

# FUEL CELL - THE FUTURE TECHNOLOGY

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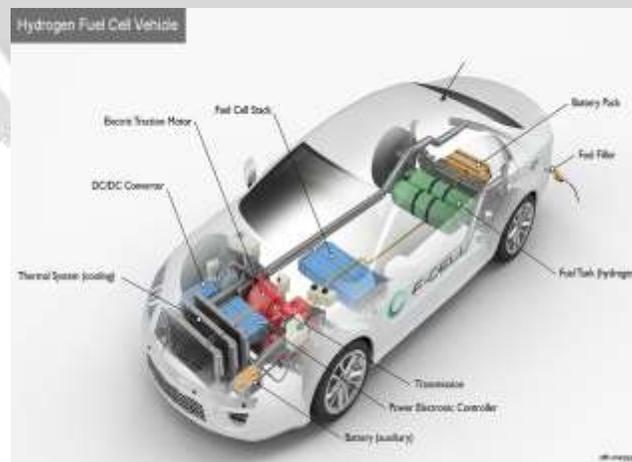
## ABSTRACT

Fuel cellular converts chemical electricity into electric electricity. Inside the future, hydrogen will be a part of power as a critical energy service, since it is able to be produced accurately from renewable energy sources and is actually non-polluting. it's going to additionally be used as a gas for '0 emission' cars, to heat homes, chambers and places of work, to produce energy, and to gas plane. In this file we have discussed about the latest technology utilized in gas cells. Diverse forms of gasoline cell, their applications and running of gasoline cell. The gasoline cellular may be used as a power source in each battery-operated device.

**Keyword:** Hydrogen, zero emission, battery operated device.

## 1. INTRODUCTION

A fuel cell is a device which converts chemical electricity into electric powered strength through redox reaction. A noble difference among rechargeable batteries and fuel cells is that gasoline cellular wishes continuous deliver of gas. In future, fuel cells should energy our automobiles with hydrogen changing the petroleum gasoline that we use in maximum automobiles nowadays. Many car producers are actively gaining knowledge of and they're growing transportation fuel cellular technology. in step with many specialists, we may additionally soon discover ourselves the use of gas cells to generate electric electricity for all kinds of things we use each day.



**Fig 1-Fuel cell in a car**

Gasoline cellular can electricity nearly any portable tool and system that works on batteries. Gasoline cells will be an opportunity supply for petroleum. Gas cells are of many different sorts however they may be used as according to the requirement.

College of Illinois has chemist's one step towards recreating the character's most green equipment for generating hydrogen fuel that's used in a gas cellular. This new development may additionally help clean the path for hydrogen fuel industries to move into a bigger position for the worldwide push towards more surroundings pleasant power assets. Various types of fuel cells

- Solid oxide fuel cell
- Molten carbonate fuel cell
- Phosphoric acid fuel cell
- Proton exchange membrane fuel cell

## 2. TYPES OF FUEL CELL

### 1) Solid oxide fuel cell

A strong oxide gas mobile is an electrochemical conversion device that produces power directly from oxidizing a gas. Gas cells are characterized by means of their electrolyte cloth; the SOFC has a ceramic electrolyte. Stable oxide gas cellular makes use of ceramic as electrolyte that is in solid kingdom, it operates at 1000oC and gasoline mobile efficiency is 50-60%.

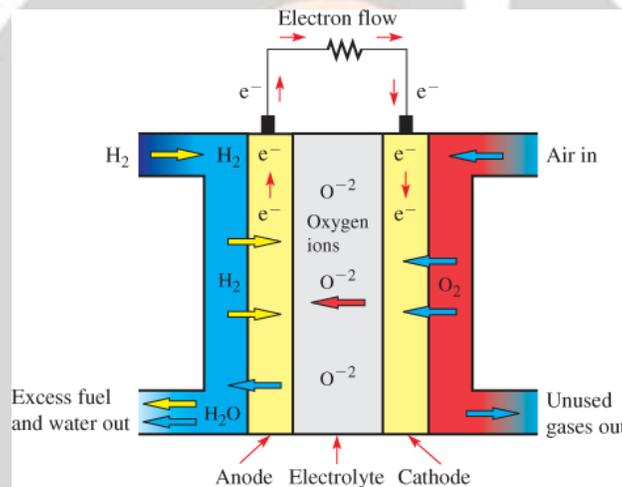


Fig 2-Solid oxide fuel cell

#### ➤ Advantages

1. High combined heat
2. High power efficiency
3. Long term stability
4. Fuel flexibility

#### ➤ Disadvantages

1. Needs high operating temperature
2. Longer startup time

#### ➤ Application

1. Transport
2. Industrial equipment

3. Cooling, power
4. Disaster relief

### 1) Molten carbonate fuel cell.

Molten carbonate gasoline cells are high temperature fuel cells that function at temperature of six hundred and above. Molten carbonate gasoline cells are these days developed kind of gasoline mobile that objectives small and massive power technology structures. The operating stress is between 1-eight atm and temperature are among 600-700°C.

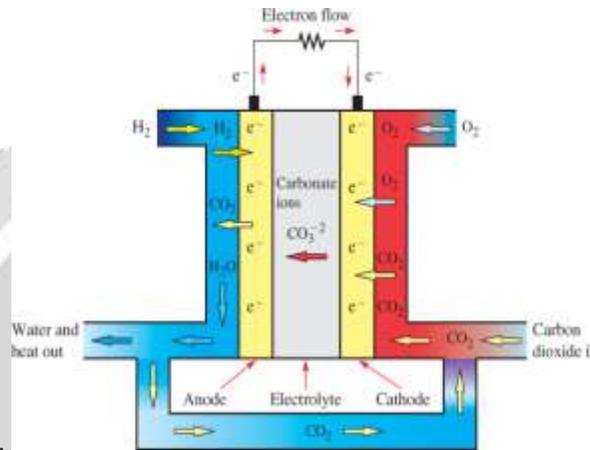


Fig 3- Molten carbonate fuel cell

Molten carbonate fuel cell uses carbonate salts as electrolyte which is in liquid state, it operates at 650°C and fuel cell efficiency is 50-60%.

#### ➤ Advantages

1. No need for precious metals to be used as catalysts
2. Tremendous cost saving benefits
3. Increases reliability and reduces maintenance costs
4. Highly efficient

#### ➤ Disadvantages

1. High temperatures decrease cell life
2. Require a considerable warm up period

#### ➤ Application

1. Large, stationary power plants

### 1) Phosphoric acid fuel cell

Phosphoric acid fuel cells are a sort of fuel mobile that makes use of liquid phosphoric acid as an electrolyte. They were the first fuel cells to be commercialized.

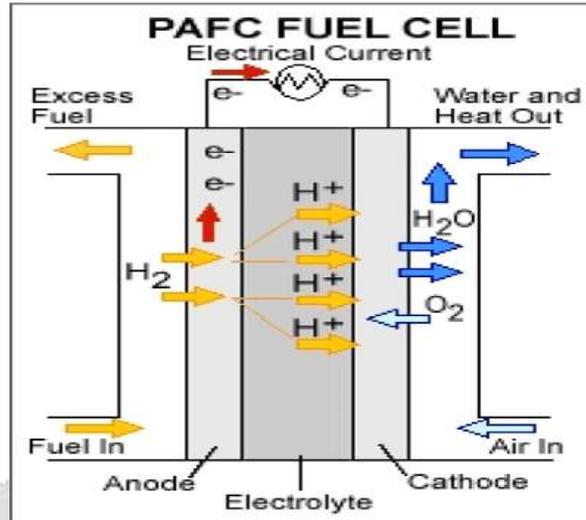


Fig 4- Phosphoric acid fuel cell

Phosphoric acid gasoline cellular makes use of phosphoric acid as electrolyte which is in liquid nation, it operates at 200oC and gasoline cell efficiency is 40-45%.

➤ **Advantages**

1. High efficiency
2. Can operate at high temperature

➤ **Disadvantages**

1. Low power density
2. Aggressive electrolyte
3. Produces less power

➤ **Applications**

1. Large vehicles such as buses

**1) Proton exchange membrane fuel cell**

The proton alternate membrane gasoline cellular is also referred to as polymer electrolyte membrane fuel cell. It has an excessive-energy density and high working temperature of fifty-100 C and the electrolyte is a polymer membrane. Proton trade membrane gas cell uses polymer membrane as electrolyte which is in stable nation, it operates at 80oC and fuel mobile efficiency is 60%.

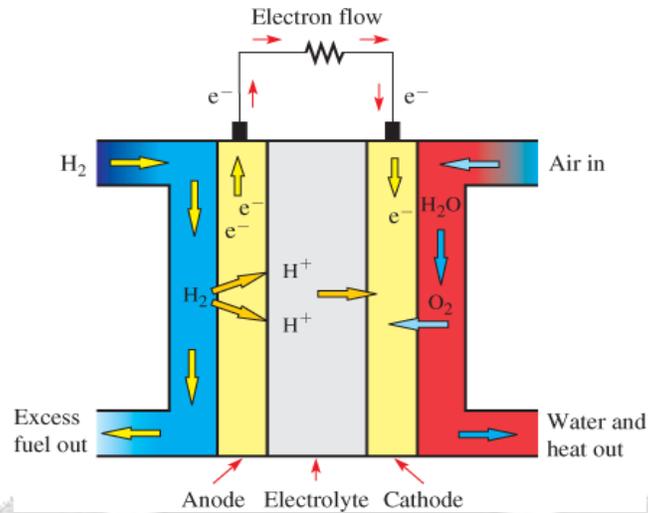


Fig 5- Proton exchange membrane fuel cell

- **Advantages**
  1. Lighter in weight
  2. Produces sufficient power
- **Disadvantages**
  1. High maintaining cost
- **Applications**
  1. PEM fuel cells focus on transportation
  2. Portable power generation

### 3. LITERATURE REVIEW

#### 1. Overview of the next sector century vision of hydrogen gasoline mobile electric vehicles.

Remaining three decades, costumers and manufacturers of car sector had been influenced positively through Hydrogen and fuel cells (FCs). The primary intention of automakers can be pointed as minimizing the gasoline intake and exhaust emissions whilst improving the range limits, electricity efficiency and modern technology edition. Therewithal, electric assisted propulsion structures introduced to vehicles and are referred to as electric vehicles (EVs). For that be counted, Battery electric automobiles (BEVs) and hydrogen gasoline cellular electric automobiles (FCEVs) have end up the focal point of researchers and manufacturers. In this mini foreseen assessment, overview of the following quarter century imaginative and prescient of FCEVs are expressed and discussed via the helped of previous researches and with destiny forecast reports. The advent element is summarized the general approach and future expectations of FCs in specified. Technical overview is represented for FCs and FCEVs in phrases of present-day nation of generation to foreseen expectancy. Infrastructure analysis and destiny elements overview component is likewise discussed for quarter's angle on FCEVs. The close to destiny perspective of the FCEVs, which is seen as the following step in EVs, is mentioned in element in the subsequent quarter century imaginative and prescient. Authors concluded that, between the 2030s-2050s, hydrogen FCEVs will keep their rising call for scale below the instances of lowering expensive technology; enhanced power optimization; extended range limits and increasing hydrogen refueling stations.

**a. Techno-economic assessment and era roadmap of the MWe scale SOFC-PEMFC hybrid gas mobile system for easy power technology.**

This paper proposes a unique hybrid gasoline mobile power generation system with excessive efficiency. The thermo monetary modeling of the MWe-scale systems the usage of different fuels is conducted to evaluate the financial feasibility below the subsidy policy of Japanese, China. This paintings goals to expand the technology roadmap for this form of smooth electricity machine. It is observed that the electricity efficiency of the herbal fuel and biogas fed structures ought to attain as much as sixty four% and sixty three.5% respectively, consequently they're efficient and fee-most suitable for the hybrid machine while liquefied petroleum fuel and water gasoline yield low efficiency and high power cost. Furthermore, underneath the subsidy policy, the biogas-fed hybrid system is greater suitable fora small-scale strength gadget, at the same time as the natural gas-fed machine is most desirable for the huge-scale case. The specific power price of small-scale biogas hybrid fuel mobile strength plant is zero.365 CNY/kWh, lower than the prevailing feed-in-tariff price 0.475e0.704 CNY/kWh of other biogas vegetation in China. Also, the price of zero.345 e0.347 CNY/kWh of massive-scale herbal gas-fed hybrid machine is a great deal decrease than the on-grid energy rate zero.7655 CNY/kWh in Shanghai. These results screen that the proposed hybrid gasoline cellular electricity gadget is efficient and economically viable. The payback length and annual return on funding are 0.8e1.2 yr and 11e12%, respectively.

**b. Float consumption assessment have a look at for gas cellular motors: toward a popularization of FCVs era.**

Climate exchange may be due to a primary element from the excessive fossil gasoline usage and consumption in transportation field. It contributes to the growth of pollutant emissions, which result in serious problems on human health similarly to the environmental degradation phenomena. Hydrogen gas cell motors (FCVs) are anticipated to have a significant impact in meeting each strength security and environmental issues globally. beginning for the idea that public attractiveness and attitudes research were commonly positive closer to hydrogen and fuel cells vehicles, although the general public knows few matters approximately this generation; authors then were given the idea to give a simplified scientific paintings managing the outline of the electricity control and flows calculations on board FCVs. This painting aims not most effective to the popularization of this era however additionally to outreach humans about its sustainable character. A variable using seasoned is followed with a total distance of one km with duration of 60 s. the overall hydrogen quantity fed on is 1,34 g km<sup>1</sup>. Beneath stress, handiest five kg of hydrogen provide most useful autonomy of seven hundred km, that's clearly competitive to the conventional gas motors. a pleasant advantage is but located and its worries the environmental seasoned.

**c. Comprehensive investigation on hydrogen and gas cellular generation in the aviation and aerospace sectors.**

The world power consumption is greatly influenced through the aviation industry with a total strength intake ranging among 2.5% and 5%. Currently, liquid fossil gas, which releases various styles of Greenhouse fuel (GHG) emissions, is the primary fuel inside the aviation industry. Because the aviation industry grows hastily to fulfill the necessities of the accelerated world populace, the call for environmentally pleasant strength era for numerous programs in the aviation area has been improved sharply in current years. Among the diverse clean power sources, power received from hydrogen is taken into consideration the destiny for power technology within the aviation industry due to its cleanness and abundance. This paper goals to present an overview of the capacity aviation programs where hydrogen and gas cell technology can be used. Also, the primary demanding situations that limit the huge adoption of hydrogen generation in aviation are highlighted and future studies possibilities are identified.

#### **d. Fuel Adaptive power control strategy for a 4-Mode Hybrid electric powered vehicle.**

A conventional car propelled with best the internal combustion engine (ICE) is not clean to decorate the fuel economy because of the huge range operation requirement of the powertrain. But, a hybrid electric powered car (HEV) which consists of an ICE and one or more than one electric automobile can successfully improve the performance of the powertrain. On this paper, we propose an adaptive energy management strategy (PMS) based totally at the equivalent fuel consumption minimization approach (ECMS) for a four-mode HEV. The four mode HEV which includes an ICE and two cars gives 4 modes of operation, including electric automobile (EV) mode, variety extended (RE) mode, hybrid mode, and engine mode. The adaptive PMS is designed for price maintaining such that the country of price (SOC) may be maintained at a certain price. A self-organizing fuzzy controller (SOFC) is employed to adaptively alter the equivalence thing of electrical electricity consumption based at the SOC deviation and the exchange of SOC deviation. An instantaneous value function which includes the gasoline consumption of ICE and the equal fuel consumption of the battery is minimized to reap the most useful electricity distributions of the ICE and two vehicles. Simulation effects display that the adaptive PMS can effectively improve the gasoline economic system for one of a kind driving cycles.

### **3. CONCLUSION**

Operation of the gasoline mobile on a petrol-based totally gasoline may be an essential condition for speedy and early commercialization but it is not enough. Improvements nevertheless desire to occur in the gasoline mobile stack, ancillaries and fuel processor, and lots more attention to mass manufacturing manufacturability desires to accept earlier than it could be taken into consideration suitable for mild-responsibility car programs. It requires the addition of many sub-systems and those have the effect of making the fuel mobile much less realistic from a fee-efficiency, volume and complexity point of view. However, the gasoline cellular must be coupled to an electric powered drive and due to drivability concerns, will want to be hybridized. Which means that gas mobile commercialization is likewise depending on upgrades happening in different immature technology.

It can be stated that there will be a bright future of this hydrogen gasoline cellular if this hydrogen fuel cellular is positioned up to use in all vehicles via properly considering the protection count number first and if this ecofriendly generation is used, the charge of pollution is genuinely going to come back down. Hydrogen gas cell isn't handiest ecofriendly however, additionally serves to be a terrific gas source. Because the traditional gasoline resources won't be sufficient, there arises a need to increase a brand-new opportunity source of energy. Even though there are a few problems associated with the garage of hydrogen fuel, which is probably overcome as the era develops in addition.

### **4. FUTURE SCOPE**

In the destiny, hydrogen will be part of strength as an important electricity service, due to the fact that it is able to be produced adequately from renewable electricity assets and is without a doubt non-polluting. It will also be used as a gas for '0 emission' vehicles, to warmth homes, chambers and workplaces, to supply energy, and to fuel plane. Hydrogen has notable capacity as a way to reduce reliance on imported strength sources inclusive of oil. But, before hydrogen can play a bigger strength role and end up a widely used alternative to gas, many new centers and gadget must be built. The era ought to be made low-priced to everybody. Growing greater protection features to the onboard hydrogen tank and also at refilling stations by means of making the usage of 'auto locking of deliver valves through the usage of hydrogen detector.

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