FUEL CELLS

Long lasting

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Polymer electrolyte fuel cells (PEFCs) are an attractive potential power source for electrified vehicles, as they can offer high power density, high energy-conversion efficiency and low-temperature operations. However, the development of high-performing and cost-effective polymer electrolyte membranes, which serve as both an ion conductor and a gas separator, still represents a significant challenge because most membranes are prone to mechanical and, in particular, chemical degradation (caused by attack of radicals present in PEFCs). Conventional approaches to mitigate the membrane chemical degradation involve the use of additives such as CeO_2 or MnO_2 as radical scavengers, but there is often a trade-off between the durability and other performance indicators such as proton conductivity. Now, Andrew Herring and colleagues in the United States develop a heteropoly acid functionalized fluoroelastomer membrane and demonstrate a high chemical durability as well as a high proton conductivity.

In their synthesis, the researchers first attached the side chains of a diethyl(4-hydroxyphenyl)phosphonate to a commercial fluoroelastomer, and then covalently bound a silicotungstic acid to the resultant fluoroelastomer. In a hydrogen–oxygen environment with this membrane, the open circuit voltage decayed by only 0.05 V after 500 hours, whereas it dropped by approximately 0.4 V after just 100 hours in the same system with a commercial Nafion membrane. The high chemical stability was attributed to the silicotungstic acid that serves as a radical decomposition catalyst so as to protect the membrane. The maximum proton conductivity of the membrane was reported to be 0.298 S cm^{-1}, which is comparable to that of the state-of-the-art polymer membranes, and was interpreted as the result of highly mobile protons in the silicotungstic acid.

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