CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S1015

Project Title

Developing a Device to Use the Products of Photocatalytic Water Splitting for Air Purification and Electrical Production

Abstract

Objectives/Goals

The goals of this project are to construct a device able to simultaneously apply the products of photocatalytic water splitting: hydrogen gas for electricity production through a fuel cell and hydroxyl radicals for air purification. This study hopes to accomplish this while keeping the device cost effective, safe to operate, sustainable, and portable while maximizing outputs. This project is an effort to increase commercial use of photocatalytic processes and efficiency was maximized through using an innovative combination of catalysts and structurally engineering the device.

Methods/Materials

In order to determine the optimal catalyst to use in the experiment, an aluminum mesh was coated with either 10g of ZnO, 10g of TiO2, or 10g combination of TiO2 and ZnO. A rectangular container was constructed using acrylic plastic panels and filled with water. The mesh was placed in the container and a fuel cell and multimeter were connected to the plastic container. A UV Lamp was placed directly above the container and measurements were taken every 10 minutes over the course of 60 minutes. After the most efficient catalyst was determined, air purification abilities of the device were measured through a PTRMS. The design of the device ensured that the hydrogen gas and hydroxyl radicals could only escape through slots in the container to oxidize pollutants or through tubing to the hydrogen fuel cell. The pollutants measured included formaldehydes, isoprene, acetone, and nitric oxide.

Results

A combination of TiO2 and ZnO proved to be 3x as effective than the catalysts used alone. The device#s shape and features were constructed to maximize surface area of the reaction. Hydrogen gas production was measured using a multimeter and the successful oxidation of pollutants by hydroxyl radicals was measured through a PTRMS. The device successfully oxidized over 80% of gaseous pollutants while producing a stable source of electricity. Studies are being conducted to observe how the device removes particulate pollutants from the air so that it may act as a comprehensive filtration system for a variety of areas.

Conclusions/Discussion

This device is a direct response to the problems of air pollution and energy and satisfies the original design goals. Ultimately, an affordable and effective device was constructed with promising results that have the potential to directly improve public health and accessibility to electricity.

Summary Statement

This project designed a dual photocatalytic air purifier and electrical source by using an innovative combination of catalysts and structural engineering to optimize both aspects of the device.

Help Received

Parents helped buy materials, Used lab equipment at UCI under the supervision of Dr. Sergey Nizkorodov