Bioenergetics: Open Access

Short Communication Open Access

# Recent advance in direct ethanol fuel cell for sustainable energy production

L An The

*Hong Kong Polytechnic University, China*

## Abstract

Direct ethanol fuel cells (DEFC), which promise to be a clean and efficient energy production technology, have recently attracted worldwide attention, primarily because ethanol is a carbon-neutral, sustainable fuel and possesses many unique physicochemical properties including high energy density and ease of transportation, storage as well as handling. However, conventional DEFCs, which use acid proton exchange membranes and precious metal catalysts, result in rather low performance. In our research, we use alkaline anion exchange membranes as the solid electrolyte in DEFCs. It is demonstrated that the change from the acid membrane to an alkaline one leads to a significant performance boost. Recent developments into technology of proton exchange membrane fuel cells (PEMFC) now allow serious consideration to be given to a direct alcohol fuel cell (DAFC) based on a PEMFC, in which alcohol is used directly as the fuel. This is particularly advantageous for mobile applications, since this will avoid the use of a bulky and expensive reformer. However, the relatively complex reaction mechanism, leading to a low electroreactivity of most alcohols, even methanol, needs the investigation of new platinum-based electrocatalysts, particularly active for breaking the C□C bond when alcohols other than methanol are to be used. Moreover, in order to overcome the deleterious effect of alcohol crossover through the proton exchange membrane, it is necessary to develop new oxygen reduction electrocatalysts insensitive to the presence of alcohols. An overview of recent advancement in fuel cell technology and its applications was presented. Different type of fuel cells namely solid polymer fuel cell (SPFC), direct methanol fuel cell (DMFC), phosphoric acid fuel cell (PAFC), solid oxide fuel cell (SOFC) and molten carbonate fuel cell (MCFC) were also described. The choice of fuel and fuel infrastructure for the fuel cell powered buses and light duty vehicles was also discussed. It was predicted that using the fuel cells zero emission vehicles could be developed in near future. Biomass is one of the most abundant renewable energy resources on the earth, which is also considered as one of the most promising alternatives to traditional fuel energy. In recent years, microbial fuel cell (MFC) which can directly convert the chemical energy from organic compounds into electric energy has been developed. By using MFC, biomass energy could be directly harvested with the form of electricity, the most convenient, wide-spread, and clean energy. Therefore, MFC was considered as another promising way to harness the sustainable energies in biomass and added new dimension to the biomass energy industry. In this review, the pretreatment methods for biomass towards electricity harvesting with MFC, and the microorganisms utilized in biomass-fueled MFC were summarized. Further, strategies for improving the performance of biomass-fueled MFC as well as future perspectives were highlighted. Direct ethanol fuel cells (DEFCs) have emerged as promising and advanced power systems that can considerably reduce fossil fuel dependence, and thus have attracted worldwide attention. DEFCs have many apparent merits over the analogous devices fed with hydrogen or methanol. As the key constituents, the catalysts for both cathodes and anodes usually face some problems (such as high cost, low conversion efficiency, and inferior durability) that hinder the commercialization of DEFCs. This review mainly focuses on the most recent advances in nanostructured catalysts for anode materials in DEFCS. First, we summarize the effective strategies used to achieve highly active Pt- and Pd-based catalysts for ethanol electro-oxidation, including composition control, microstructure design, and the optimization of support materials. Second, a few non-precious catalysts based on transition metals (such as Fe, Co, and Ni) are introduced. Finally, we outline the concerns and future development of anode catalysts for DEFCs. This review provides a comprehensive understanding of anode catalysts for ethanol oxidation in DEFCs. Energy storage and conversion is a very important link between the steps of energy production and energy consumption. Traditional fossil fuels are a natural and unsustainable energy storage medium with limited reserves and notorious pollution problems, therefore demanding a better choice to store and utilize the green and renewable energies in the future. Energy and environmental problems require a clean and efficient way of using the fuels. Fuel cell functions to efficiently convert oxidant and chemical energy accumulated in the fuel directly into DC electric, with the by-products of heat and water. Fuel cells, which are known as effective electrochemical converters, and electricity generation technology has gained attention due to the need for clean energy, the limitation of fossil fuel resources and the capability of a fuel cell to generate electricity without involving any moving mechanical part.

Note: This work is partly presented at International Conference on Membrane Science and Technology September 11-12, 2017 | Paris, France