WATER ELECTROLYSIS STUDIES AND CHEMICAL TECHNOLOGICAL DESCRIPTION

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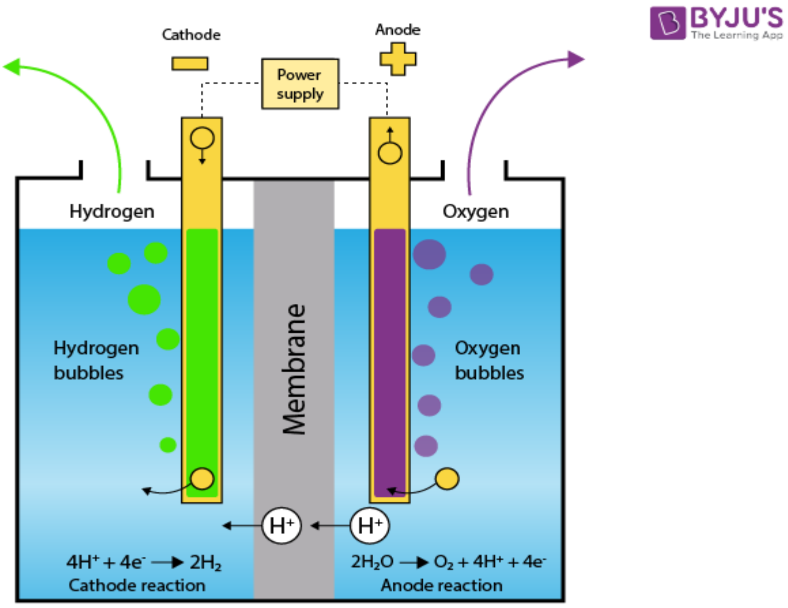
https://doi.org/10.5281/zenodo.7831415

Abstract: In particular, more attention is being paid to the electrolysis of water for the production of hydrogen a number of researches are being conducted to collect renewable energy. Here we have comprehensively reviewed all water electrolyzers research directions through computational analysis using citation networks to objectively identify emerging provides interdisciplinary information to forecast technologies and trends. The results show that all research areas increase the number of publications every year, and the following two areas in particular increasing in number of publications: "microbial electrolysis" and "alkaline catalysts" water electrolyzer and polymer electrolyte membrane water electrolyzer. Other areas of research, solid oxide electrolysis and in general the renewable energy system has recently received few review studies, although the focus is on articles on specific technologies and not published in a frequently cited citation network. This shows that these areas are being focused on, but there are no new technologies that are the focus research like this from the citation network can be very rewarding. Emerging technologies identified in these research areas are presented we can review and comment on this. In addition, a comparison with fuel cell research is made due to water electrolysis is the reverse reaction to fuel cells, and both industries use similar technologies. Technologies fuel cells and water are not transferred between electrolysis and water will be introduced in the future helps speed up the electrolysis process.
Key words: Water electrolysis, electrolysis technologies, membrane-based electrolysis, solid oxide electrolyzer; microbial electrolyzers, water splitting technologies.

Introduction

Because of renewable energies, chemical technologies and chemical processes in them are increasing and does not generate waste. However, renewable energy varies over time and its energy the density is small compared to the land area. The solution, of course, is to store energy in excess. In chemical technological processes power is generated and use it during shortages and monitor processes. Can cope with low energy density it will be possible to transfer renewable energy from a state of excess energy to transportation. Not rechargeable batteries Because the metals used in batteries are expensive, they differ in their suitability for storing and transporting energy. and the energy density per unit weight will have a low value. Water electrolysis is promising as a power supply can be stored as hydrogen from renewable energy, which is in a state with a high energy density per unit weight. For the above reasons, water electrolysis research has recently received much attention. Understanding which topics are important not only for researchers but also for government agencies. It gives promising results for their further development. Currently there are more than 10,000 scientific articles has been published on water electrolysis and more than 1,300 articles are published annually. It is tough it takes some time to read such a large amount by hand. Research topics are divided into several categories with the largest number It will be difficult to understand unless you are an expert on each subject. It is difficult even for professionals it is inevitable that the understanding of the entire research topics and their overview will be somewhat customized to objectively identify noteworthy and well-developed areas of research for their knowledge and interests It is necessary to have information about the observation of a number of processes, the use of methods that require research, calculation and objective analysis.



Picture 1. Illustration of the water electrolysis process.

This review provides an objective and comprehensive analysis of water electrolysis research. bibliometrics. Scientific works on water electrolysis are divided into several clusters focused on specific research topics based on citation networks.Trends in Water Electrolysis Areas depends on the processes that are being implemented in the next stages of development in each field. The importance of research in the field of fuel cells and electrolyzers is obvious. This has excellent mechanical strength, proton conductivity, and chemical and thermal stability. However, its obvious drawback, which has not yet been resolved, is its high fuel conductivity, which leads to the loss of fuel cell and direct methanol fuel cell systems. Fuel, reduces performance. Electrolyzers also have ion crossovers that reduce hydrogen production. It is also very expensive due to the process high cost of membrane production. Recently, many attempts have been made to overcome these shortcomings, including introduction of inorganic fillers, acid doping and introduction of various polymers the spine enters the research membrane. In addition, work with an electrolysis cell resulting in more efficient production due to increased hydrogen production at higher temperatures reduction of ion conductivity and anode and cathode activation overpotential. In fuel cells, high temperature performance decreases and improves performance carbon monoxide (CO) emissions; at the same time, it also accelerates fuel degradation cellular components. High operating temperature in the electrolyzer increases the yield of hydrogen. In chemical technology, electrolysis mechanisms operate at temperatures below 100 ◦C and at atmospheric pressure. Two electrodes are separated through a diaphragm that passes

hydroxide ions (OH-) through the KOH solution and traps oxygen and hydrogen is removed to prevent recombination. This technology is the most mature for hydrogen generating up to megawatts at commercial scale. However, it has its drawbacks diaphragm. A high ohmic loss occurs across the diaphragm immersed in the alkaline solution and restricts it maximum current density. In addition, the diaphragm does not completely prevent oxygen and hydrogen from mixing. Therefore, high pressure cannot be achieved, otherwise it will be useful for large volume stack design. In addition, the passage of product gas allows oxygen and hydrogen recombines and reduces the Faraday efficiency. Despite these disadvantages, this type of electrolyzer is considered the most common because it does not require expensive materials. Alkaline conditions allow us to use other cheap metals such as nickel that are not part of the platinum group. KOH solution for electrolytes are also cheap and convenient.
The half-cell reaction at the anode in alkaline electrolysis is shown in Eq:
Anode: $2OH^- \rightarrow H2O + ½\ O2 + 2e^-$
As for the cathode, the half-cell reaction in alkaline electrolysis is described in Eq:
Cathode: $2H2O + 2e^- \rightarrow H2O + 2OH^-$

Electrolytes Concentration

In some water electrolysis processes, the electrolyte concentration plays an important role in determining the reaction rate and the amount of hydrogen produced. A strong dependence of the amount of hydrogen produced has been reported increases with electrolyte concentration, i.e. higher concentration in the electrolyte the ionic conductivity of the solution, which in turn favors hydrogen evolution reactions and improves yield, increased fourfold the rate of hydrogen production in amphoteric electrolysis using 3 M was observed KOH and 2 M H2SO4 in the temperature range from 30 to 50 °C. However, excessive electrolyte concentration can cause component deterioration including membrane, electrodes, gaskets, current collector, bipolar plates, etc. which in turn affects the hydrogen yield. The corrosive nature of concentrated electrolytes, whether acidic or alkaline, can damage the peristaltic pump.Components, electrolyte tube, thermocouples, heating elements, etc. Therefore, careful research should be done on suitable electrolyte concentrations to achieve the optimal concentration for maximum enhancement.

Conclusions

Despite significant progress in the development of all necessary components membrane-based electrolytic hydrogen production systems significantly improve durability properties, performance and efficiency, some electrolysis technologies processes still in the early stages of development, such as solid oxide, anion exchange membrane, microbial and photoelectrochemical electrolysis. In this review, we have provided a brief overview Introduction to various water splitting technologies for hydrogen production including discuss the type of membrane currently in use and the progress related to them. In addition, we highlighted and highlighted recent developments in membrane-based electrolysis. This review not only discusses in detail the availability of hydrogen production technology, but also summarizes the trends. It is necessary to review the technologies of water electrolysis, hydrogen production over the last decade, including the advantages, disadvantages and performance indicators of the various products. Parameters and technologies affecting the performance of membrane electrolysis was also discussed. Finally, we summarize the challenges in the development of membrane-based electrolysis technologies and outline our ideas for future research directions in order to fully exploit this potential energy source with a zero carbon footprint. In the future, we have plans to implement several processes, such as the development of membranes for water separation technologies, especially membrane-based electrolysis. Alkaline water electrolysis is one of the easiest and simplest methods and simplifies efficient processes for hydrogen production. Less efficiency is one of the best, there are drawbacks and difficulties for widespread use of this system. Efforts for development and research must be completed disadvantages such as energy consumption, cost and so on maintenance, durability, reliability and safety will need to be ensured. Thermodynamic analysis shows the energy requirements as well as theoretical and actual, resistances offered by the system and also have discussed different efficiencies, these parameters help to identify and eliminate the main problems in the way of improvement. This kinetic analysis indicates the rate of alkaline reaction solution, ion transfer electrode surface activity and also will depend on the effect of various electrolytes and additives on the production. Research to improve this program serious consideration should be given to electrochemical reduction reaction resistance, cheap electrode options, increase electrocatalysts, electrolytes and its additives ionic mass transfer, corrosion resistant electrolytes and electrodes for the resistance of the electrolyzer to reduce the electrode surface tension, changing the electrode surface profile and surface coatings and most importantly gas management the bubble causes the resistance of the medium and slows down the electrolysis processes.

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