



Improved Photocatalyst for Reducing Small Molecules

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Inventors: Robert Hamers, Di Zhu, Nigel Becknell

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method that uses photo-illuminated diamond as the photocatalyst in the reduction of nitrogen and other small molecules.

Overview

The reduction of small molecules such as nitrogen and carbon dioxide is extremely difficult because one-electron reduction processes often involve high-energy intermediates. Nitrogen reduction usually is coupled with the transfer of one or more protons to generate a more stable intermediate, but the energy level associated with this reaction remains relatively high. Several modifications to the original doped titanium dioxide powder catalyst have been developed for use in the photocatalytic reduction of nitrogen; however, the overall efficiency of this reaction remains poor. A new method for the reduction of small molecules is needed.

The Invention

UW–Madison researchers have developed a reaction system and method for the photoreduction of molecules that uses diamonds with a negative electron affinity as the photocatalyst. The method involves illuminating a fluid sample containing the molecules to be reduced and a hydrogen surface-terminated diamond having a negative electron affinity. The illuminating light wavelength induces the emission of electrons from the diamond directly into the fluid sample. These emitted electrons induce the reduction of the molecules, forming a reduction product. The product then can be separated from the fluid sample and collected. This method can be used to reduce a variety of molecules, including small molecules such as N_2 , CO_2 , CO or NO_x and aromatic molecules that include one or more benzene rings.

Applications

- Photocatalyst for the reduction of small molecules
- Ammonia production

Key Benefits

- Hydrogen-coated diamond possesses higher photocatalytic activity and retains this activity for a longer period of time than existing catalysts.
- Diamond powder may be less expensive than Ru-impregnated TiO_2 .
- The energy level associated with this reaction is significantly lower than existing catalysts

Stage of Development

Reduction of nitrogen using diamond grit, electrochemical-grade diamond and high-quality diamond all yielded comparable

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Additional Information

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WARF
Wisconsin Alumni Research Foundation

| info@warf.org | 608.960.9850

For More Information About the Inventors

- [Robert Hamers](#)

Related Intellectual Property

- [View Continuation Patent in PDF format.](#)

Publications

- Zhu D., Zhang L., Ruther R.E. and Hamers R.J. 2013. Photo-Illuminated Diamond as a Solid-State Source of Solvated Electrons in Water for Nitrogen Reduction. Nat. Mater. 12, 836-841.
- [View a news story about this technology.](#)

Tech Fields

- [Materials & Chemicals : Catalysts](#)
- [Materials & Chemicals : Synthesis](#)

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