International Sustainable World

Energy Engineering Environment Project Olympiad 2016

Abstracts of projects selected to represent Hong Kong in the I-SWEEEP 2016

International Sustainable World
Energy Engineering Environment Project Olympiad
I-SWEEEP 2016
Houston, Texas, USA

ABSTRACT

Project No. Intel2016_014
Title: Investigation and application of quick detection assay for organophosphate pesticides residue in food

Organophosphate pesticides have been widely used in developing world but causing many pesticide poisonings. A Rapid Detection Assay has been developed in this study to tell us whether or not the pesticide is over the tolerance by colour change. It makes use of simple metal salts instead of metal complex to catalyze the hydrolysis of pesticides. A strong oxidizing agent with colour is used for titration. The result showed that a safe sample gave a yellow colour, but purple for sample exceed the maximum residue limit. After constructing the calibrating standard, we have tested Chinese cabbage, Chinese lettuce, Chinese kale, blueberry, and pear. If the sample is safe, its absorbance value is generally more than 4.0 at 428nm. A prototype of a portable RD assay meter has been developed, where a dimmer light represents a safe sample. Our RD assay overcomes the disadvantage of commonly used methods in the laboratory, and can be conducted in the field.

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ABSTRACT

Project No. Intel2016_024

Title: UV- visible Light- induced Hydrogen Production Using Natural Chlorophyll sensitized Cu^{2+}- doped TiO2

Energy crisis has become an imminent threat due to the excessive exploitation of natural resources such as petroleum, coal and natural gas. So, an alternative source of energy becomes a prerequisite for sustainable development. In the meantime, gutter oil and waste oil problem has arisen in recent decades and numerous tons of redundant oil are disposed everyday.

In light of this, our team has developed a way to produce hydrogen in an environmental way named photocatalytic water-splitting. By using a photocatalyst - Titanium Dioxide, and under the illumination of UV, water is split into hydrogen and oxygen. Reducing agents such as glycerol from oil, and dopants such as cations from metal can also be added to enhance the yield of hydrogen gas, by producing extra hydrogen and alter the lattice structure of Titanium Dioxide respectively.

Dye sensitization is also a method adopted to improve the production of hydrogen. Through the addition of natural dye such as crude chlorophyll from spinach, more visible light can be harvested for water-splitting during the reaction. Having further investigation, we successfully utilized the visible light and UV spectrum during water-splitting, also, we developed a one-pot system in which all reactants are contained inside, and most importantly, waste oil can be converted to useful fuel, i.e. hydrogen which can be used in fuel cell or direct combustion to produce energy.

After investigating all the parameters, the optimised condition for photocatalytic water-splitting was found: 0.4 g copper(II) ion-doped Titanium Dioxide under 400 degree celcius calcination and sensitised by 9 mL 3 M chlorophyll in a water to glycerol volume ratio of 9:1 has shown the best production of hydrogen.

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ABSTRACT

Project No. Intel2016_025

Title: Magnetically Levitated-Horizontal Axis-Spiral Shaped-Wind Turbine

Wind energy systems have been utilized for centuries as a source of energy for mankind. At present, wind power is growing at a rate in excess of 35% per annum, which is predicted to continue at this rate at least until 2020. Most of wind turbines install today are HAWT, largely due to significant investments made by many countries over the last decades that have overshadowed progress in VAWT technology. Recently there is a resurgence of interests on HAWT, because of growing environmental concerns and the demand for more enhanced energy security.

The involute spiral shaped turbine is an innovative wind turbine design; small, silent, and affordable. Main characteristics of this design wind turbine are high efficiency (~39%), low start-up wind speed (1 m/s), providing for the highest yield, silent operation, insensitive to turbulence, low maintenance, and an organic appearance. All together making this involute spiral shaped wind turbine is able to generate about twice greater electricity than standard conventional wind turbines (3 blades) of the same diameter.

This wind turbine uses two pairs of permanent magnet rings on the supporting shaft and the pedestal stand. It provides a stable rotation during the change of direction of wind blowing, which is normally used on conventional wind turbines. Power will then be generated with a power generator.

Also a **SEPIC** converter (S*ingle Ended Primary Inductor Converter)* will be used to regulate the varying voltage from the rectifier to output a steady DC voltage.
So it has great potential to be developed.