Single-Atom Tailoring of Platinum Nanocatalysts for High-Performance Multifunctional Electrocatalysis

Tech ID: 31666 / UC Case 2019-819-0

SUMMARY

UCLA researchers in the Departments of Chemistry and Biochemistry, and Material Science and Engineering, have developed a single-atom tailoring method to boost the electrocatalytic activity of platinum-based catalysts with low loss of generatable current.

BACKGROUND

Platinum is the most universal catalyst for electrochemical energy conversion systems, mainly due in part to its high stability and intrinsic electrocatalytic activity. This electrocatalytic activity stems from the specific activity (SA) of the metal or, more generally, the current that can be generated for a unit surface area. Considering the scarcity of platinum, much research has been invested in the minimization of the amount of platinum while retaining a high SA: in the past decades, this goal has not been realized. Currently, synthetic protocols sacrifice SA for the purpose of conserving platinum, which has led to limited advances in electrocatalysis.

INNOVATION

UCLA researchers have developed a single-atom tailoring method to boost the electrocatalytic activity of platinum-based catalysts with low loss of SA. The researchers begin with platinum-nickel alloy nanowires that, through electrochemical dealloying, are turned into single atom nickel platinum nanowires. These nanowires feature abundant activated platinum sites with minimal blockage due to neighboring single-atom nickel sites. The researchers have therefore developed a strategy to minimize platinum usage in catalysis without sacrificing electrocatalytic activity. This work may help to significantly propel the fields of electrochemical energy conversion, and storage.

APPLICATIONS

- This single atom decoration strategy could be used to help achieve the DOE hydrogen production target for 2020 due to a lower overall energy expenditure need
- The single atom decoration strategy could also be combined with other dopant elements (i.e. Fe, Cu) to achieve lower costs to other power production and storage applications (methanol fuels and proton-exchange membrane fuel cells)

ADVANTAGES

- Circumvents alternative strategies that utilized nickel or nickel-hydroxide nanoparticles, thereby protecting the number of platinum active sites
- Can be combined with other dopant elements

STATE OF DEVELOPMENT

The single atom decoration technique has been utilized to produce platinum-nickel nanowires, that minimize the mass of platinum needed to retain high numbers of active sites.

RELATED MATERIALS

- Li, M. et al. Single-atom tailoring of platinum nanocatalysts for high-performance multifunctional electrocatalysis. Nature Catalysis 2, 495–503 (2019).

PATENT STATUS

Country	Type	Number	Dated	Case

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OTHER INFORMATION

KEYWORDS

Fuel Cell, Fabrication, Platinum Catalyst, Electrocatalysis, Cost Effective

CATEGORIZED AS

- **Materials & Chemicals**
  - Other

RELATED CASES

2019-819-0

United States Of America	Issued Patent	12,255,339	03/18/2025	2019-819

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Approaching Schottky-Mott Limit in Van Der Waals Metal Semiconductor Contacts
- Ultrafine Nanowires As Highly Efficient Electrocatalysts
- Chemical Vapor Deposition Growth of the Large Single Crystalline Domains of Monolayer and Bilayer
- Double-Negative-Index Ceramic Aerogels For Thermal Superinsulation
- Palladium Alloy Hydride Nano Materials
- High Performance Thin Films from Solution Processible Two-Dimensional Nanoplates

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