Ultrafine Nanowires As Highly Efficient Electrocatalysts

Tech ID: 27063 / UC Case 2017-108-0

SUMMARY

UCLA researchers in the Department of Chemistry and Biochemistry have developed a novel process of synthesizing ultrafine jagged Pt nanowires with a record high utilization efficiency for fuel cell catalyst applications.

BACKGROUND

Hydrogen fuel cell, with water as the only by-product, is a promising green energy source. Platinum has been used as the catalyst for oxygen reduction reaction (ORR). However, the critical limiting factor for making hydrogen fuel cells economical for transportation is the low Pt catalyst utilization efficiency, i.e. mass activity.

INNOVATION

Researchers at UCLA designed and synthesized ultrafine jagged Pt nanowires with a record high utilization efficiency of 13.59 A/mgPt, which nearly doubles the highest mass activity value ever reported. The Pt nanowires also exhibit the highest electrochemical active surface area, and high specific activity. These Pt nanowires can also be made in contact with carbon support via multiple points, which promises efficient charge transport and collection.

APPLICATIONS

• Electrocatalysts for different reactions:

o Oxygen reduction reaction (for fuel cells, air batteries)

o Oxygen evolution reaction and hydrogen evolution reactions (for water splitting or hydrogen generation)

o CO2 reactions

o N2 reduction reaction (ammonia synthesis),

o Methanol oxidation reaction (MOR).

• The less mobile nanowire catalyst could also offer robust and active catalysts for other important reactions in gas phase

o CO oxidation

o Methane oxidation reaction

ADVANTAGES

• Record high utilization efficiency

o Highest electrochemical active surface area

o High specific activity

• Stability using multiple-point contacts with carbon support

o No migration and aggregation during charge cycling

• Possible more efficient charge transport and collection

• Possible acceleration of the reaction speed the Pt catalyst is responsible for

STATE OF DEVELOPMENT

The UCLA researchers have synthesized the ultrafine jagged Pt nanowires and demonstrated experimentally the record high mass activity (13.59 A/mgPt) for oxygen reduction reaction, and robust mass activity (7.9 A/mgPt) for hydrogen evolution reaction.

CONTACT

UCLA Technology Development Group
ncd@tdg.ucla.edu
tel: 310.794.0558.

INVENTORS

- Duan, Xiangfeng

OTHER INFORMATION

KEYWORDS

Nanowire, Platinum, fuel cell, oxygen reduction reaction, mass activity, utilization efficiency, hydrogen evolution reaction, electrochemical active surface area, specific activity, multi-point contact

CATEGORIZED AS

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

RELATED CASES

2017-108-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,421,345	08/23/2022	2017-108

RELATED MATERIALS

- Ruan, L., Zhu, E., Chen, Y., Lin, Z., Huang, X., Duan, X. and Huang, Y. (2013), Biomimetic Synthesis of an Ultrathin Platinum Nanowire Network with a High Twin Density for Enhanced Electrocatalytic Activity and Durability. Angew. Chem. Int. Ed., 52: 12577–12581. doi:10.1002/anie.201304658

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Approaching Schottky-Mott Limit in Van Der Waals Metal Semiconductor Contacts
- Chemical Vapor Deposition Growth of the Large Single Crystalline Domains of Monolayer and Bilayer
- Double-Negative-Index Ceramic Aerogels For Thermal Superinsulation
- Single-Atom Tailoring of Platinum Nanocatalysts for High-Performance Multifunctional Electrocatalysis
- Vertical Heterostructures for Transistors, Photodetectors, and Photovoltaic Devices
- Palladium Alloy Hydride Nano Materials
- High Performance Thin Films from Solution Processible Two-Dimensional Nanoplates

UCLA Technology Development Group
10889 Wilshire Blvd., Suite 920,Los Angeles,CA 90095
tdg.ucla.edu
Tel: 310.794.0558 | Fax: 310.794.0638 | ncd@tdg.ucla.edu