High Performance Platinum-Based Catalyst Combined with Carbon Support Engineering

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SUMMARY

UCLA researchers in the Department of Materials Science and Engineering have developed a fuel cell catalyst system comprised of platinum-based alloys with a novel carbon support. The fuel cell has improved mass activity targets and increased stability.

BACKGROUND

Proton-exchange-membrane fuel cells (PEMFCs) are of considerable interest for direct chemical-to-electrical energy conversion and may represent an ultimate solution for mobile power supply. Currently, commercialization is limited by the sluggish kinetics of the cathodic oxygen reduction reaction (ORR), which requires a significant amount of platinum (Pt)-based catalyst with a substantial contribution to the overall cost. Additionally, even though the performance achieved in some of the most advanced ORR catalysts has far exceeded the U.S. Dept. of Energy (DOE) target for mass activity in a device, none such extraordinary performance metrics has been successfully translated into real fuel cell devices. An effective and simple synthetic approach to address these challenges is to grow nanoparticles on carbon supports directly. The adoption of advanced catalyst supports with high conductivity, sufficient corrosion resistance and strong chemical interactions can offer an additional degree of freedom to tune the ORR catalysts. Hence, the combination of Pt-nanocatalysts and advanced support materials with well-defined interfacial interactions may offer a powerful pathway to advance ORR catalysts with superior performance.

INNOVATION

UCLA researchers have invented a type of highly stable and active materials Pt-based alloy loaded on a novel carbon support, which is developed through carbon engineering. The fuel cell performance of the catalysts is significantly improved, leading to mass activity values above the DOE target. The material design is innovative; simple in term of synthesis and preparation; and stable enough to be stored at room temperature. This novel method of design and manufacturing on Pt-based alloys on novel carbon-support structures could allow the development cost-effective and efficient fuel cells to be used as portable power generators.

APPLICATIONS

- Fuel cells
- Heterogeneous catalysis
- Portable power generation
- Transportation fuel (motor vehicles)

ADVANTAGES

- Simple preparation
- Stable composites
- High mass activity
- Low cost

STATE OF DEVELOPMENT

Model fuel cells have been synthesized and their activity and density performance tested at the lab scale.

PATENT STATUS

Country	Type	Number	Dated	Case

CONTACT

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INVENTORS

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OTHER INFORMATION

KEYWORDS

Fuel cells, platinum-alloys, carbon support, carbon-engineering, portable power generators

CATEGORIZED AS

- **Energy**
  - Hydrogen
- **Materials & Chemicals**
  - Composites
  - Nanomaterials

RELATED CASES

2019-469-0

United States Of America	Published Application	20220336822	10/20/2022	2019-469

RELATED MATERIALS

- Huang, Y., et al. High-performance transition metal–doped Pt3Ni octahedra for oxygen reduction reaction. Science, 2015, 348, 1230-1234
- Zhao, Z., et al. Surface-Engineered PtNi-O Nanostructure with Record-High Performance for Electrocatalytic Hydrogen Evolution Reaction. Journal of the American Chemical Society 2018, 140, 9046-9050

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Highly Durable and Active Fuel Cell Electro-Catalyst Designed with Hybrid Support

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