High-Temperature Polymer Electrolyte Membrane Fuel Cells for Heavy-duty Vehicle Applications: Recent Development and Catalyst Challenges

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Abstract Content:

High-temperature polymer electrolyte membrane fuel cells (HT-PEMFCs), which can operate above 100 °C under anhydrous conditions, have attracted increasing interest in recent years. Several merits over low-temperature PEMFCs, including reduced complexity in fuel cell systems, easier heat management and higher CO tolerance, make it an ideal solution for heavy-duty vehicle applications. Recently developed ion-pair HT-PEMFCs has a significantly lower concertation of phosphoric acids in the membrane electrode assembly (MEA), which leads to both elevated performance and durability. More importantly, these ion-pair HT-PEMFCs exhibit stable performance at 80 – 160 °C operating temperature range, making it potentially feasible for vehicle applications. Here in this talk, we first explain the difference in MEA configuration and fuel cell performance between conventional polybenzimazole-based HT PEMFCs and ion-pair HT PEMFCs, as well as the performance gap with 2nd Generation MIRAI fuel cells. Next, we discuss the catalyst challenges, which mainly come from the phosphate anion poisoning. The correlation and difference of oxygen reduction reaction (ORR) on Pt and a series of platinum alloy (Pt-M) catalysts in both dilute and concentrated phosphoric acid will be discussed. Lastly, we will share our perspectives of key questions that need to be addressed to design high-performance catalysts for HT-PEMFCs.