TECHNOLOGY

Three-Dimensional, Biotemplated Hierarchical Electrodes for Microbattery Applications

OVERVIEW

Micro-batteries are essential components in miniaturized systems and portable devices as small scale power sources for electronics as well as for energy storage devices from environmental sources such as vibration energy harvesting and solar energy. As the auxiliary components of such systems decrease in size, their power supplies must scale accordingly to enable next-generation devices with equivalent performance to larger assemblies to have smaller footprints. Consequently, this is a major thrust area in the field of battery technology research.

Primary efforts in this research have been focused in two major approaches. The first leverages on Microelectromechanical Systems (MEMS) technology and is based on the fabrication of three-dimensional electrodes. When electrodes are fabricated in the out-of-plane dimension, both the available surface area and material mass loading are increased, resulting in an increase in energy and power density compared to planar thin film batteries. The second approach involves the use of nano-structured materials due to significant advantages they offer compare to their bulk counterparts. Notwithstanding individual benefits of these techniques, independently they bear limitations in regards to their use in high performance small scale power sources. Three-dimensional electrodes cannot be arbitrarily increased in thickness and height as this will limit their rate capabilities at high current densities due to slower reaction kinetics. While nano-structured materials are a promising solution for the concern, the amount of active material loading they enable in small footprint areas does not allow high aerial energy densities.

Researchers at the University of Maryland have developed a novel technology prototype based on the use of electrodes with both micro and nano components, which combine the advantages of both approaches. More specifically, the electrodes consist of bio-templated nano-structured active materials which self-assemble onto three-dimensional micro-pillars. The nano-structured electrodes offer high surface area and fast reaction kinetics while the microstructures enable higher material loading compared to nano-structures alone. Their data demonstrated the feasibility of this technology in increasing the energy density of bio-templated materials by accommodating more mass loading per footprint area. The research also demonstrates the benefit of this approach in maintaining the high rate performance that nano-structures allow while at the same time increasing the achievable energy density.

Applications:
· Any miniaturized electronic portable device
· Energy storage devices from remote environmental vibration energy harvesting and solar energy systems
Advantages:
· Increases both the energy and power density of micro-battery devices

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Additional Information

INSTITUTION

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PATENT STATUS

Patent(s) pending

LICENSE STATUS

Contact OTC for licensing information

CATEGORIES

- Power Electronics
- Microelectronics
- Nanotechnology + Nanoparticles + Nanomaterials

EXTERNAL RESOURCES

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