Facile Synthesis Of Ni Nanofoam Architectures For Applications In Li-Ion Batteries

Tech ID: 32666 / UC Case 2017-047-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	10,964,942	03/30/2021	2017-047

FULL DESCRIPTION

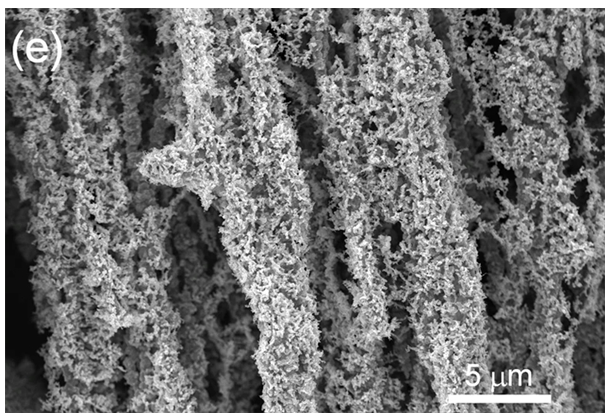
Background

According to the US DOE information, the 2022 Tesla Model 3 Long Range AWD has a range of 131 miles of combined city and highway driving – on a single charge. One of the range limiting factors of EVs is that the current graphitic anodes have a capacity limitation of 372 mAh/gram. Among potential options for new anode materials, Nickel Oxide (NiO) is appealing due to its theoretical capacity of 718 mAh/g and lower cost. The challenges with current NiO based anodes are:

- Low cycling stability.
- Low-rate capability due to its volume expansion.
- Poor electrical conductivity.
- The variety of nanostructures that have been developed to address these challenges still suffer from drawbacks such as high processing costs and low capacity retention.

Current Invention

Researchers led by the faculty team of Profs. Cengiz and Mihrimah Ozkan have discovered a novel, patented technology. The anode developed is NiO decorated Nickel (Ni) nanowires that are grown directly on Ni nanofoam. In their development, Ni nanowires are synthesized on the nanofoam by heating with Nickel Acetate and Glycerol at 400 deg. C. Additional details can be found in the related materials cited below.



Scanning electron microscopy (SEM) images of the NiO nanowire foam (Ni-NWF)

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OTHER INFORMATION

KEYWORDS

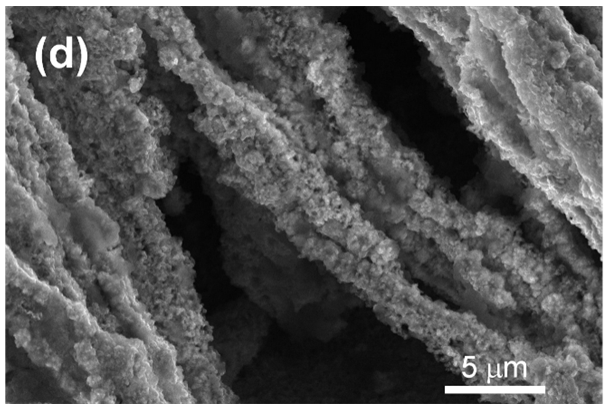
Lithium-ion battery, Anode, Lithium battery anode, Nickel Oxide, Nanowire Foam, Nickel Nanowire, Energy storage, Electric vehicles, Consumer electronics, Drone battery

CATEGORIZED AS

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

RELATED CASES

2017-047-0, 2016-183-0



SEM images of the Ni-NWF after 1,000 cycles, the fabricated lab-level prototype

ADVANTAGES

The significant benefits of their discovery are:

- Demonstrated high stability with a capacity of 680 mAh/g after 1,000 cycles at a rate of 0.5C.
- Low resistance that translates to superior power performance and lower losses.
- The materials are synthesized without any carbon, binders, templates or conductive additives.
- Low operating temperature.
- Easily transferred from lab scale to mass production.

SUGGESTED USES

Lithium-ion battery anodes for:

- Electric Vehicles and Plug-in Hybrid Electric Vehicles
- Drones
- Consumer electronics
- Renewable energy storage

STATE OF DEVELOPMENT

Lab level prototype

RELATED TECHNOLOGY

Free-Standing Ni-NiO Nanofiber Cloth Anode for High Capacity and High Rate Li-ion Batteries

RELATED MATERIALS

- Template Free and Binderless NiO Nanowire Foam for Li-ion Battery Anodes with Long Cycle Life and Ultrahigh Rate Capability

RELATED TECHNOLOGIES

- Free-Standing Ni-Nio Nanofiber Cloth Anode For High Capacity And High Rate Li-Ion Batteries

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