



# Porobello Mushroom Based Hierarchically Porous Carbon Nanoribbons And Architectures

Tech ID: 32654 / UC Case 2015-444-0

## PATENT STATUS

| Country                  | Type          | Number     | Dated      | Case     |
|--------------------------|---------------|------------|------------|----------|
| United States Of America | Issued Patent | 10,818,914 | 10/27/2020 | 2015-444 |

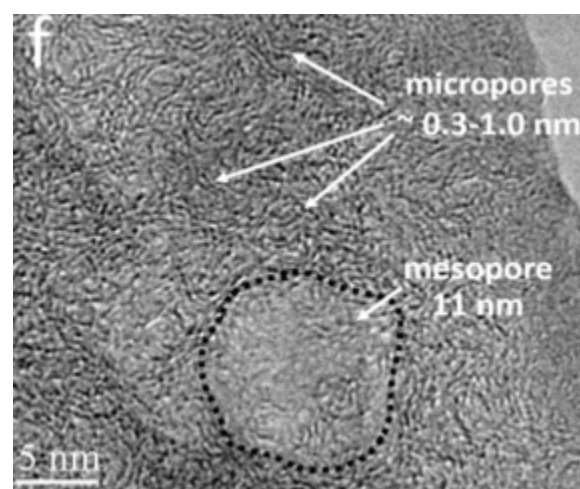
## FULL DESCRIPTION

### Background

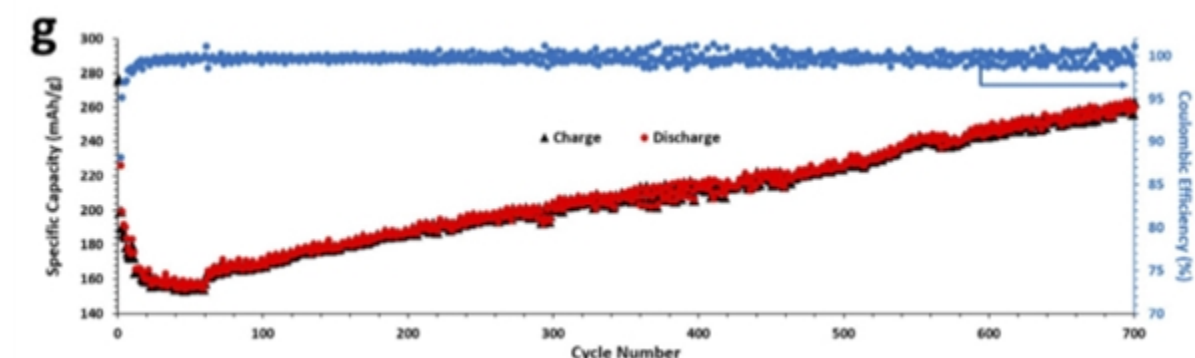
The industry standard for rechargeable lithium-ion battery anode is synthetic graphite due in part to its high cycling ability and low hysteresis. The disadvantages of graphite are it is relatively expensive and has relatively lower lithium storage capacity per carbon weight. Hard carbon anodes offer a good alternative in comparison with graphite due to its higher specific capacity (~ 500 mAh/gram) though they have significant irreversible capacity. Carbon anodes derived from biomass are of interest because of their low cost and environmental benignity.

### Current Invention

Biologically inspired, the research team led by Prof(s). Cengiz Ozkan and Mihrimah Ozkan studied the tissues of Portobello Mushroom and the electrochemical performance of the pyrolytic carbons derived from these tissues. Their research led to the discovery and synthesis of a patented, novel, free-standing, carbon anodes derived from the cap skin tissue (CST) of the mushroom. Pyrolysis of the CST, at temperatures of 900 – 1100 deg. C resulted in a morphology of interconnected network of hierarchically porous carbon nanoribbons.



Transmission Electron Microscopy image of CST processed at 1100 deg. C showing hierarchically porous nanoribbons



## CONTACT

Venkata S. Krishnamurty  
[venkata.krishnamurty@ucr.edu](mailto:venkata.krishnamurty@ucr.edu)  
tel: .

## OTHER INFORMATION

### KEYWORDS

Hard carbon, Carbon anode, Lithium-ion battery, Energy storage, Portobello Mushroom, Nanoribbon, Nanostructures

## QUICKSTART LICENSING



This technology is available through the [UC QuickStart](#) program for startups.

## CATEGORIZED AS

- ▶ Energy
  - ▶ Storage/Battery
- ▶ Materials & Chemicals
  - ▶ Biological
  - ▶ Nanomaterials

## RELATED CASES

2015-444-0

Charge-discharge plot and coulombic efficiency of carbon anode derived from CST processed at 1100 deg. C.

## ADVANTAGES

The novelty and significance of their discovery are:

- ▶ A binder free, additive free, and current collector free, carbon anode.
- ▶ Minimal processing and naturally self-activating.
- ▶ Higher energy density.
- ▶ Lower cost and lower environmental impact.

## SUGGESTED USES

- ▶ Lithium-ion battery anode
- ▶ Rechargeable energy storage

## TESTING

The team fabricated 2032 type coin cells to test the performance of the carbon anodes. The CSTs processed at temperature of 1100 deg. C displayed the optimum performance with initial discharge capacity of 771.3 mAh/gram, 99.75% coulombic efficiency after 700 cycles.

## RELATED MATERIALS

- ▶ [Bio-Derived, Binderless, Hierarchically Porous Carbon Anodes for Li-ion Batteries](#)

**University of California, Riverside**  
**Office of Technology Commercialization**  
200 University Office Building,  
Riverside, CA 92521  
[otc@ucr.edu](mailto:otc@ucr.edu)  
[research.ucr.edu/](http://research.ucr.edu/)

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