



## Metal-Coated Vertically Aligned Carbon Nanofibers

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**The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method for decorating carbon nanostructures with uniform metal coatings to provide electrodes with high structural stability and surface area.**

### Overview

Although electrochemically active materials with high density and surface area have many potential uses in electrocatalysts, batteries, fuel cells and sensors, creating these materials can be challenging. Vertically aligned carbon nanofibers are a promising option. In addition to having similar electrochemical and mechanical properties as other nanoscale carbon materials, the physical dimensions of these nanofibers can be controlled to allow for large, accessible surface areas.

### The Invention

UW-Madison researchers have developed a method for decorating carbon nanostructures with uniform metal coatings to provide electrodes with high structural stability and surface area. The process uses arrays of vertically aligned carbon nanofibers separated by interstices. The nanofibers are functionalized by covalently binding a layer of organic linker molecules to their surface. Electroless deposition is then used to deposit a continuous metal coating onto the functionalized surfaces. The resulting metal-coated nanofibers form highly stable and reproducible electrodes with high surface areas. These electrodes can be used in devices such as supercapacitors and fuel cells.

### Applications

- High-density energy storage (i.e., supercapacitors and fuel cells)

### Key Benefits

- Because of the shape and accessibility of the carbon nanofibers, the resulting structures are highly stable and reproducible, and have high surface areas.
- Electrodes have approximately 10 times greater capacitance than carbon nanofiber electrodes and approximately 100 times greater capacitance than typical planar surfaces.
- Because the nanofibers are organized into brush-like arrays, rather than randomly oriented into spaghetti-like mats, the analytes used for functionalizing or coating the nanofiber surfaces can easily access the nanofibers.
- Electroless deposition uniformly and continuously coats the entire length of the nanofiber, rather than just the top, as is seen with electrochemical deposition.
- In some embodiments, at least 75 percent of the weight of the metal-coated nanofibers comes from the metal.
- Unlike previous methods, the functionalization steps do not involve oxidizing bare carbon substrates in acidic solutions, which can be detrimental to the nanostructures.
- Many forms of vertically aligned carbon nanofiber arrays may be used.
- Many types of metals, such as Ag, Au, Pd, Pt, Rh, Cu or Ni, may be used to coat the nanofibers.

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- Nanofibers can be grown on a variety of electrically conductive substrate surfaces, including silicon nitride, silicon oxide, silicon, molybdenum, stainless steel and titanium.

## Additional Information

### For More Information About the Inventors

- [Robert Hamers](#)

### Tech Fields

- [Clean Technology : Energy storage, delivery & resource efficiencies](#)
- [Engineering : Micro & nanotechnologies](#)

For current licensing status, please contact Jennifer Gottwald at [jennifer@warf.org](mailto:jennifer@warf.org) or 608-960-9854

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