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Nano-Technology Fuel Cells

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Abstract:*Integration of NANO TECHNOLOGY and REGENERATIVE FUEL CELL provides a better way for using hydrogen as a fuel. By using this fuel cell with Nano tech we can easily onboard the hydrogen storage equipment on automobiles and it will give more power without any harmful emissions. Water is obtained as a byproduct from fuel cell. Hydrogen is regenerated from the byproduct (water).Maximum efficiency will be obtained than internal combustion engines. Medical devices are likely to be a major application for Nano fuel cells. They can also supply energy to Nano robotics and microelectromechanical systems (MEMS).*
Keywords:*Carbon Nano-tubes, FuelCells, Efficiency*

I. Introduction

A fuel cell is a device which converts a fuel directly into electricity in an electrochemical reaction. This is in contrast to most methods of generating electricity, which use the heat from burning fuel to generate electricity mechanically.

Fuel cells have the potential to be an incredibly efficient power source. They can theoretically operate on a wide range of fuels, and the technology can be scaled from portable fuel cells in laptops, up to huge stationary installations to power data centres.

There are many limitations preventing fuel cells from reaching widespread commercial use, however. Expensive materials such as platinum are needed for the electrode catalysts. Fuels other than hydrogen can cause fouling of the electrodes, and hydrogen is costly to produce and difficult to store. The most efficient types of fuel cell operate at very high temperatures, which reduce their lifespan due to corrosion of the fuel cell components.

Nanotechnology may be able to ease many of these problems. Recent nanotechnology research has produced a number of promising nanomaterials which could make fuel cells cheaper, lighter and more efficient.

Fuel cell provides a clean source of power in comparison to other sources like hydro, thermal, nuclear etc. It is known as cell because of some similarities with primary cell. It has two electrodes and an electrolyte between them which produces dc power. However, active materials are supplied from outside unlike conventional cell. A static device which converts the chemical energy of fuels into electrical energy.

First crude fuel cell was developed in1839.It was developed by welsh physicist William GroveFist commercial use of fuel cells was in NASA space programs to generate power for probes, satellites and space capsules.

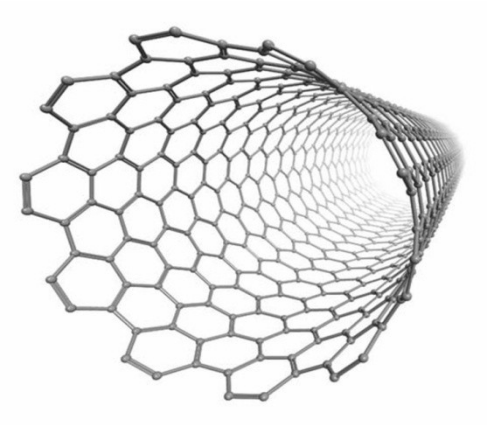
II. Fuel Cell

- A fuel cell is an electrochemical conversion device. It produces electricity from fuel (on the anode side) and an oxidant (on the cathode side), which react in the presence of an electrolyte.
- In a fuel cell the fuel is also oxidized but the resulting energy takes the form electricity.

Anode side:$2H_2 \rightarrow 4H+ + 4e-$
Cathode side : $O_2 + 4H+ + 4e- \rightarrow 2H_2O$
Net reaction: $2H_2 + O_2 \rightarrow 2H_2O$

III. Carbon Nanotubes

- Carbon nanotubes (CNTs) are allotropes of carbon with a cylindrical nanostructure.
- since the diameter of a nanotube is on the order of a few nanometers (approximately 1/50,000th of the width of a human hair)
- The chemical bonding of nanotubes is composed entirely of sp^2 bonds, similar to those of graphite.
- It also makes the onboard hydrogen storage easier.



IV. Regeneration Of Hydrogen

- The BY-PRODUCT from the fuel cell(water) is used to regenerate the fuel
- A reversible fuel cell can accomplish "Electrolysis" through the supply of electricity to the cell
- This allows one to consider the completely renewable production of electricity by using a renewable energy supply (e.g., solar, wind) to produce hydrogen and oxygen from water.
- REGENERATION

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

V. Working

- Hydrogen from carbon nanotube is entered into the fuel cell.
- Hydrogen reacts with oxygen in polymer electrolyte membrane and the chemical energy is produced.
- In fuel cell, chemical energy is converted into electrical energy.

$$O_2 + 4H+ + 4e- \rightarrow 2H_2O$$

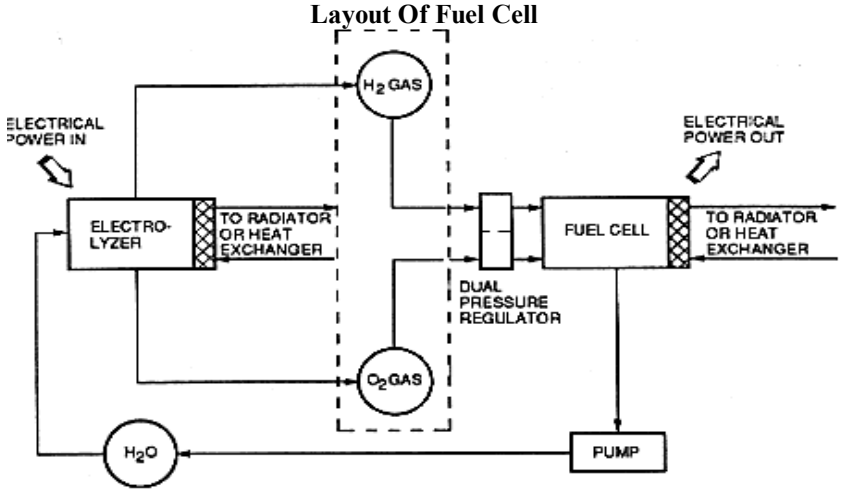
$2H_2 \rightarrow 4H+ + 4e-$

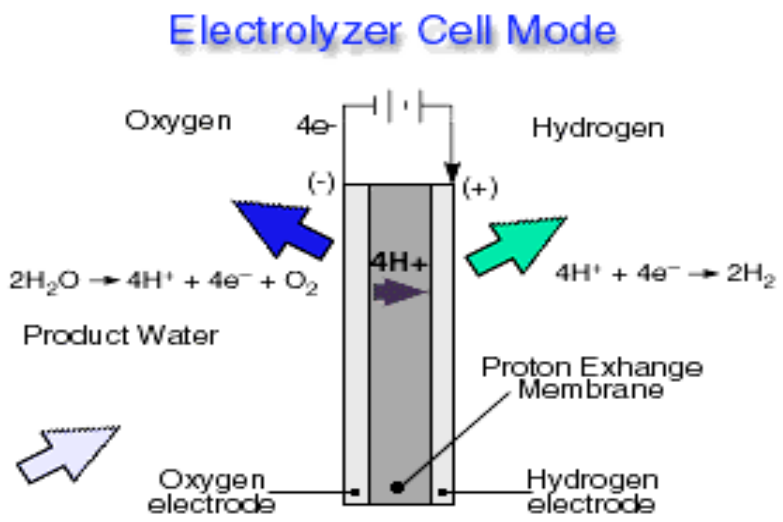
- Electrolysis of water is the decomposition of water (H2O) into oxygen (O2) and hydrogen gas (H2) due to an electric current being passed through the water.
- Water is obtained from the reaction.
- The byproduct water is used to regenerate the hydrogen by the process of electrolysis.

$$2H_2O(l) \rightarrow 2H_2(g) + O_2(g)$$

Therefore,we plan to modify the existing design to enhance the efficiency.

Layout Of Fuel Cell





VI. Process

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$$2H2O(l) \rightarrow 2H2(g) + O2(g)$$

VII. Methods

a. New Proposal

Nowadays the existing electrodes anode and cathode are porous are made up of compressed carbon containing small amount of substances such as Pt,Pd and Ag.

b. Discussion

With these new modified scheme the efficiency of the fuel cell is to enhance.In scheme 1,MWCNT(Multi-Walled Carbon Nano Tubes) and Nano-Catalyst will enhance the energy production.In scheme 2,we are incorporating Graphene with MWCNT in the ratio of 9:1 and it was impregnated with Nano-catalyst(Au,Ag,Pt,Pd and Cd).The addition of Graphene,Nano-material will speed up the reaction rate and increase the efficiency.

The Cell may be represented as

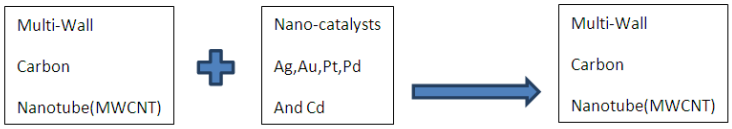
MWCNT,Pt or Ni / KOH(25%) / MWCNT , Pt or Ni

We are expecting an emf of ~1.5V.The cell power output range in 500 watts to 10 Kilowatts.

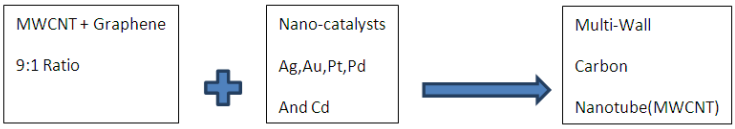
In scheme 2,the multiwall Carbon Nanotube,Graphene impregnated with Pt or Pd or Ag we are expected to enhance the efficiency.Because Graphene will play vital role in the reaction rate.Graphene initiates the oxidation of H_2 gas and makes it split up into H^+ ions and electrons.These electrons are shuttled to me cathode through an external source to produce electric current.The H^+ ions migrate towards the cathode through the electrolyte and get reduced into H_2O in presence of oxygen.

In the newly modified electrodes,we are going to design with multi-wall carbon nano-tubes(MWCNT) with nano-catalysts Ag,Au,Pt,Pd and Cd in different propotions.Both Anode and Cathodes are made from MWCNT impregnated with nano-catalyst of different propotions.

Scheme 1



Scheme 2



1. Application

- Transport
- Portable
- Stationary

a. Transport

- The fuel cell bus sector is showing year-on-year growth, with more prototypes being unveiled
- Successful deployments have taken place in Europe, Japan, Canada and the USA
- Forklift trucks and other goods handling vehicles such as airport baggage trucks etc
- Light duty vehicles (LDVs), such as cars and vans
- Buses and trucks
- Trains and trams
- Ferries and smaller boat

b. Portable

- Portable fuel cells are those which are built into, or charge up, products that are designed to be moved
- These include military applications, auxiliary power units, personal electronics, portable products
- Portable fuel cells are being developed in a wide range of sizes ranging from less than 5 W up to 20 KW.
- Off-grid operation.Longer run-times compared with batteries.Rapid recharging
- Significant weight reduction potential (for soldier-borne military power)
- Convenience, reliability, and lower operating costs also apply

c. Stationary

- Stationary fuel cells are units which provide electricity but are not designed to be movedThese include combined heat and power (CHP), uninterruptible power systems (UPS) and primary power units.
- Residential CHP units have been deployed extensively in Japan with more than 10,000 cumulative units by the end of 2010
- South Korea has also deployed CHP units for residential use
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VIII. Merits

- It is eco-friendly, noiseless and has no rotating part.
- It is a decentralized plant.
- Because of modular nature ,any voltage/current level can be realized
- High efficiency up to 60% as compared to conventional which has 30%
- No transmission and distribution losses
- Wide choice of fuel for fuel cell
- In addition to electric power, fuel cell plant also supply hot water, space heat and steam
- Requires less space
-

IX. Demerits

- Cost to implement a fuel cell system exceeds $4,000 per KW
- Feasible way to produce, ship, and distribute hydrogen
- Lack of Hydrogen Infrastructure
- Low lifetime of fuel cell.

X. Conclusion

- The NANOTECH REGENERATIVE FUEL CELLS provides solutions for the problems, which are effectively in internal combustion engines.
- Here, developments in fuel cells are making it useful in ultimate ways.
- It concludes that our environment and renewable resources will be preserve.
- It will lead to a new evolution in automobiles.

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