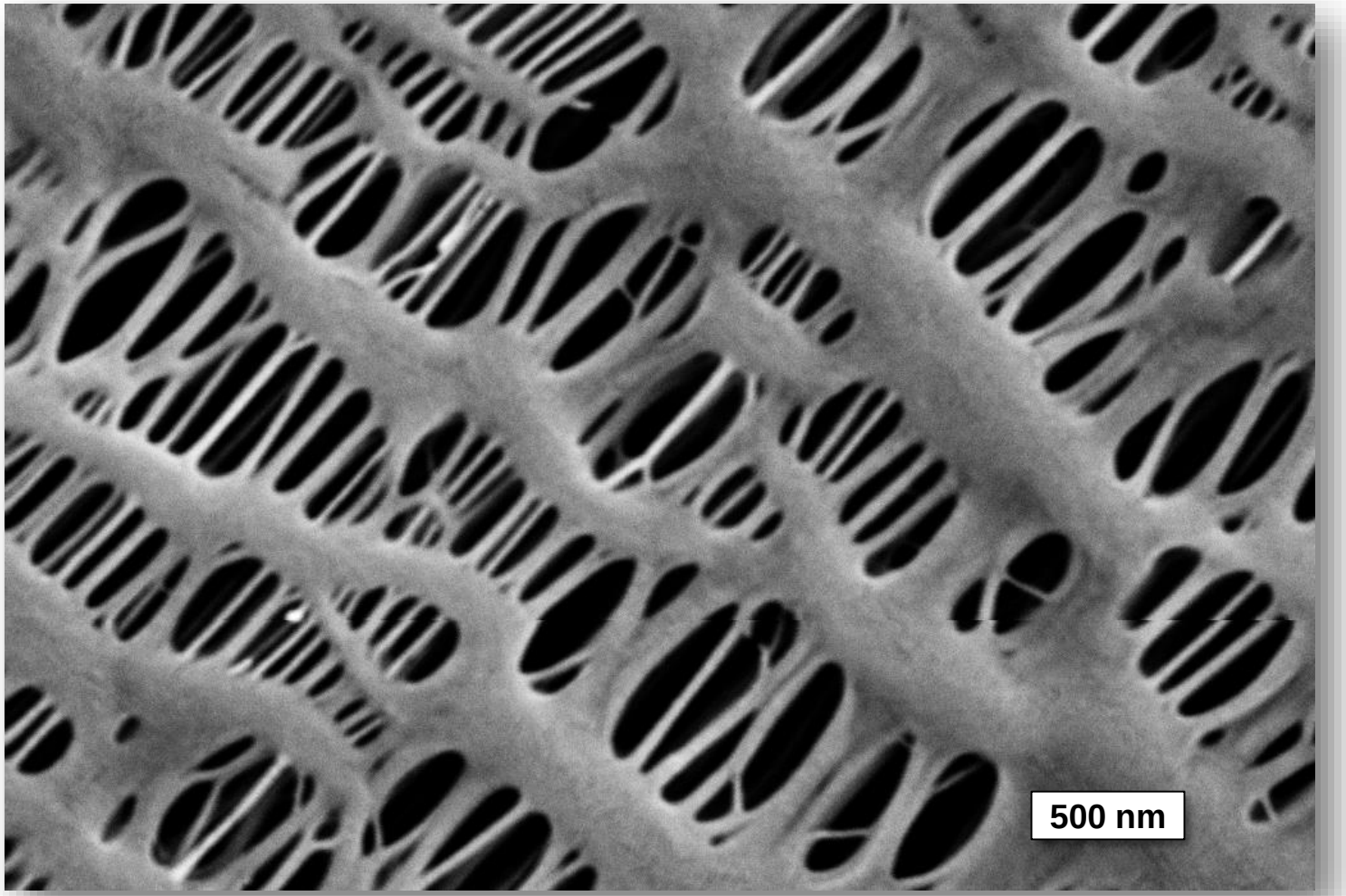
- >40% porous
- Minimal tortuosity
- Thin

Cell Manufacturing

- Roll-to-roll handleable
- Electrolyte wettable

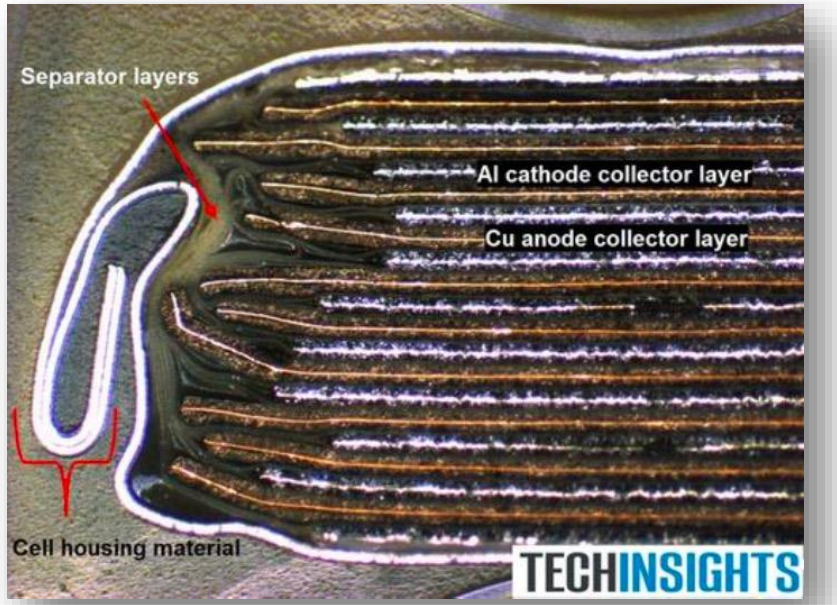
Porous Polyolefins are 99% of the Market

No significant shift expected in the next 5–10 years



Separator Specs

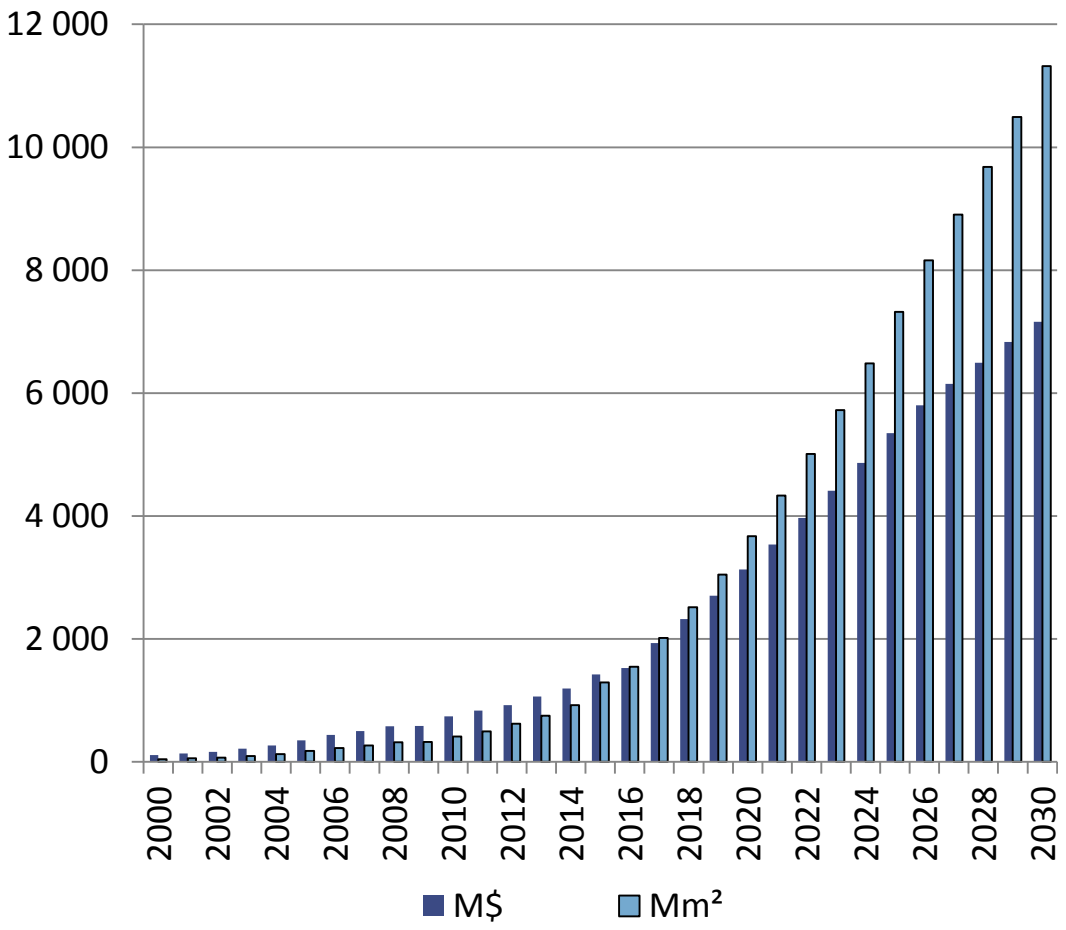
- Wet & dry processed (PE vs PP)
- 8–25 microns thick
- 20–500 nm pores



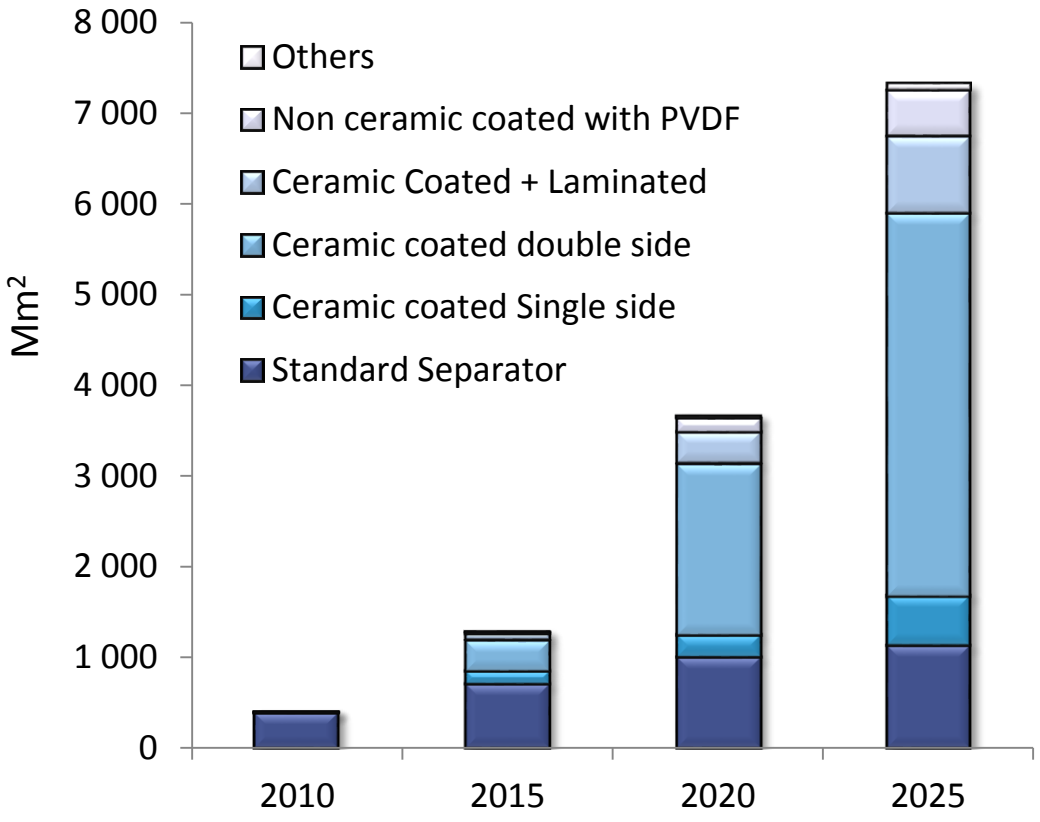
$7 Billion Market for Li-ion Separators in 2030

Coated separators are in demand with market share >80% by 2025

Separator Revenue & Volume

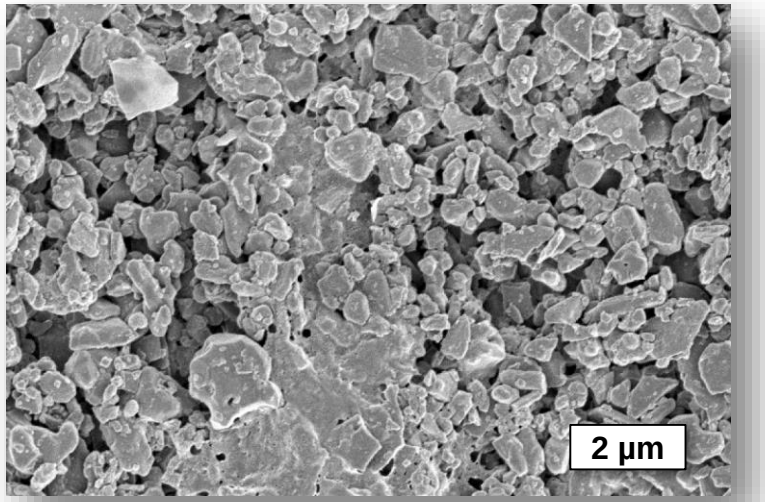


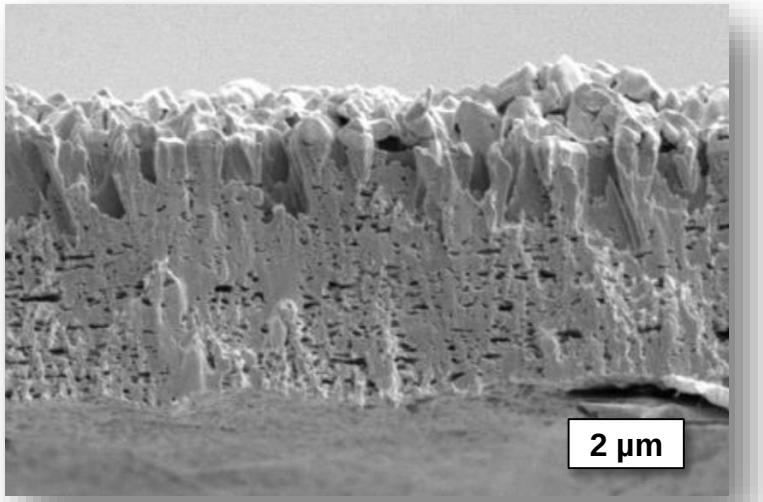
Volume by Separator Type

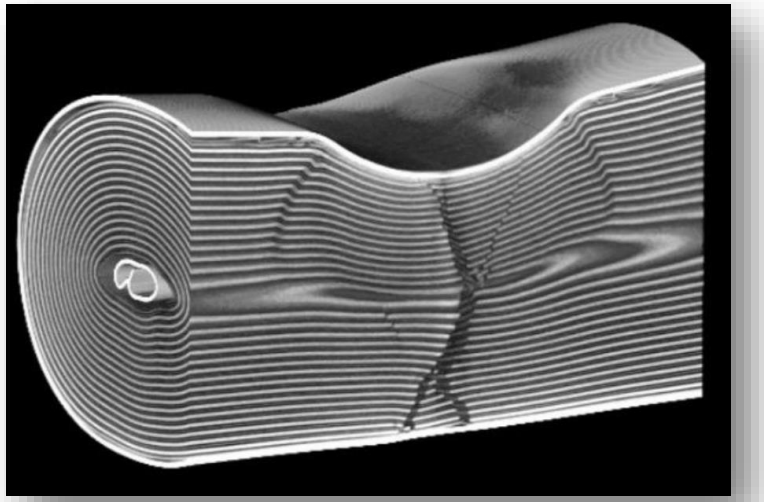


Use Smarter

Simple ceramic coatings improve safety and electrolyte wetting adding only 2-3% to total $/kWh





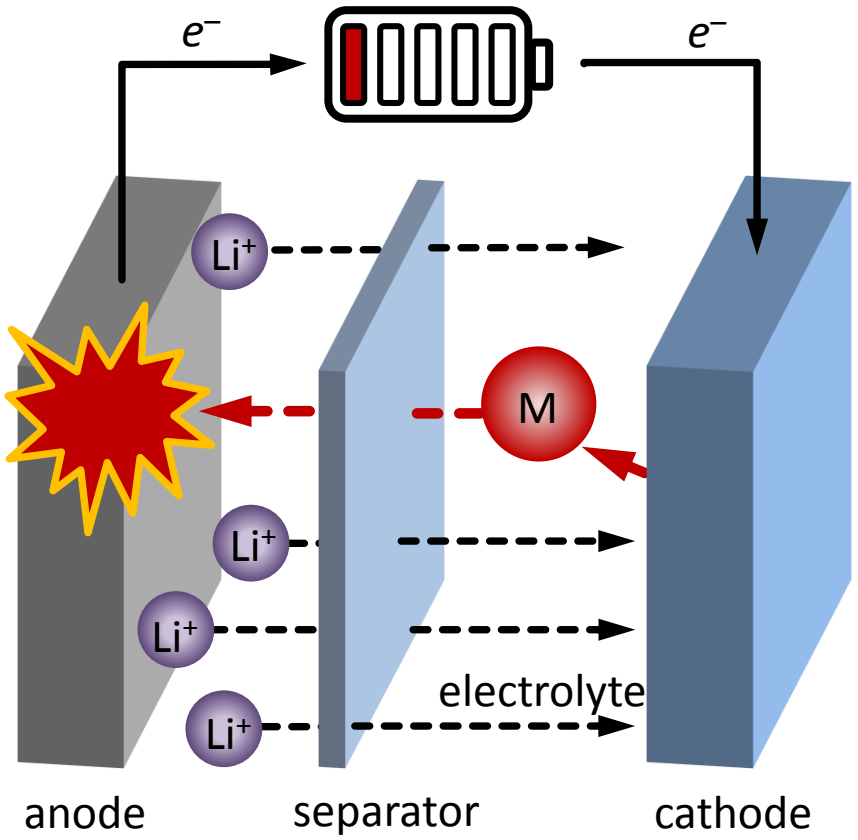


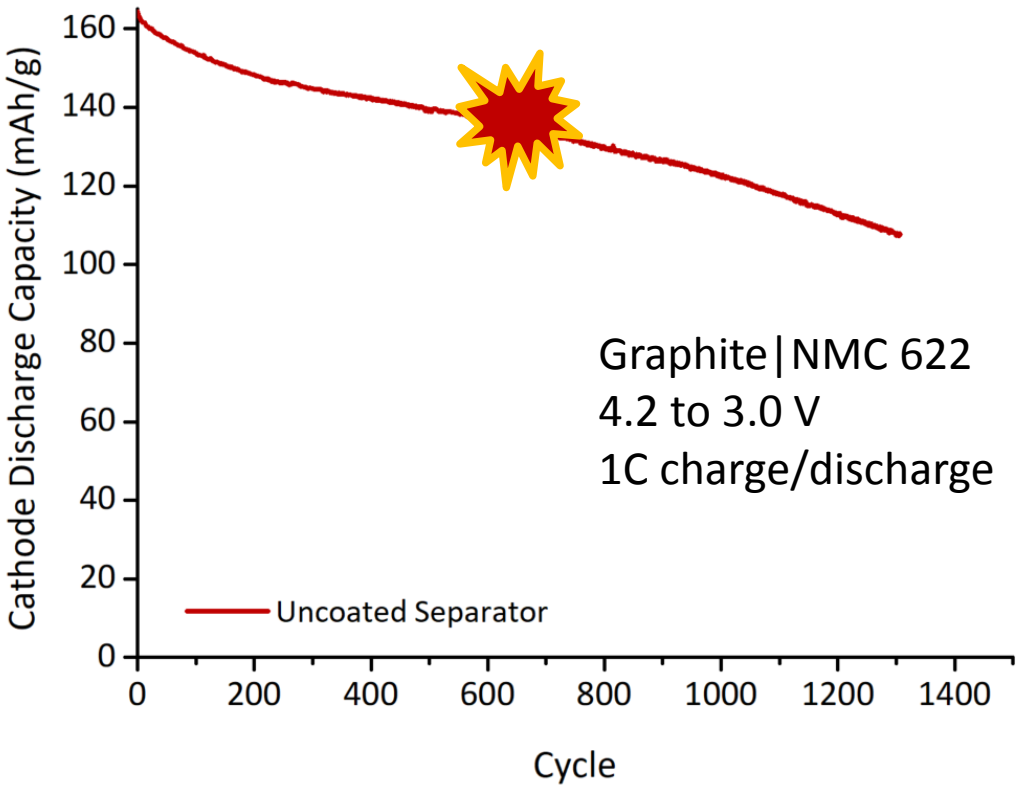
Ceramic Coating Specs & Features

- 2–4 micron thick Al_2O_3 or SiO_2 coating with PVDF binder
- Reduced risk of catastrophic failure
- Faster electrolyte wetting
- Near 100% adoption for EV batteries

Use Longer

Standard separators allow transition metals to freely diffuse from cathode to anode, reducing cycle life and safety



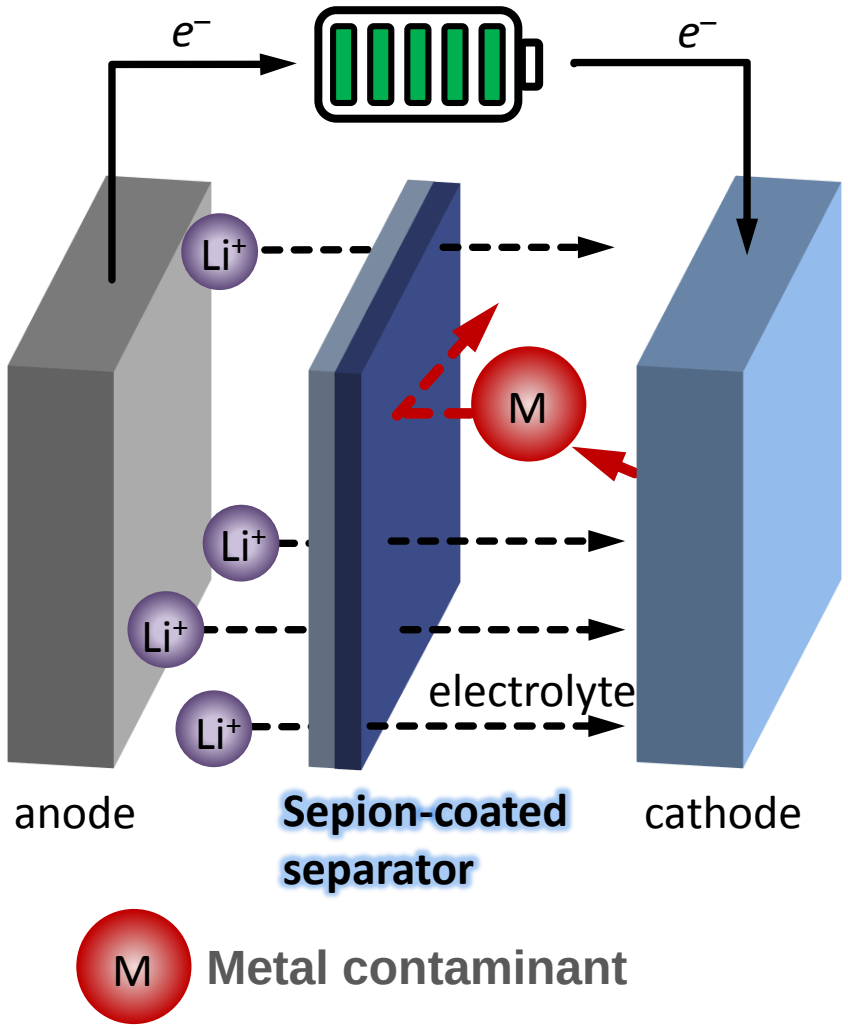


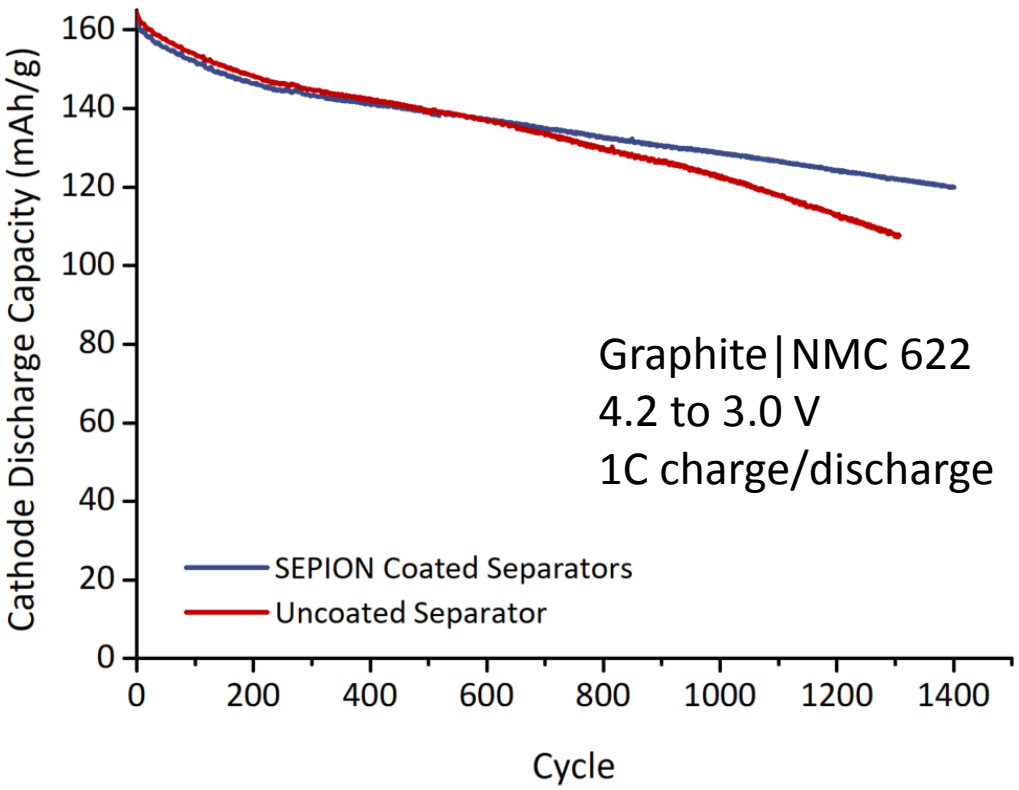
M **Metal contaminant**

- Transition metals at graphite catalyze electrolyte decomposition and trap lithium

Use Longer

>20% increase in low-Co cathode cycle life and improved manufacturing yield with Sepion's ion-selective coatings



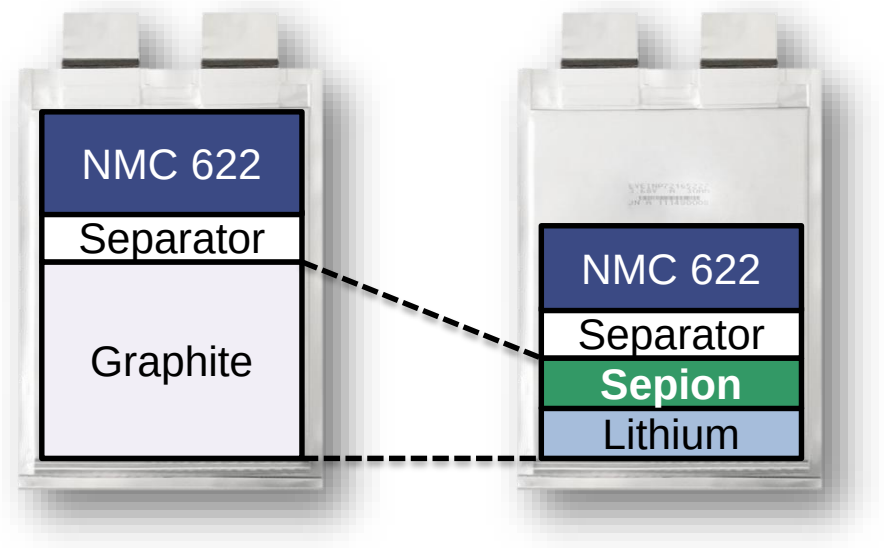


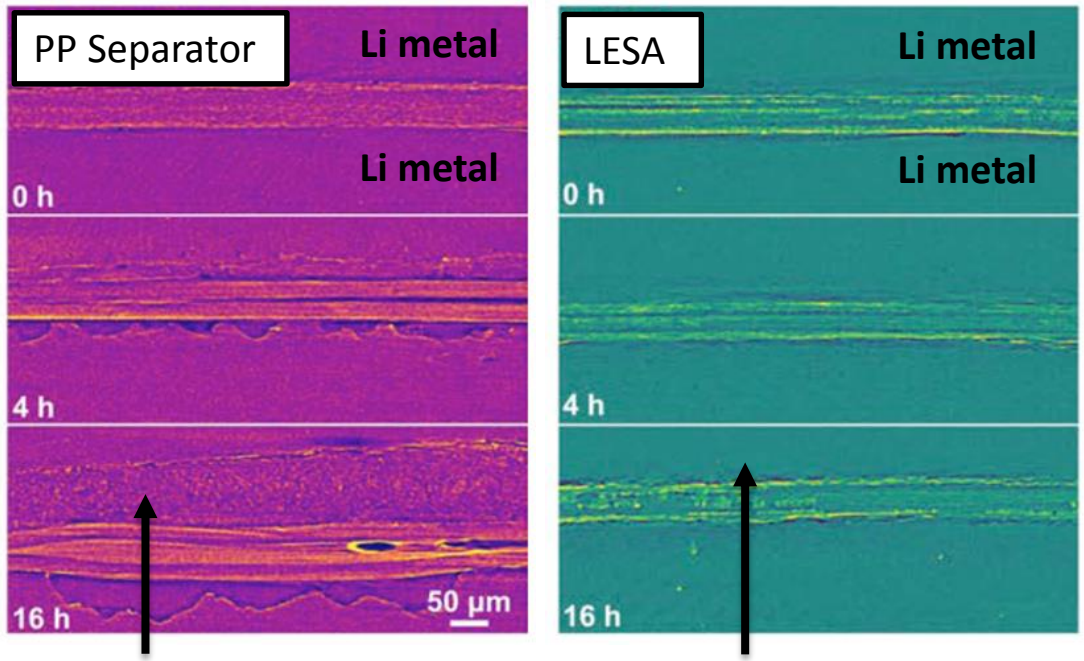
- Nanoscale pores in coating block Ni and Mn
- Up to 3-fold less Ni and Mn found at the anode

Use Less

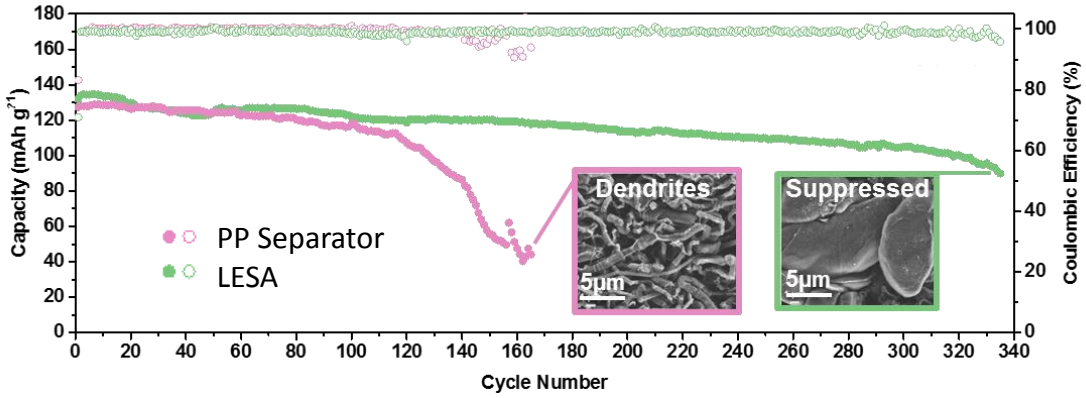
More energy dense batteries require >30% less inactive materials – Copper, Aluminum, Electrolyte, Packaging, etc.

Today's Cell	Tomorrow's Cell
700 Wh/L & 250 Wh/kg	>1000 Wh/L & >350 Wh/kg





Mossy & Dendritic Lithium **Smooth & DenseLithium**

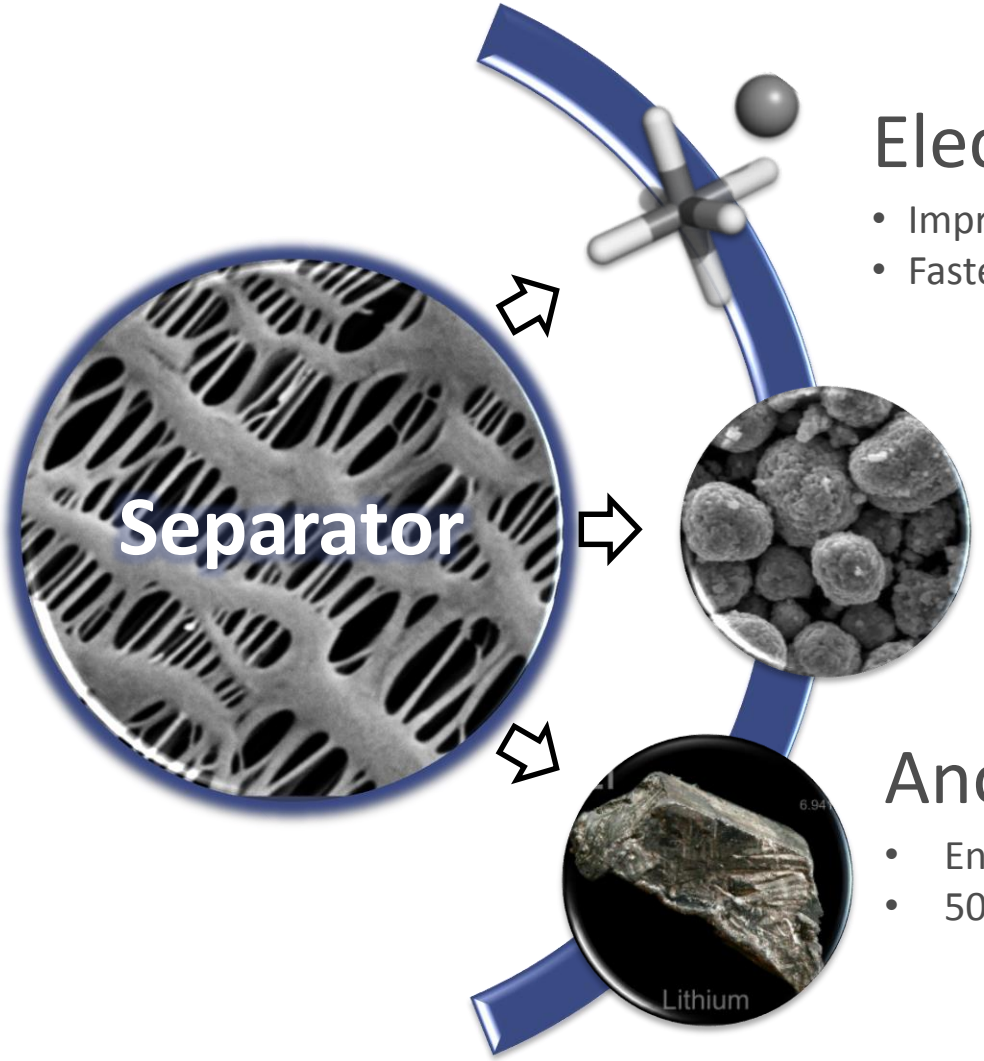


Protect Lithium with a Separator Coating

- Liquid electrolyte compatible
- Works with existing manufacturing

Separator Innovation Beyond Safety & Power is the Future

Focus on synergies between separator, electrolyte and active materials will accelerate new materials time to market



Electrolyte

- Improve Li-ion conductivity
- Faster wetting

Cathode

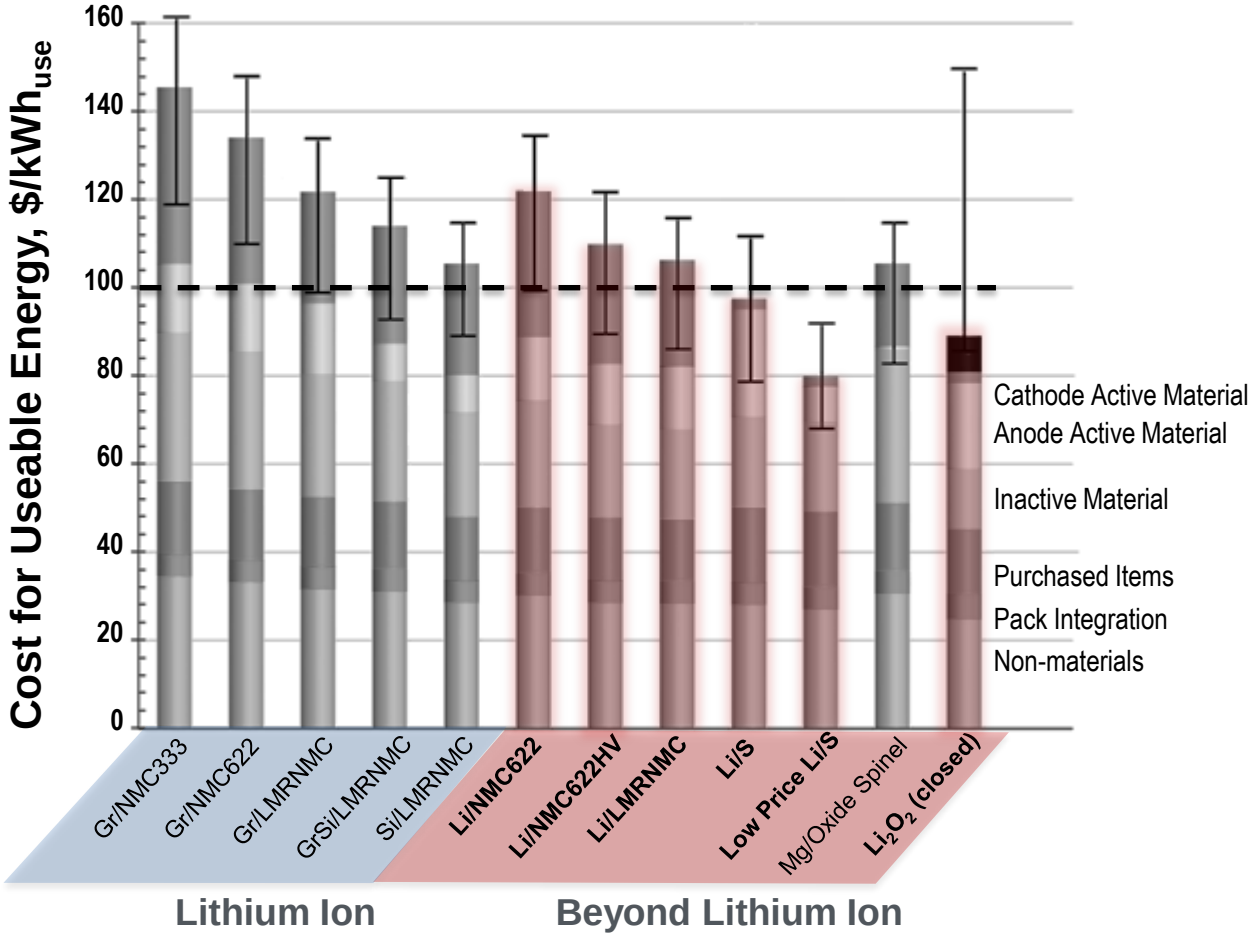
- Improve low-Co NMC cycle life
- Faster path to no-Co cathodes

Anode

- Enable Li-metal
- 50% energy density gain

Lithium Metal Anodes

The future of high-energy density batteries



Potential

- 10-fold increase in anode capacity
- Up to 50% energy density increase
- Most promising route to <$100/kWh pack-level useable energy

Challenge

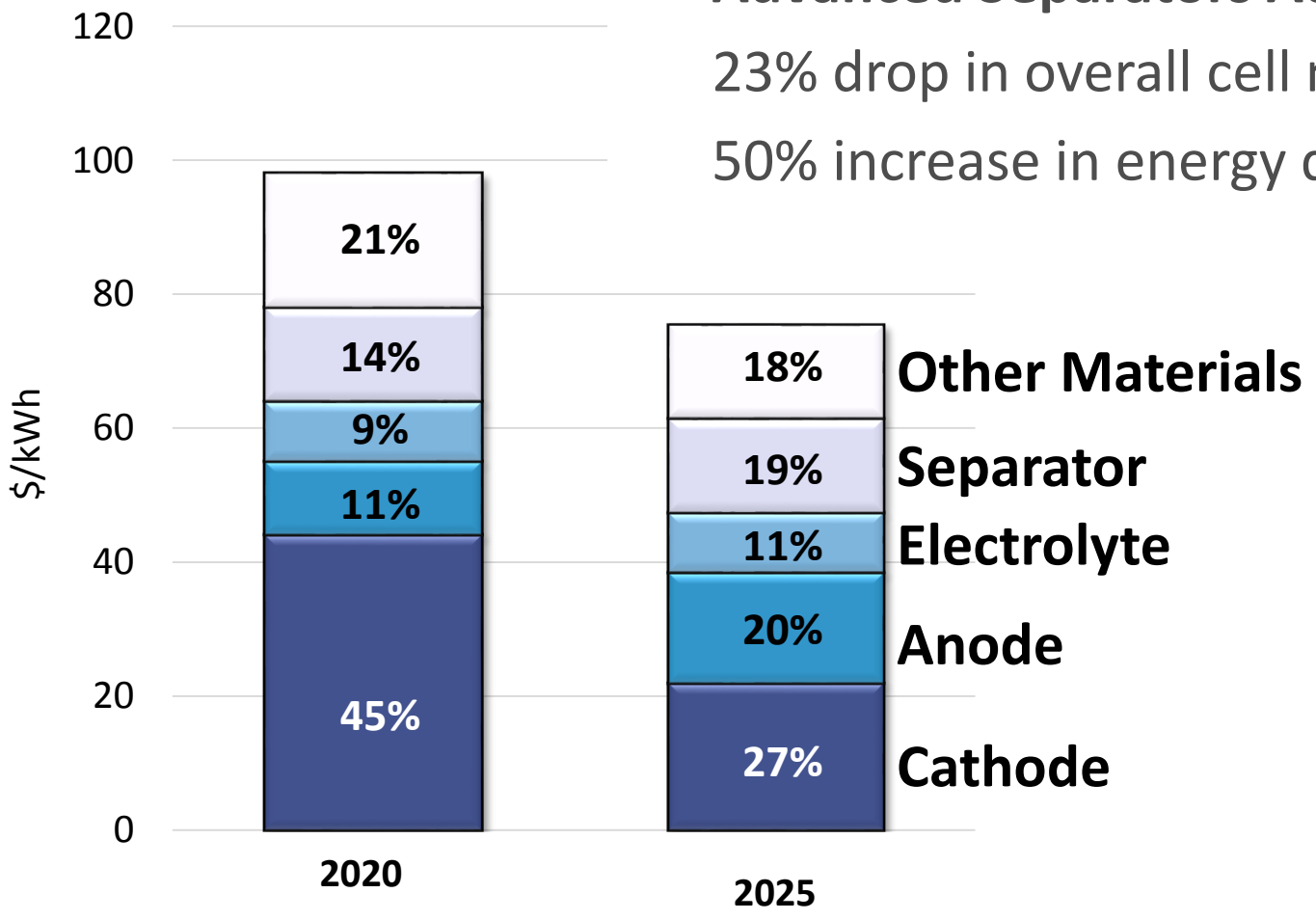
- Poor safety and cycle life are preventing commercialization

Outlook

- Solid-state electrolytes are well known
- Liquid electrolyte solutions emerging

Separator is Central to Smarter, Longer, & Less Material Goals

Lower $/kWh will drive market adoption of e-mobility and grid storage solutions



Advanced Separators Accelerate:

23% drop in overall cell materials cost

50% increase in energy density (Li metal & high V)