Hybrid Nanostructured Materials For Rechargeable Energy Storage Technologies

Tech ID: 32649 / UC Case 2014-173-0

FULL DESCRIPTION

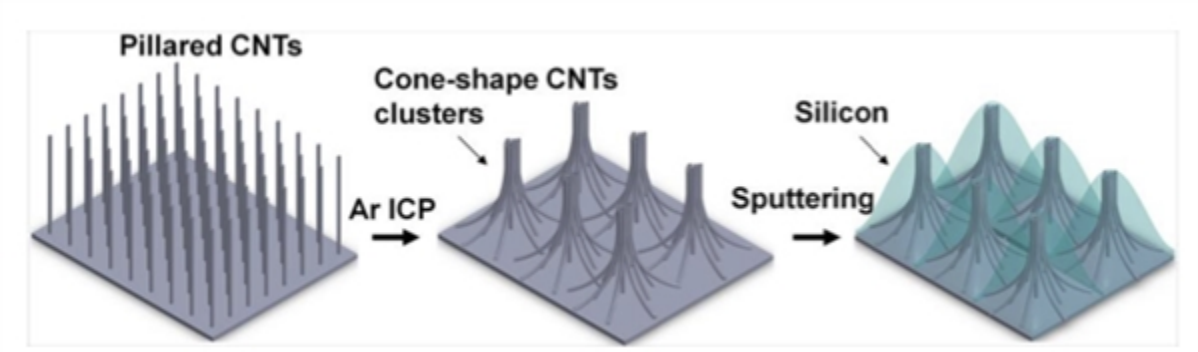
Background

Graphitic anodes in current Lithium-ion batteries (LIB) are limited to theoretical capacity of 372 mAh/gram. Silicon based anodes are identified to be the next generation for LIBs due to their theoretical capacity limit of 4200 mAh/gram. Obstacles that delay the adoption of Lithium-Silicon batteries are:

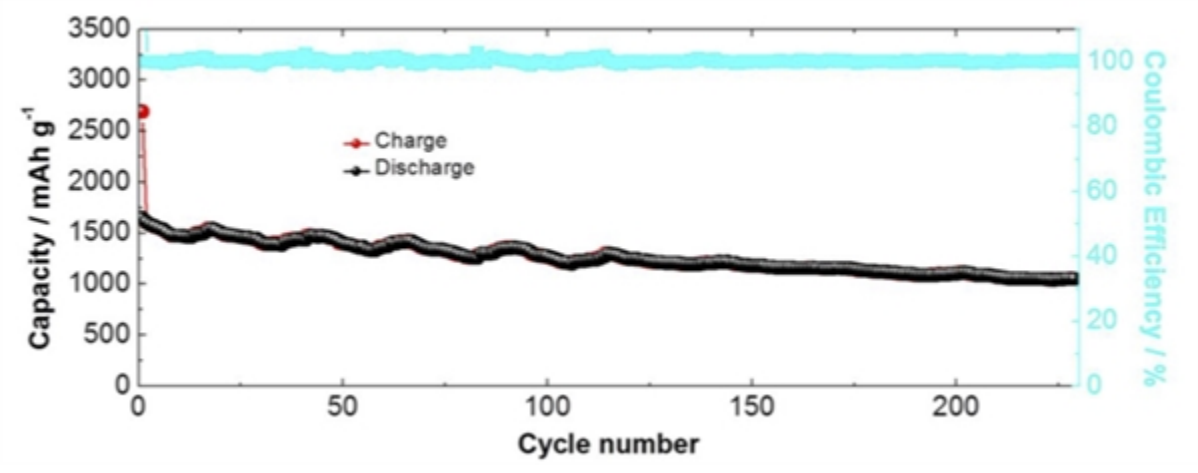
- Significant increase in volume of the silicon anode during alloying and de-alloying process.
- Large solid electrolyte interface layer that quickly kill the performance of the electrode.

Current Invention

In this patented technology, UCR research team led by Prof. Cengiz Ozkan describe an innovative, 3-dimensional silicon decorated Cone shaped Carbon nanotube Clusters (Si-CCC) architecture and its application as LIB anode. The pillared carbon nanotubes (CNT) and graphene nanostructure are grown by a 2-step, Chemical Vapor Deposition (CVD) process on a copper foil – which is a commonly used current collector in batteries. Button type half cells, with Si-CCC anodes and Lithium metal cathodes, were assembled and tested. The cells achieved a very high, fully reversible capacity of 1,644.4 mAh/gram. After 230 charge-discharge cycles, the cells had a capacity of 1050 mAh/gram and exhibited 100% coulombic efficiency.



Synthesis of silicon decorated, cone shaped CNT clusters



Cycling performance and coulombic efficiency of the PGN electrode at a current density of 1000 mA/gram

ADVANTAGES

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OTHER INFORMATION

KEYWORDS

Lithium ion battery, Energy storage, Lithium silicon, Carbon Nanotube, Silicon carbon cluster, Graphene

CATEGORIZED AS

- **Energy**
  - Storage/Battery
- **Materials & Chemicals**
  - Nanomaterials
- **Nanotechnology**
  - Materials
- **Transportation**
  - Automotive

RELATED CASES

2014-173-0

The advantages of this invention are:

- Seamless connection of the graphene and pillared CNTs facilitates thermal and charge transfer.
- Cone shaped nature of the Si-CCC architecture enhances the rate performance.
- Si-CCC architecture is a binder free process for preparing electrodes for LIBs.

SUGGESTED USES

- Lithium-Ion Batteries.
- Electrochemical energy storage devices.

RELATED MATERIALS

- Pillared graphene and silicon nanocomposite architecture for anodes of lithium ion batteries

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,211,448	02/19/2019	2014-173

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