
Image Credit: NASA

National Aeronautics and Space Administration

Power Generation and Storage

Fabrication of Multilayer Ferritin Arrays

A method of creating a thin-film electrode for a bio-nanobattery

NASA Langley Research Center has developed a method of depositing arrays of a ferritin protein on a substrate to create a thin-film electrode for a bio-nanobattery. The NASA Langley developed method is a spin self-assembly procedure. By this procedure, a first ferritin layer is first formed on the substrate, followed by building a second, oppositely-charged ferritin layer on the top of the first ferritin layer to form a bilayer structure. Oppositely-charged ferritin layers are subsequently deposited on top of each other until a desired number of bilayer structures are produced. The result is an ordered, uniform, stable and robust, thin-film electrode material of enhanced packing density, which provides optimal charge density for the bio-nanobattery.

BENEFITS

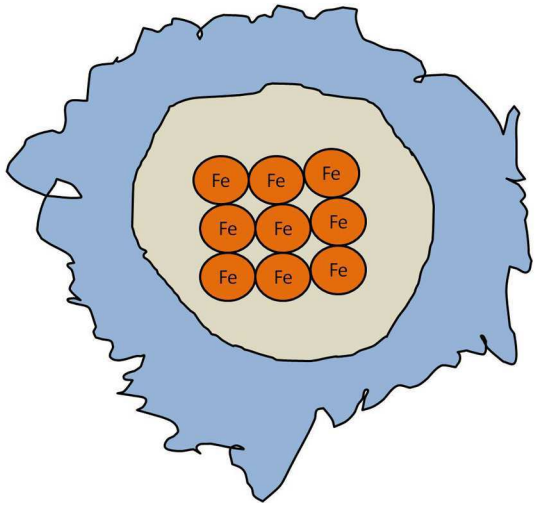
- Low fabrication costs
- Robust process

technology solution

THE TECHNOLOGY

The concept of a bio-nanobattery is based on ferritin, an iron storage protein that naturally exists in most biological systems. The ferritin molecule consists of a segmented protein shell with an outer diameter of 12.5 nm and an inner diameter of 7.5 nm, containing up to ~4500 Fe3+ atoms as Fe(OH)3 within its hollow interior. Biomineralization allows ferritins to reconstitute themselves with various metallic cores such as cobalt, manganese, and so forth. The bio-nanobattery basically consists of two ferritin half-cell units with a charge disparity between them. When the ferritin half cells are integrated into a complete battery system, the fabrication of well-organized ferritin arrays is very important to enhance the overall battery performance, for example, the battery power density, the power discharge rate, the compactness of battery size, etc.

A novel fabrication method of thin-film electrodes of ferritin-based bio-nanobattery was conceived and demonstrated in the development of bio-nanobattery. The ferritin electrode assembly method produced a highly ordered, flat, and robust ferritin layer in a much shorter period of time, compared with Langmuir-Blodgett or dipping deposition. The deposition can be repeated until multilayer structures of desired dimensions are achieved.



Ferritin is an iron storage protein found widely in biological systems of humans, animals, and even bacteria. Image credit: Wikimedia Commons/einouye

APPLICATIONS

The technology has several potential applications:

- Ultra-high density data storage devices
- Quantum electronic devices
- Nanoelectromagnetics
- Biomedical
  --biochips
  --biosensors (in-vivo and in-vitro)
- Nano-robots

PUBLICATIONS

Patent No: 7,510,802

More Information

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