

DYNAMIC FUTURE OF THE FUEL CELLS: FROM EARTH TO MARS

Surbhi Dahiya

MARS is highly projected to be the next place for human settlement in the coming decades. Hence, the article will focus on how the energy needs of the people settling on Mars or the manned missions there would be fulfilled through the most talked about fuel cells. It shall highlight the technological intervention needed for these fuel cells based on the resources present on the planet. The fuel cell technology will be more viable by embedding solar cells to store and use this energy. Mars' atmosphere typically comprises 95% carbon dioxide, 3% N₂, and 1.6 % argon. There is a high possibility of reducing this carbon dioxide into carbon monoxide and utilising this as a part of the fuel cell system.

Fuel-cells convert chemical energy supplied in the form of hydrogen, methanol, etc., into electricity. They are the source of clean and efficient energy and are capable of greater efficiency than conventional sources. They leave no residue except water, which can be reused as the source of water-splitting and providing hydrogen to the fuel-stack system and regenerating electricity. The biggest asset of this system is that it works if the fuel gets supplied; hence, no recharging is required. Typically, a simple fuel cell system consists of an anode, a cathode, and an electrolyte. The fuel is sent at the side of the anode, and air is sent to the cathode; the electrons generated at the anode make a movement along the electrolyte and create a flow pattern of electrons, thus generating electricity. This is the simplest way a fuel cell working can be explained. However, it is not as simple as it seems. This is because there are several types of fuel cells.

There are different types of fuel cells depending on the electrolyte it is embedded with, and this electrolyte shall determine the kind of fuel that should be supplied to the system, and what are the reactions that may occur to generate the electricity. One commonly used fuel cell is a Polymer electrolyte fuel cell or Proton Exchange Membrane (PEM) fuel cell. It employs polymer as the electrolyte, platinum as the catalyst, hydrogen and air as the fuel. This type of fuel cell has one major drawback that platinum catalyst is sensitive to the carbon monoxide poisoning, which makes this type of fuel cell ineffective for its implementation of Mars. Then, there are direct methanol fuel cells that use methanol as the fuel, which is sent to the anode side of the system. Alkaline fuel cell systems employ alkaline membranes instead of acidic ones as electrolytes and use non-precious metals as catalysts.

They have found applications in several space missions. However, these also pose a challenge to the CO₂ poisoning. Molten carbonate fuel cells can operate at higher temperatures and use electrolytes made up of molten carbonate salt, which means that they have the potential to be used on Mars, as they are not susceptible to poisoning by carbon dioxide. They are highly durable, with an efficiency of up to 85%. Solid oxide fuel cells employ hard ceramic material as an electrolyte and have an efficiency of around 65%. They operate at very high temperatures and do not require precious metals as catalysts. They can be regenerative and help in storing energy. They can find vast applications in the space industry. These fuel-cell systems are used on Earth or for various space missions. It is necessary to find the possibility of these fuel cells acting as the dynamic force for their use on Mars if human settlement occurs there. It will have transformational change not only in terms of structure and fuel supplied but also in its dynamic applications, which will support several new reactions.

Fuel-cell Assembly on MARS!

For any system to work efficiently, it is desirable to know the resources available to run it. It would be difficult to provide oxygen and hydrogen on Mars as its atmosphere is scanty, and transferring it from Earth would be practically impossible for larger requirements. The other case is that this requirement gets fulfilled if some new regions get explored on the planet and it contain an earth-like atmosphere.

However, the space scientific community is excited to send humans on Mars and explore the next level opportunity to dive into the solar system with a new footprint. It is imperative to meet our energy needs, especially in terms of electricity, before any other future engagements. Fuel cells are easy to carry or develop and provide high efficiency. They can operate at different ranges of temperatures and with catalysts from the metal present on Mars. Therefore, fuel-cell systems need a detailed description as the energy source for the next century, MARS TRAVEL!

In terms of elemental needs, Mars contains almost all the elements that Earth has expected in terms of quantity. They are silicon, iron, magnesium, aluminum, etc. This means that the requirement for the catalyst to set up the power generation unit using a fuel-cell stack system can be done using the elements present there. Now, the focus is on the fuel which can be provided to the system.