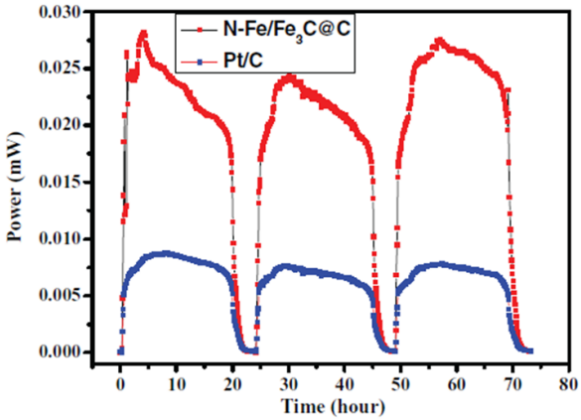
UWM RESEARCH FOUNDATION **Technology Overview**

Advanced Electrocatalyst for Economical Oxygen Reduction Reaction

OTT ID# 1328

TECHNOLOGY

The technology is an oxygen reduction reaction (ORR) catalyst made of nitrogen-enriched graphite shells with iron-based composite nanorod cores and has applications in fuel cells with neutral phosphate buffer, alkaline, and acid solutions, including in microbial fuel cells (MFC) and metal-air batteries. This nitrogen-enriched graphite iron nanorod catalyst, in specific tests conducted with an H-type MFC, has a measured charge efficiency of 57%, outperforming the charge efficiency of a conventional platinum-based catalyst by more than a factor of 1.75. This advanced electrocatalyst has a kinetic current density of 26.89 mA cm^{-2} at 0V, compared to 14.20 mA cm^{-2} for platinum-based catalysts.



The UW-Milwaukee ORR catalyst is synthesized from inexpensive raw materials, has a bulk manufacturing method, and outperforms conventional platinum catalysts allowing for a further reduction in the volume cost of a fuel cell stack from $51/kW in 2010 towards a national target of $30/kW by 2015. In contrast, competing ORR catalysts often have more complex methods of manufacturing that are not readily scalable, with performance levels that are viewed as only comparable to platinum.

FEATURES/BENEFITS

- **Low Cost Raw Materials** – Materials estimated 5% of platinum-based catalyst (10%) cost.
- **Facile and Scalable Manufacturing** – Bulk chemical and thermal reduction processing.
- **Broad Application Potential** – Functional in neuteral, alkaline, and acid based fuel cells.

INTELLECTUAL PROPERTY

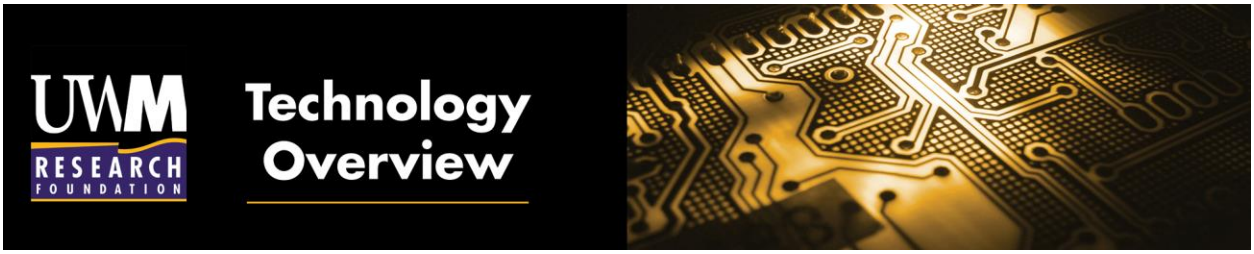
A utility patent application was filed in 2014. This technology is available for commercialization and licensing under either exclusive or non-exclusive terms.

MARKETS

Microbial fuel cell and proton exchange membrane fuel cell markets would observe increased ORR performance and reductions in the cost of electrodes through integrating fuel cells with the UW-Milwaukee ORR catalyst over commercial platinum-based catalysts.

The fuel cell industry is an international heavyweight with the potential to reshape how we think about energy

The fuel cell market faces challenges in cost reductions limiting the fuel cells to subsidy-strong markets. With technologies like the UW-Milwaukee ORR catalyst contributing to major cost reductions the global fuel cell industry is expected to surpass $15 billion by 2017.



INVENTOR(S)

Junhong Chen

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Dr. Junhong Chen is a professor in the Department of Mechanical Engineering at UW-Milwaukee. His research focuses on nanomaterial innovations, specifically in the areas of carbon nanotubes, graphene, and hybrid nanomaterials. The materials developed in Dr. Chen's lab are characterized and have been applied to applications including nanostructure-based gas sensors, biosensors, lithium-ion batteries, solar cells, liquid sensors, and water treatment. Dr. Chen is the director of both the NSF I/UCRC on Water Equipment and Policy and the Laboratory of Nanotechnology for Sustainable Energy and Environment.

Related Publications

Wen et al. "Nitrogen-Enriched Core-Shell Structured Fe/Fe3C-C Nanorods as Advanced Electrocatalysts for Oxygen Reduction Reaction," Advanced Materials, Volume 24, Issue 11, February 2012

Xiao et al. "Carbon/iron/based nanorod catalysts for hydrogen production in microbial electrolysis cells," Nano Energy, Volume 1, June 2012

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