In-plane Channel-structured Catalyst Layer for Polymer Electrolyte Membrane Fuel Cells

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In this study, we present a novel catalyst layer (CL) with in-plane flow channels to enhance the mass transports in polymer electrolyte membrane fuel cells (PEMFCs). The membrane electrode assembly (MEA) with the in-plane channel-patterned CL (IC-CL) has superior power performances in high current densities compared with an un-patterned, flat CL (FCL), demonstrating a significant enhancement of the mass transport property by the in-plane channels carved in the CL. The performance gain is more pronounced when the channel direction is perpendicular to the flow field direction, indicating that the in-plane channels increase the utilization of the CL under the rib area. An oxygen transport resistance analysis shows that both molecular and Knudsen diffusion can be facilitated with the introduction of the in-plane channels. The direct CL patterning technique provides a platform for the fabrication of advanced CL structures with a high structural fidelity and design flexibility and a rational guideline for designing high performance CLs.