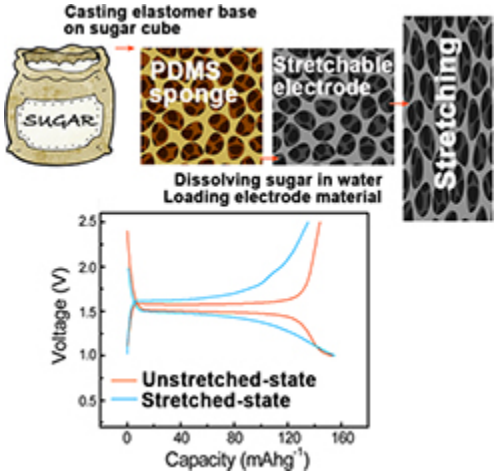
Docket #: S16-131

Electrodes and Separator for Stretchable Lithium-Ion Batteries

A team of engineers has developed high-performance, stretchable components for lithium-ion batteries using an easy, low-cost, scalable synthesis. These electrodes and separators could replace rigid components to fabricate stretchable batteries capable of powering flexible and wearable electronics. The technology creates a three-dimensional 3D porous sponge-like PDMS (polydimethylsiloxane) scaffolds using a low-cost sugar template. This stretchable scaffold can then form the backbone for LTO (Li4Ti5O12) anodes, LFP (LiFePO4) cathodes, or separators. When combined, these components form a full cell with 80% stretchability, high specific capacity, and good cycling stability. These stretchable electrodes for lithium-ion batteries offer the potential to boost the development and application of a wide range of emerging devices such as wearable electronics, conformable skin sensors or implantable medical devices.



Overview of fabrication and performance of stretched and unstretched material.

Stage of Research

The inventors have successfully fabricated LTO/LFP electrodes by 3D interconnected porous PDMS scaffolds and assembled a full cell using a PDMS separator. The electrodes had: high specific capacity; 80% stretchability; 82-91% capacity retention

for the half cells after 500 stretch-release cycles; and slight capacity decay of 6% in the battery using electrode in stretched state. They are continuing their research to assemble a whole battery with electrode and sensor.

Applications

- **Flexible and stretchable lithium-ion batteries** with end-user applications such as:
  - wearable, portable electronics
  - conformable skin sensors
  - implantable medical devices

Advantages

- **Easy, low-cost, scalable synthesis** - simple, high-efficiency process to fabricate 3D porous sponge using sugar template can be easily scaled up for commercial fabrication
- **High stretchability** - >80% stretchability in any direction while maintaining good electrochemical performance
- **Stable, high performance electrodes:**
  - 82-91% capacity retention the stretchable LTO anode and LFP cathode after 500 stretch-release cycles
  - functions under large mechanical strain

Publications

- Liu, W., Chen, Z., Zhou, G., Sun, Y., Lee, H. R., Liu, C., ... & Cui, Y. (2016). 3D Porous Sponge?Inspired Electrode for Stretchable Lithium?Ion Batteries. *Advanced Materials*, 28(18), 3578-3583.

Innovators

- Wei Liu
- Yi Cui

- Min-Sang Song

Licensing Contact

Jon Gortat

Licensing & Strategic Alliances Director for Physical Science

Email