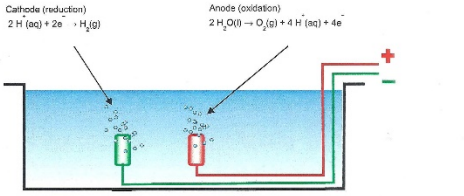
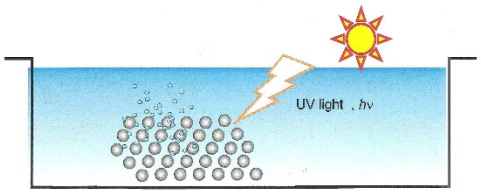
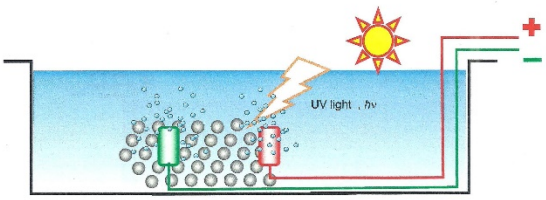
Hybridised Photocatalysis-Electrolysis Hydrogen Generation System



Schematic diagram of water electrolysis



Schematic diagram of photo-catalytic decomposition of water



Schematic diagram of combined processes of electrolysis and photo-catalysis

Technology Overview

In conventional electrolysis, water molecules first dissociate into intermediate ions, namely, negative hydroxyl ions (OH-), positive hydrogen ions (H+) and positive hydronium ions (H3O+), before further decomposition into oxygen and hydrogen. This process of generating hydrogen is inefficient due to the high probability of hydroxyl ions recombining with either hydrogen ions or hydronium ions to form back water molecules.

The technology described herein is related to a hybridised process which enhances hydrogen production rate of a conventional electrolysis system through combining the hybridised process with photocatalytic decomposition reaction. By combining the hybridised process with photo-catalytic decomposition, the probability of intermediate radical/ion recombination is reduced. This results in an increase in hydrogen and oxygen production of up to 25%. A prototype has been developed to demonstrate the feasibility and effectiveness of producing hydrogen and oxygen based on the hybrid photocatalyst-electrolysis method. With a strong knowledge in optimisation of the operating parameters in a hybrid photocatalyst-electrolysis reaction, the technology owner would like to seek partnership from the industry to commercialise the technology.

Technology Features & Specifications

Conventional electrolysis of water requires the use of appliances that operate with at least 13-amp current or with a 3-phase power source. During electrolysis, water molecules first dissociate into intermediate ions, before further decomposing into oxygen and hydrogen. However, there is a high probability for these ions to recombine with each other to form water again. By combining electrolysis with photocatalytic decomposition, the presence of nanoparticles and UV light will help reduce the probability of intermediate ion recombination.

In conventional electrolysis, the electrolyte has high resistance which contributes to unwanted heat generation. Although electrolysis is an endothermic process, it is unable to absorb all the waste heat itself. Photocatalytic decomposition, too, is also an endothermic process. Thus, when combining with electrolysis, it will help in the absorption of heat that would otherwise be lost. This causes the hydrogen generation process to be more energy effective.

Potential Applications

Hydrogen gas applications

One of the main interests of the invention is its use as a hydrogen gas generator. Using hydrogen as fuel to produce naked flame offers an alternative for various applications such as

- Acrylic Process
- Commercial Cooking
- Cooking Application
- Copper Brazing
- Steam Boiler Application
- Steel Cutting Application.

Oxygen gas applications

The secondary interest of the invention is its use as an oxygen gas generator. High concentration or purity oxygen has medical uses, such as:

- Provide a basis for virtually all modern anaesthetic techniques
- Restore tissue oxygen tension by improving oxygen availability in a wide range of conditions such as chronic obstructive pulmonary disease (COPD), cyanosis, shock, severe haemorrhage, carbon monoxide poisoning, major trauma, cardiac/respiratory arrest
- Aid resuscitation
- Provide life support for artificially ventilated patient aid cardiovascular stability.

Market Trends and Opportunities

According to a market research conducted by Markets and Market, the global hydrogen generation market value is expected to reach $138.2 billion by 2019, growing at a CAGR of 5.9%, from 2014 to 2019 with Asia & Oceania being the largest market followed by Europe and North America. The factors responsible for the hydrogen generation market growth include strict regulatory norms to desulfurize petroleum products, cleaner fuel potion as hydrogen is produced by electrolysis of water using renewable energies like wind, solar, and water. While the high cost of generating hydrogen and lack of proper distribution and transportation infrastructure are key concerns for the hydrogen generation industry, technological development to improve the efficiency of hydrogen generation and on site method of hydrogen generation will eliminate or reduce problems associated with the cost and transportation of hydrogen.

Customer Benefits

- Safety - Storage of flammable compound is not required. As the system is designed to enable safe release of residual hydrogen gas into the atmosphere, any risk of hydrogen explosion is eliminated
- Minimise wastage or any possible risk of hydrogen leakage - hydrogen is generated on demand from water
- Higher Energy Efficiency - Lesser electricity required to produce hydrogen gas compared to conventional electrolysis
- Cost Effective - Lower cost of generating hydrogen gas compared to conventional electrolysis and investment in hydrogen gas storage system is not required

OVERVIEW

- Technology Category Energy - Thermal Power System
  Materials - Nano Materials
- Technology Status Available
- Technology Readiness Level TRL7

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