All Solid State Battery Based on Glass Electrolyte

Objective

Develop a manufacturable all solid-state battery with superior performance metrics
Lithium metal battery with glass infused cathode
High Energy Density
>450 Wh/kg and >1100 Wh/l
Two step manufacturing process
Highly scalable manufacturing process
27% less cost than Lithium Ion at scale

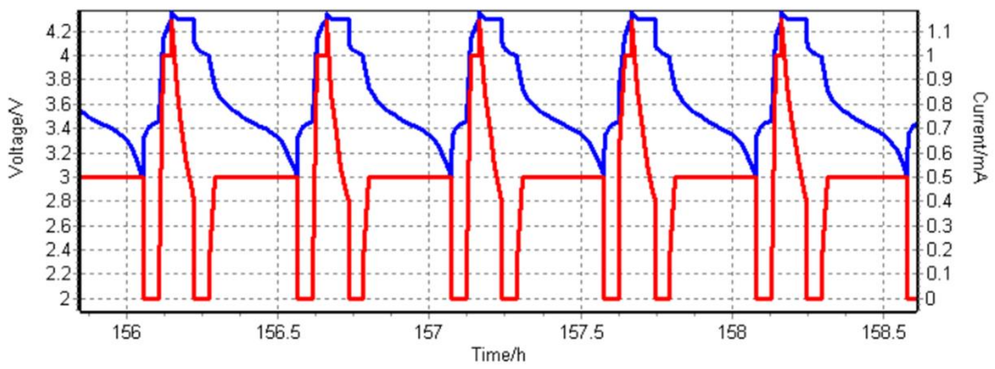
Approach

Utilize a glass electrolyte to replace flammable liquids used in lithium-ion batteries
Processing the glass from liquid state provides high surface electrolyte/cathode contact similar to lithium-ion batteries
Dense glass electrolytes with no grain or grain boundaries limit potential for dendrites
This is in contrast to ceramic oxides and pressed sulfide electrolytes
The JES glass can be formed in layers as thin as 10 microns
Working with oxy-sulfide glass to tailor properties
Oxide glass are known for high stability with cathodes and lithium metal
Sulfide electrolytes are known for high conductivities
JES Oxy-Sulfide glasses provide both high conductivity and good stability

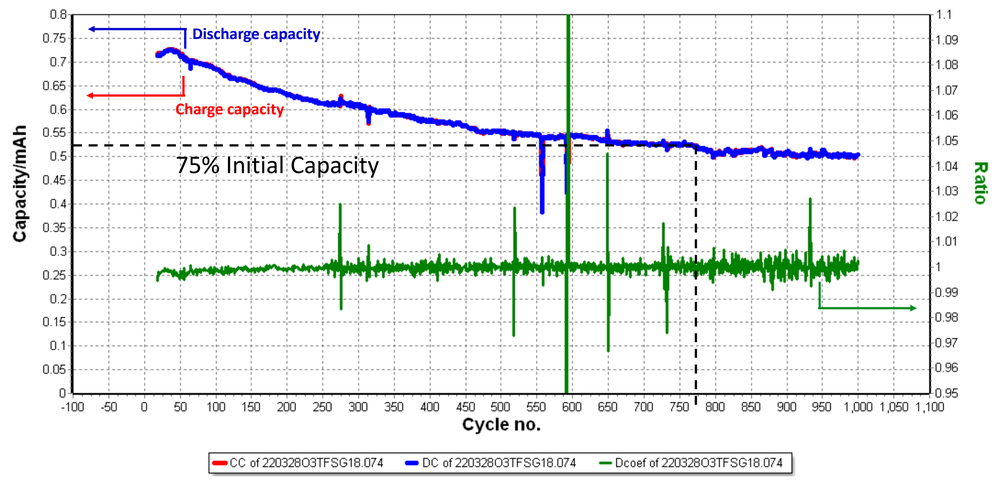
Oxide Glass Based Cell Performance

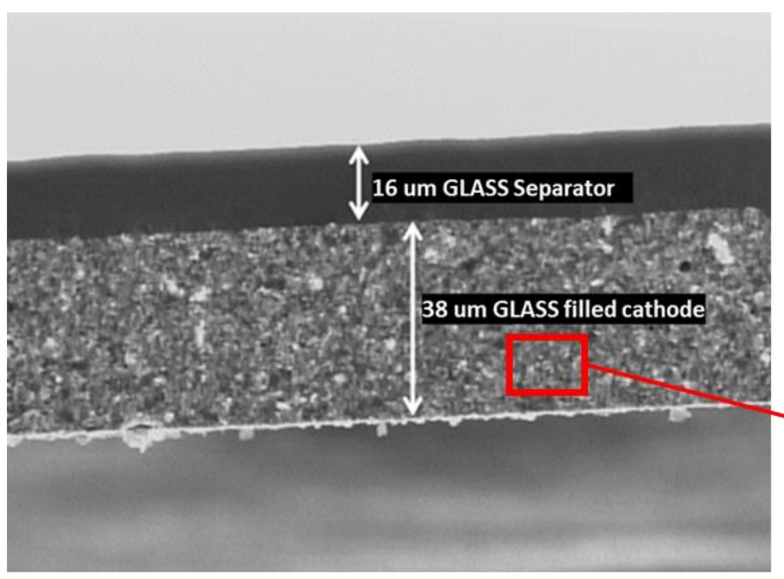
Cells of 20 mAh in serial lab production
Cathode capacity of greater than 2 mAh/cm^2
Complete theoretical cathode capacity at low rate
Long Durability and High efficiency
Oxide glass conductivity only 1 x 10^{-6} s/cm
Limits performance
Cells typically tested at 80°C

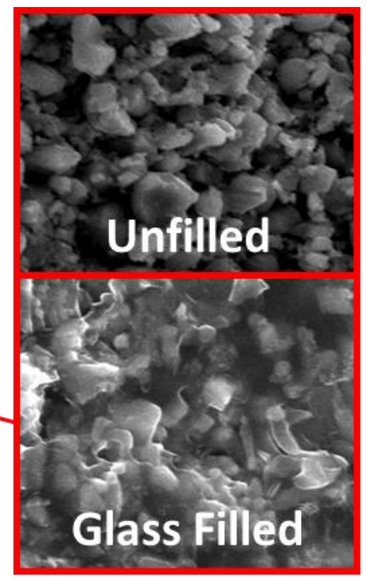
High Rate Charge/Discharge at 80°C



Coin Cell – 1000 Cycles at 80°C







Cost Reductions

Manufacturing
No Anode casting
No degassing, ageing or forming steps (bottlenecks)
Anticipate 1/3 cost reduction
Typical Battery $101/kWh
Based on 2021**
JES Glass Battery
~$74/kWh scaled production

** https://www.visualcapitalist.com/breaking-down-the-cost-of-an-ev-battery-cell/

Same Cathode as Li-Ion
Similar Cost
Fewer Process Steps
Reduction TBD
Lithium Free
Full 12% savings
No stand alone separator
Full 7% savings
Electrolyte similar costs
Packaging similar costs

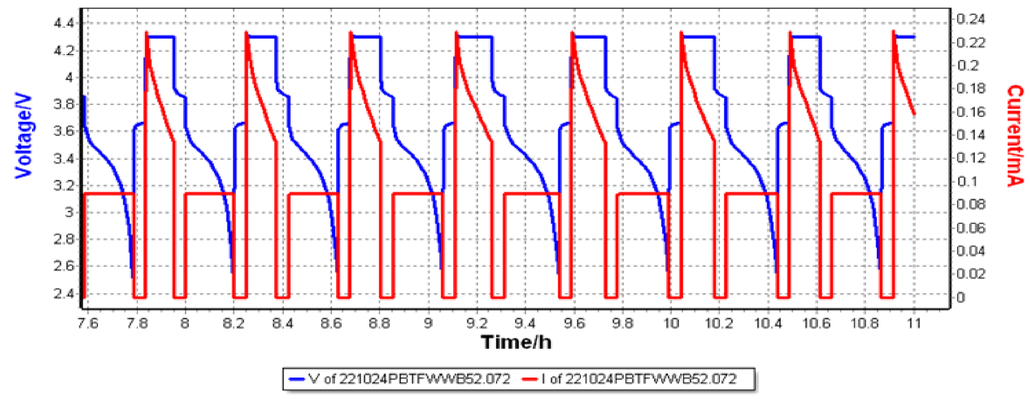
Oxy-Sulfide Electrolyte Glass

Sulfides will provide increased performance through higher conductivity
Research in sulfide electrolytes is widespread (σ>5x10^{-3})
Sulfide electrolytes typically directly used as pressed powders
JES is working with new Oxy-Sulfide based glasses
Maintain good conductivity and stability within battery environment utilizing this glass as an electrolyte/separator
Glass is required to prevent dendrites (battery shorting)
Adapting flow properties to integrate into full cell processing developed for oxide glass

Current Status

Oxy-Sulfide glass in development
Currently at 1 x 10^{-3} s/cm conductivity
Small cells in construction utilizing the same process
Flow properties of glass adapted for penetration
Glass shows stable cycling in lithium half cells
30-month timeline in place for scaled prototype line
Looking towards 200 mAh cells
4 C-rate charge capability at room temperature
1100 Wh/l and 450 Wh/kg

Oxy-Sulfide Glass Cell at Room Temperature



For More Information Scan HERE

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22nd Annual advanced automotive battery conference
DECEMBER 5 - 8, 2022
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