Layered Mxene/Sn as a Promising Anode for Lithium Ion Batteries with Ultrahigh and Stable Capacity

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OBJECTIVE

Currently, lithium ion batteries dominate the field of portable electronics and alike in terms of energy storage. With the rise of demand for better energy storage in cars and homes, lithium ion batteries show promise. Being that current electrodes do not have to storage capacity to meet this demand, a better alternative is sought.

Presented is a lithium ion anode with improved capacitance and energy density. This electrode is made of a MXene and tin nanocomposite. MXene is a 2D layered metal carbide or nitride material that shows a high potential of enhancement for electrode use. Uniformly dispersed tin particles improve conductivity and overall performance of the MXene matrix.

APPROACH

- Synthesis of MXene begins with MAX powder, which consists of alternating layers of titanium carbide and aluminum
- The MAX powder is etched in HF, removing the layers of aluminum
- Extensive ultrasonication is done to help increase the spacing between MXene layers

CHARACTERIZATION

- Scanning Electron Microscopy (SEM) was used before and after dispersion of Sn nanoparticles
- SEM confirms uniform dispersion of Sn particles onto MXene layers
- D-spacing of the MXene layers is also observed under SEM
- Transmission Electron Microscopy (TEM) was used to observe the detail of a single MXene layer with Sn particles
- Using TEM, individual Sn particles can be observed to confirm optimal size and dispersion
- X-Ray Diffraction (XRD) was used to confirm correct synthesis of MXene and MXene/Sn composite
- XRD also shows the sufficient d-spacing between the MXene layers
- Quality of both MXene and MXene/Sn are verified through the use of XRD

RESULTS

- The assembled coin cell showed an initial specific capacitance of ~1150 mAh/g and ~500 mAh/g after 90+ cycles
- These results show high capacitance and good coulombic efficiency
- The MXene/Sn anode was assembled into a half cell and used to light up LEDs to show functionality
- The results of the MXene/Sn nanocomposite material shows promise for next generation lithium ion battery anodes
- Performance can be improved in future experiments through more precise methods of Sn particle dispersion and the use of different MXenes with a higher capacitance and larger spacing between layers

BIBLIOGRAPHY


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