PURDUE INNOVATES | Office of Technology Commercialization

Piezo-electrocatalytic Oxidation of Methanol with UV-ozone Treated Wurtzite Zinc Oxide Nanostructures

UV-ozone treated ZnO nanosheets/nanorods exploit piezo-electrocatalysis to accelerate methanol oxidation in DMFCs, reducing noble-metal reliance.

Fuel cells, a technology that converts chemical energy into electrical energy, have become more prominent due to their ability to provide high efficiency clean energy with lower greenhouse gas emissions when compared to traditional fuel sources. Direct methanol fuel cells (DMFCs) are emerging as competitors to the more common hydrogen fuel cells because of their compatibility with existing petroleum distribution networks. An issue with DMFCs, however, is that these fuel cells suffer from slow anode methanol oxidation reaction (MOR) kinetics, which deteriorates the fuel cell over time and decreases the overall efficiency of the technology. Additionally, expensive noble metals are often used. To combat these issues, researchers at Purdue have developed an electrocatalyst system, based on ZnO nanosheets (ZnO NSs) and ZnO nanorods (ZnO NRs), that is cost-effective and shows high performance for anodic methanol oxidation. Reaction kinetics were improved by leveraging the piezoelectric effect in ZnO NSs and NRs. Application of this technology could allow for longer lifetimes of DMFCs and lower material costs.

Technology Validation: Continuous methanol oxidation testing over 4 weeks showed minimal decrease in electrocatalytic performance. Inducing mechanical stress on the ZnO anodes led to a piezoelectric effect that decreased over-potentials of methanol oxidation and improved current density.

Related Publications: Piezo-electrocatalytic oxidation of methanol with UV-ozone treated wurtzite zinc oxide nanostructures, Nano Energy, Volume 109, 2023, https://doi.org/10.1016/j.nanoen.2023.108311.

Advantages:

Technology ID
2023-WU-69964

Category
Energy & Power Systems/Energy Storage
Energy & Power Systems/Power Generation

Authors
Wenzhuo Wu

Further information
Aaron Taggart
adtaggart@prf.org

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Appealing properties of methanol (e.g., energy-dense, reasonably stable, liquid state)

Strong poisoning tolerance, and their photosensitivity and heat sensitivity are more conducive to the modulation of catalyst performance

Applications:

Use in direct methanol fuel cells

Electrocatalysis

TRL: 3

Intellectual Property:

Provisional-Gov. Funding, 2022-10-14, United States

Utility-Gov. Funding, 2023-10-13, United States

Keywords: Clean Energy, fuels, Green Technology, Sustainability