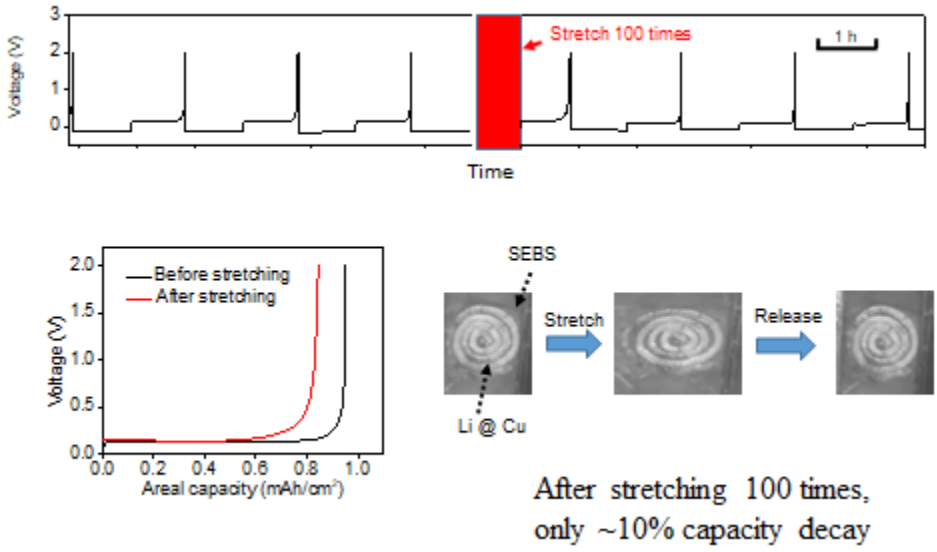
Docket #: S17-145

High-performance, stable, stretchable lithium metal anode for flexible lithium ion batteries

Engineers in Prof. Yi Cui's laboratory have developed a stretchable, stable, high energy density anode to be used in lithium ion batteries that power stretchable electronic devices (e.g., wearable electronics, bendable phones or flexible displays). Until now, the energy density of stretchable lithium ion batteries has been extremely low due to materials with low lithium (Li) storage capabilities, while high performance Li metal has been too brittle for elastic deformation. To enable use of Li metal in stretchable batteries, this technology integrates Li into a hierarchical copper (Cu) spiral which is covered with rubber for flexibility. This simple design makes the whole electrode highly stretchable with stable electrochemical performances during mechanical stretching/releasing cycles. The anode could enable Li ion batteries that can adapt to the dynamic motions of electronic devices while maintaining good electrochemical performance.



Anode performance *when subjected to stretching during battery charging/discharging*

Stage of Research

The inventors have demonstrated this anode with a working coin and pouch cell and tested it in over 100 cells. They are continuing their work with plans to create a similar stretchable cathode.

Applications

- **Lithium ion batteries** - stretchable anode for batteries that power end-user applications such as wearable/implantable devices, electronic skin, microfluidics, stretchable electronics displays and bendable smart phones

Advantages

- **High performance electrode:**
  - high Li storage capacity (10 times capacity of graphite) with low working potential (-3.040 V vs standard hydrogen electrode) and stable electrochemical performances
  - high columbic efficiency

    - stable electrochemical cycling performance during stretching/releasing cycles because the design provides an unchanged electron conduction pathway
- **Mechanically robust:**
    - highly stretchable from elasticity of rubber
    - excellent extendibility due to the hierarchical spiral structures of self-wrapped Cu spring
    - good integration of Cu and rubber greatly alleviates issues associated with modulus differences
- **Low cost, easy to use, simple design**

Publications

- Kai Liu, Biao Kong, Wei Liu, Yongming Sun, Min-Sang Song, Jun Chen, Yayuan Liu, Dingchang Lin, Allen Pei, and Yi Cui, "Stretchable Lithium Metal Anode with Improved Mechanical and Electrochemical Cycling Stability,"Joule (2018) doi:10.1016/j.joule.2018.06.003

Patents

- Published Application: 20190148737
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