



Using innovative approaches, Livent seeks to build on our partnerships with industry to deliver on the promise of **pioneering technologies which can improve battery safety, performance, manufacturing efficiency and sustainability.**

◀ A fully functional high-performance battery from Sakuu that was 3D printed with LIOVIX<sup>®</sup> (Courtesy Sakuu. Learn more at [sakuu.com](http://sakuu.com))



**LIOVIX<sup>®</sup>** is a unique printable lithium formulation that can improve the performance of lithium-ion batteries, reduce manufacturing costs and enable the next generation of battery technology, all while enhancing safety and sustainability.

### Higher Capacity, Longer Life Batteries

LIOVIX<sup>®</sup> can boost a battery's output and extend its useful life with more recharge cycles. Performance improvements have been validated by several leading OEMs and battery manufacturing customers around the world.

### Enhanced Safety and Sustainability

Since LIOVIX<sup>®</sup> delivers lithium in a stable, protected form, it reduces the need for very stringent environmental conditions. LIOVIX<sup>®</sup> also gives battery manufacturers greater control and precision in how much lithium they use (reducing waste), allows for higher process efficiency (i.e., throughput) and opens pathways to shift away from conflict minerals and use more accessible battery materials.

### Commercially Scalable

LIOVIX<sup>®</sup> can be incorporated into existing battery manufacturing processes using standard equipment and common industry methods for scaling operations.

### Lower Manufacturing Costs

LIOVIX<sup>®</sup> significantly reduces the need for a battery cell manufacturing process called "formation" and provides other cost savings and efficiencies resulting from improvements in battery capacity and cyclability.

### Pathway to Next Generation Solid State Batteries

LIOVIX<sup>®</sup> is an important technology for the development and commercialization of solid-state batteries using lithium metal anodes. These next generation batteries will address many of the challenges and limitations of today's liquid electrolyte-based battery cells.





**LIOVIX® Printable Lithium Technology** describes the collective set of Livent intellectual property that allows Lithium to be deposited onto a substrate in a safe, controlled, scalable manner.



**Stabilized Lithium Metal Powder (SLMP®)**  
Source of Lithium and active ingredient



**Solvents and Rheology Modifiers**  
Know-how to make a consistent, flowable, printable formulation despite Lithium's unique physical properties



**Safety and Handling**  
LIOVIX® presents Li in a form amenable to scalable manufacturing



**Printing Equipment**  
LIOVIX® is delivered onto a substrate using off the shelf coating or printing equipment

Improvement to Battery Performance

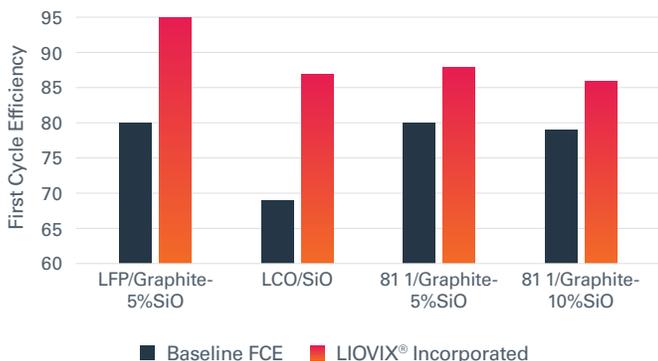
Safe + Controlled Delivery of Lithium Metal

Scalable Manufacturing Process for Customers

LIOVIX® technology can be applied across two broad areas: (1) pre-lithiation of Li-ion Batteries and (2) metal anode production.

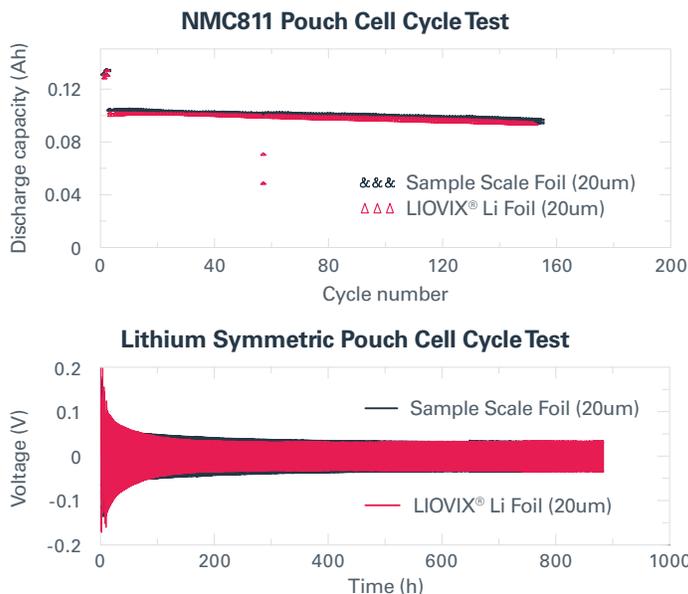
	Where is the Printable Lithium Technology Used?	Key Benefits
<b>Pre-Lithiation</b>	<p>Sacrificial lithium is deposited on the anode to reduce / eliminate irreversible capacity loss during first charge</p> <p>SEI formation during rest!</p> <ul style="list-style-type: none"> <li>● Active anode material</li> <li>● Carbon fiber</li> <li>● Binder</li> <li>● Anode with SEI layer</li> </ul>	<ul style="list-style-type: none"> <li>● First cycle capacity improved by 10% – 30%</li> <li>● Improves capacity retention over life of battery by 20% – 50%; cells last longer resulting in lower cost of ownership</li> <li>● Pre-lithiation step simplifies cell manufacturing process and reduces capital required</li> </ul>
<b>Li Metal Anode</b>	<p>Anodes, which are currently made out of graphite (carbon) in conventional Li-ion batteries, will be made out of a thin (&lt;20 micron) layer of Li Metal</p> <ul style="list-style-type: none"> <li>● LIOVIX® based lithium anode</li> <li>● Solid electrolyte layer</li> <li>● Cathode composite</li> <li>● Current collector</li> </ul>	<ul style="list-style-type: none"> <li>● LIOVIX® provides affordable, high-quality pathway for manufacturing the Li metal anodes with desired width and thickness</li> <li>● Solid state batteries have potential to store more energy relative to conventional Li-ion batteries per unit mass and volume</li> <li>● Safer to operate (e.g., no flammable electrolyte)</li> </ul>

### LIOVIX® INCORPORATED FULL CELL RESULTS IN FIRST CYCLE EFFICIENCY (FCE) IMPROVEMENT



LIOVIX® technology is cathode agnostic and is effective for a wide range of silicon containing anodes.

### LIOVIX® THIN LITHIUM FOIL (20UM) VS. SAMPLE SCALE FOIL (20UM) CYCLING PERFORMANCE COMPARISON



The performance of LIOVIX® based thin foil is similar to extruded, roll pressed thin foil.

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