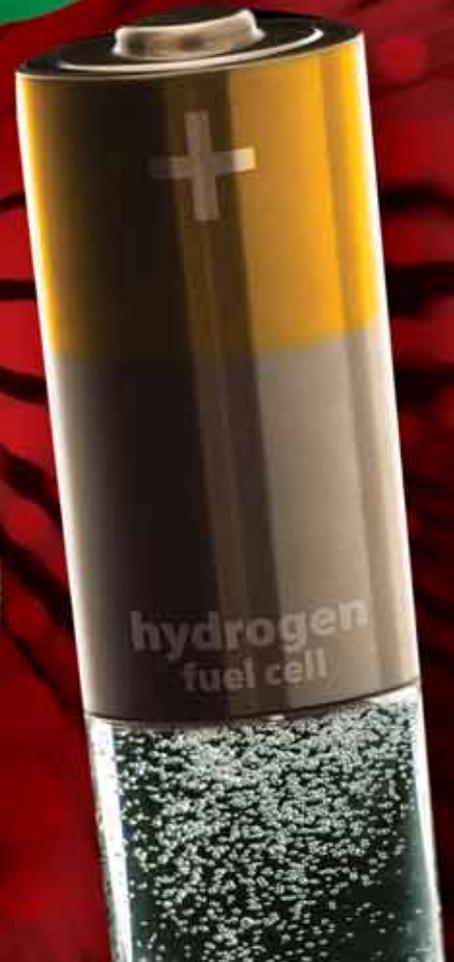


FUTURE POWER ENERGY

HYDROGEN POWER

POWERING THE FUTURE



A GREEN NOTE
A MESSAGE TO CHILDREN
BY DR R K PACHAURI, CHAIRMAN
INTERGOVERNMENTAL PANEL
ON CLIMATE CHANGE
JOINT WINNER OF THE
NOBEL PEACE PRIZE 2007





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The Energy and Resources Institute

A note from Dr R K Pachauri

Human society has reached a stage of prosperity, which was not expected several decades ago. Yet, a large number of people live in poverty and are barely able to keep alive. It appears that they have not been touched by human progress at all. At the same time, what we regard as progress has resulted in damage and destruction of our natural resources and caused serious problems such as human-induced climate change, which threaten all forms of life in different parts of the world in the form of sea-level rise, heatwaves, floods, droughts, and melting of glaciers.

All of this provides a strong reason for us to re-examine what we have mistakenly believed as human progress and change the way we have been pursuing human activities. For instance, we must now use renewable sources of energy and eco-friendly methods of production and consumption, make efficient use of water in every activity, and protect biodiversity.

It is in the hands of the children to try to change their own lives towards greater protection of the environment and all our natural resources. They can also take active part in changing the thinking of adults. Children can take the lead in organizing actions, which support conservation of resources, recycling of waste water, and greater use of renewable sources of energy, at the community level.

This series of children's books is aimed at providing children with knowledge on what needs to be done in all these areas. I hope those who read these books will not only enjoy them greatly but also feel inspired to implement actions that are described in these pages, so that we create a beautiful, peaceful, and healthy future for the human race.

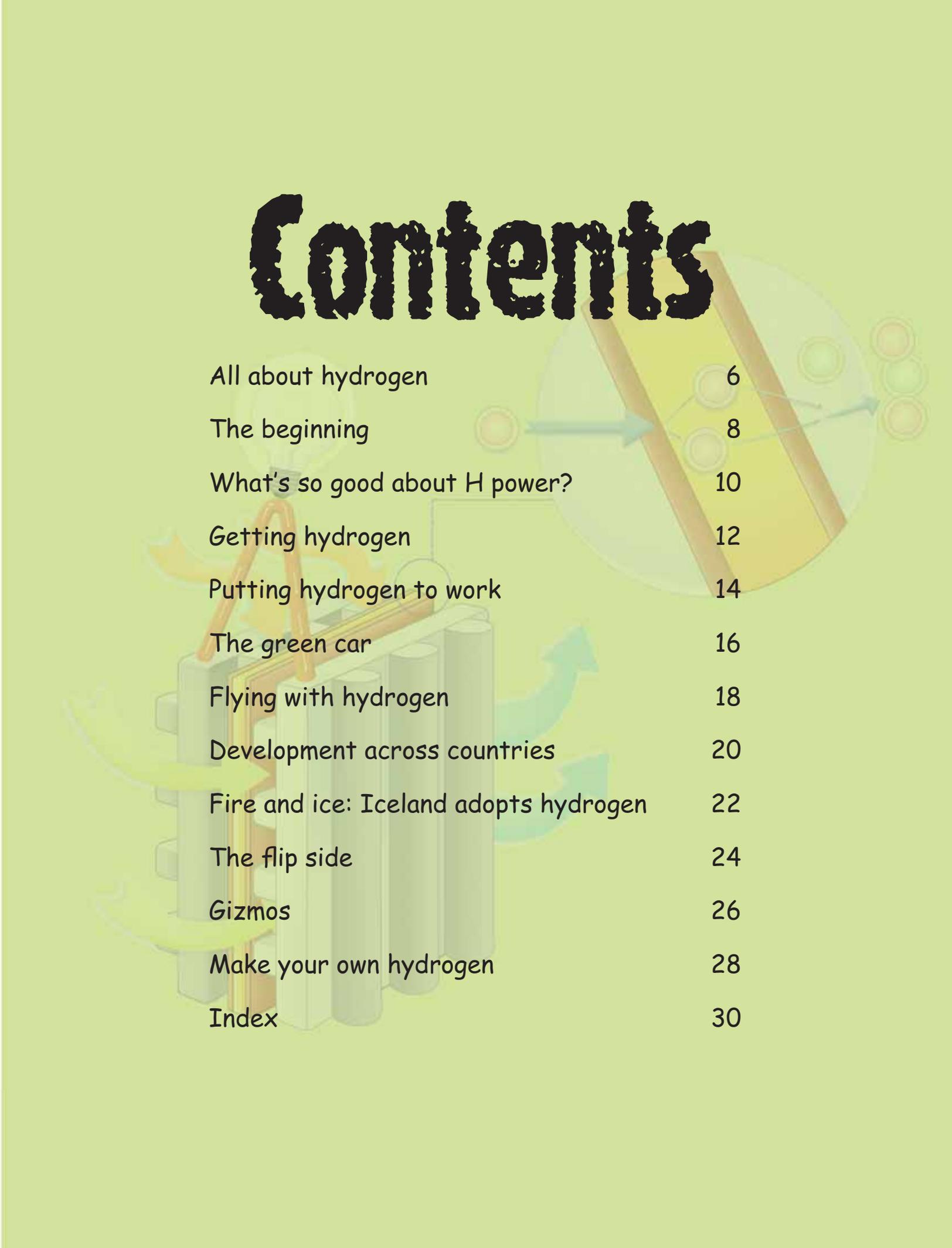


R K Pachauri

Director-General, TERI

Chairman, Intergovernmental Panel on Climate Change

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All about hydrogen

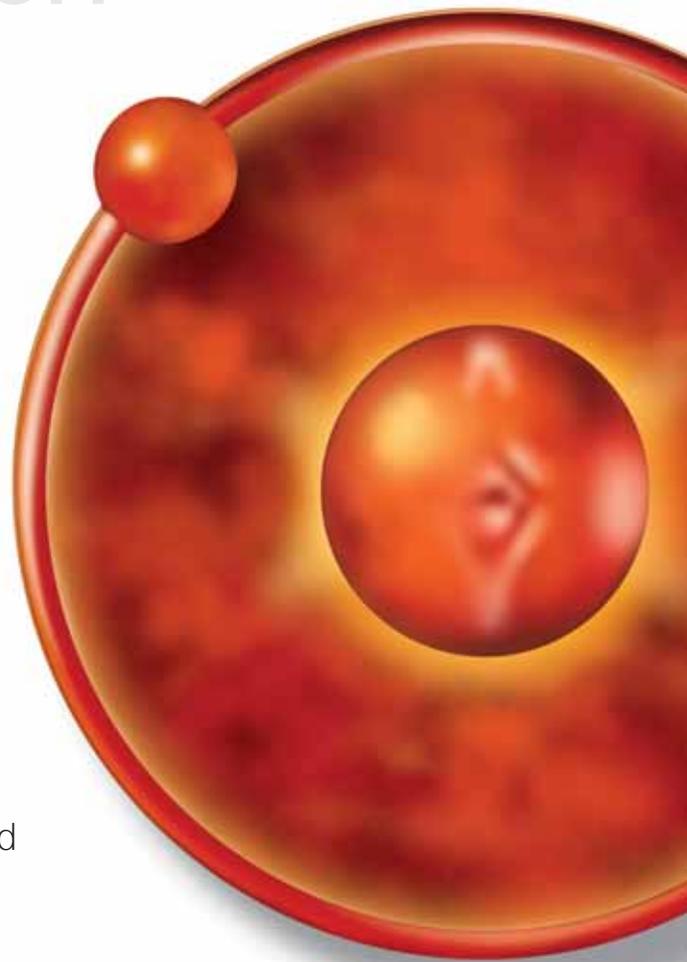
Ever wondered how some balloons are so light, they just fly up in the air? What is it that makes these balloons so light? It is a gas called hydrogen, which is lighter than air.

Small wonder

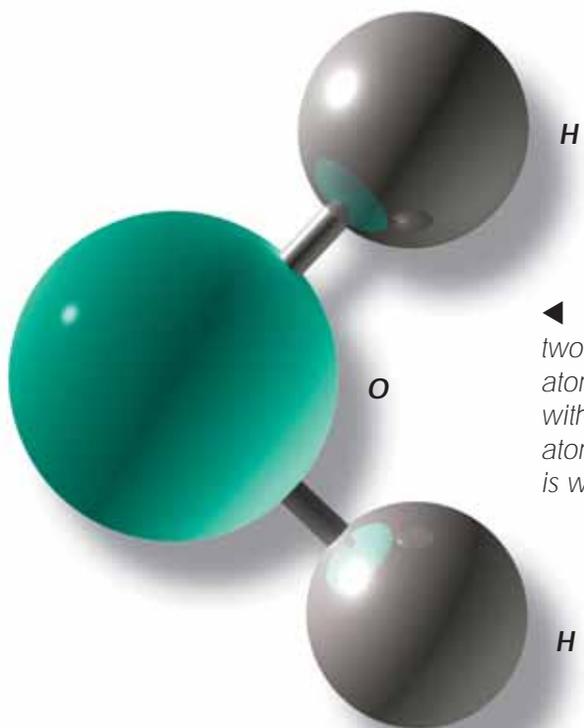
Hydrogen is the simplest and lightest element known to man, symbolized by the letter H. It is a colourless, odourless, and tasteless gas.

On the earth

Hydrogen constitutes 0.000055 per cent of the earth's atmosphere. It is so light that it stays above the air. That is why it is not found in its free form on the earth, but combined with other elements in the form of compounds. The most common compound of hydrogen is, of course, water (H_2O). Hydrogen is found in combination with carbon—in compounds such as methane (CH_4) and glucose ($C_6H_{12}O_6$) and in coal and petroleum. It is also found in the earth's crust.



▲ *Hydrogen is so common that about three-fourths of the universe has this element.*



◀ *When two hydrogen atoms combine with an oxygen atom, the result is water.*

In the stars

Hydrogen is the most abundant gas in the universe. Giant gas planets like Jupiter, as well as stars, are mainly made up of hydrogen. The sun, which is also a star, is basically a giant ball of hydrogen and helium. In the sun's core, or centre, hydrogen atoms combine to form helium atoms. This process, called fusion, gives off huge amounts of energy.



Powerhouse

The tiny hydrogen atom is packed with energy. Scientists are working on methods to use hydrogen as a source of energy. In fact, the hydrogen fuel cell is a developing technology that will allow large amounts of electrical power to be obtained using hydrogen gas.

Explosive!

Hydrogen gas is highly inflammable, that is, it burns easily. Hydrogen forms explosive mixtures with air and chlorine that ignite spontaneously.

▼ *Jupiter is composed mainly of hydrogen and helium, with small amounts of methane, ammonia, water vapour, and other compounds.*

SUPERPOWERED **FACT**

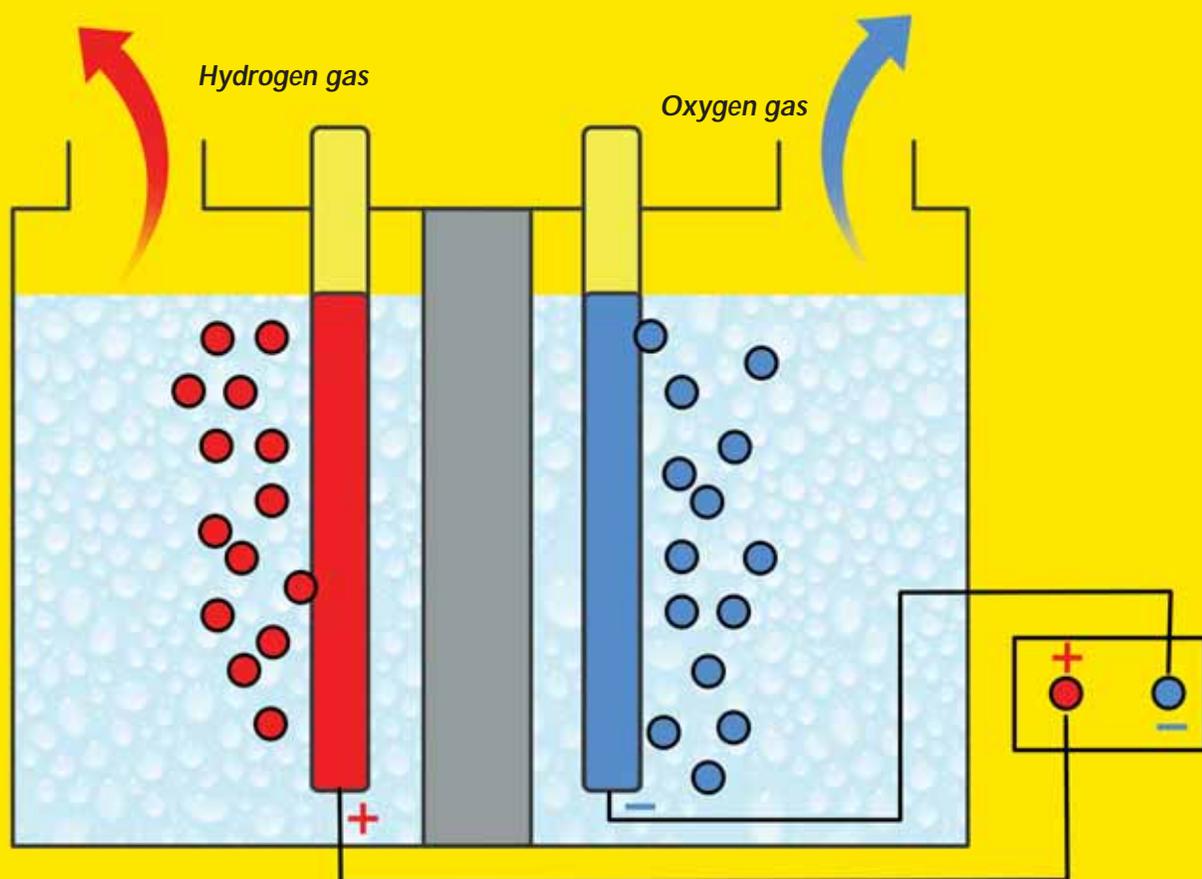
Hydrogen was used to make airships and air balloons because it is so light. The French Army used a hydrogen balloon to spy on the Austrian Army during the Battle of Fleurus in 1794.

The beginning

Hydrogen has been considered important since its discovery, but its potential as a source of energy is being realized only today.

► *Electrolysis is a method of separating elements by passing an electric current through a compound.*

▼ *Antoine Lavoisier proved wrong the earlier theory that during combustion a substance called phlogiston gets emitted. In fact, phlogiston never existed!*

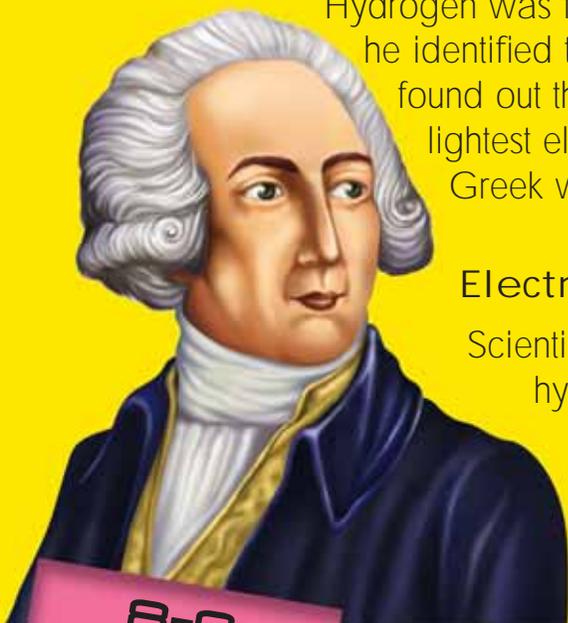


Discovery

Hydrogen was first discovered in London by Henry Cavendish in 1766, when he identified the gas from a metal-acid reaction as 'flammable air'. He also found out that water was made up of hydrogen and oxygen. It was the lightest element ever known. Antoine Lavoisier named the gas from the Greek words 'hydro' and 'gene', meaning 'water former'.

Electrolysis: splitting of water

Scientists continued with their experiments trying to produce hydrogen. In 1800, in England, Sir Anthony Carlisle, a surgeon, and renowned chemist William Nicholson discovered that by passing an electric current through water, it could be split into hydrogen and oxygen. This process is called electrolysis.



8-9

HYDROGEN POWER



▲ Sir William Grove is known as the father of the fuel cell.

Birth of the fuel cell

In 1838, Sir William Grove, a Welsh lawyer, inventor, and physicist conceived the first fuel cell. He used a platinum electrode immersed in nitric acid and a zinc electrode in zinc sulphate to generate electricity.

During the 1950s and 1960s, scientists working at the GE company modified the original fuel cell design by using a catalyst. GE continued to develop this technology, in collaboration with NASA and McDonnell Aircraft. The fuel cell was used in NASA's Project Gemini, a project involving testing equipment and mission procedures and training astronauts and ground crews for future Apollo missions.

Practical applications

The term 'fuel cell' was coined by Ludwig Mond and Charles Langer. In 1889, they built a working fuel cell using air and industrial coal gas, also called Mond gas. The first practical hydrogen fuel cell was developed by Francis Bacon in 1932. It was perfected 27 years later when it was used to power a welding machine. He named it the 'Bacon Cell'. In the same year, Harry Karl Ihrig demonstrated a tractor, the first fuel-cell-powered vehicle.

SUPERPOWERED

FACT

Hydrogen condenses to a liquid at a temperature of -253 degrees Celsius. It is the coldest liquid known on the earth!

Future Power,Future Energy : Hydrogen Power



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