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Superhydrophilic porous transport layer enhances efficiency of polymer electrolyte membrane electrolyzers

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A prominent technology for green hydrogen generation is the polymer electrolyte membrane (PEM) electrolyzer. However, the energy efficiency of PEM electrolyzers must improve dramatically to become economically competitive. Here, we engineer the wettability of commercial porous transport layers (PTLs) to make them superhydrophilic. We find the superhydrophilic PTLs increase the efficiency of PEM electrolyzers by >11% at high current operation (up to 20%). We show via electrochemical analyses and in-operando neutron imaging that the improved efficiency stems from reduced gas saturation in the anode PTL, which significantly decreases the mass transport overpotential. We conduct ex-situ microfluidic experiments and demonstrate that capillary-driven corner flow is a key physical mechanism responsible for the reduced oxygen gas saturation and enhanced liquid water transport. Our findings illustrate the importance of PTL wettability on mass transport in PEM electrolyzers and enable design of next generation electrolyzers with much greater efficiency.

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Participation

Online

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