Investigation and Development of a New Solid Polymer Electrolyte Using an Natural Membrane for Fuel Cell Devices

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PEFCs are expected to become high-efficiency next-generation power sources. However, for over 40 years, the performance of the solid polymer electrolyte membrane has been the primary bottleneck in their development. Natural plant membranes have several functions to preserve the biological activity of internal tissues and provide protection from the external environment. Therefore, in this study, we examined the possibility of utilizing natural membranes as a new electrolyte membrane in PEFCs. PEFCs consist of electrodes, a platinum catalyst, and a solid polymer electrolyte. The fuel is decomposed at the anode, water is generated at the cathode, and electricity is generated as a result of these processes. In our first attempt to prepare the solid electrolyte, we introduced a raw cut-out natural membrane into a fuel cell module, only to find that no electricity was generated. We also prepared an improved membrane that was platinum coated using a sputter coating device. In this case, power generation was confirmed when methanol was dripped onto the membrane. Based on this result, we expect that proton conduction, which occurs in the proteins of the natural membrane, contributed to the power generation. Next, to improve the performance of these membranes, we optimized the procedure for positioning and fixing the natural membrane to the electrode to prevent the crossover of fuel, and treated the membrane with metal chlorides (HAuCl4, H2PtCl6, PdCl2, FeCl3, NiCl2, CuCl2, etc.). Our results show that this improved the power generation by roughly a factor of 30 compared with the untreated membrane.

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