Enhanced Cycle Lifetime With Gel Electrolyte For Mn02 Nanowire Capacitors

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OTHER INFORMATION

KEYWORDS

Gel electrolyte, Nanowire, Energy storage, Capacitor, Long cycle lifetime

CATEGORIZED AS

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

» Electronics

» Materials

» Tools and Devices

RELATED CASES

2016-760-0

BRIEF DESCRIPTION

The invention is novel way of preparing electrodes for nanowire-based batteries and capacitors with extremely long cycle lifetimes. The proposed assemblies last much longer than any comparable state of the art nanowire energy storage device, without loss of performance, and are comparable to liquid electrolyte-based technologies in terms of their figures of merit.

FULL DESCRIPTION

The use of nanowires in electronic and energy storage devices enables miniaturization and, often, also improves performance. Nanowires have long been sought for use in batteries not only for their extremely diminutive size (thousands of times thinner than a human hair), but also because they are highly conductive and feature a large surface area for the storage and transfer of electrons. As such, nanowire-based architectures can enable higher power production in either batteries or capacitors than would be possible to obtain with films or powders from the same materials. However, the nanowires' small size also makes them very fragile and highly susceptible to damage by electrochemical processes in which they participate – the repeated discharging and recharging (cycling) leads to dissolution and corrosion of the fine structures, which grow brittle and crack, and, as a result, to rapid loss of electrical continuity through the nanowires and an irreversible loss of capacity.

Researchers at UCI have now demonstrated a nanowire battery system with recharging stability of up to 200,000 cycles without measurable loss of capacity, which is an exceptional improvement over other state of the art nanowire energy storage devices. The stability of the nanowires towards electrochemical stresses is achieved via their encapsulation into a flexible plastic, which is permeable to charge but not to air and moisture. The encapsulation step of the device manufacturing process is straightforward, inexpensive, and compatible with any nanowire material, yet affords an unprecedented level of improvement in device stability towards recharge cycling. In addition, the invention includes a description of a new Degradation and Failure Discovery Platform, which consists of a symmetrical, all-nanowire capacitor, and enables the testing and studying of diverse materials and energy storage systems.

SUGGESTED USES

Nanowire battery technologies for computers, smartphones, cars, and spacecraft.

ADVANTAGES

Extended battery lifetime, i.e. > 200,000 recharging cycles, without loss of capacitance – such performance is unprecedented for nanowire-based electronics, with current state of the art systems only lasting for 2,000-8,000 cycles.

Inexpensive and facile improvement to the existing nanowire manufacturing process, which is compatible with a multitude of materials and device architectures.

Efficient novel testing platform that enables the study of energy storage materials and systems.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,610,742	03/21/2023	2016-760
United States Of America	Issued Patent	10,347,434	07/09/2019	2016-760

STATE OF DEVELOPMENT

The invention is currently in the working prototype stage.

RELATED MATERIALS

» Thai, M. L.; Chandran, G. T.; Dutta, R. K.; Li, X.; Penner R. M. 100k Cycles and Beyond: Extraordinary Cycle. ACS Energy Lett, 2016, 1, 57-63. - 04/20/2016

» Nanowire Batteries - UC Irvine - 04/20/2016

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Lithographically Patterned Nanowire Electrodeposition

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