Channel Structure-controlled Porous Carbon Microparticles for High-Performance Fuel Cell Catalysts with Ultra-low Pt Loadings

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Developing a highly efficient and durable proton exchange membrane fuel cell (PEMFC) using a low amount of platinum (Pt) is essential for minimizing the total cost. Herein, we demonstrate the development of high-performance PEMFC catalysts using ultra-low Pt loaded (1 wt%) porous carbon with controlled channel diameters (D_{ch} = 13-63 nm), produced from block copolymer particles. The single cell based on the catalyst with the largest D_{ch} of 63 nm yields an initial maximum power density of 1230 mW cm^{-2} and high durability showing 1120 mW cm^{-2} after 30,000 cycles under H_2/O_2 flow, which outperforms those of commercial Pt/C catalysts despite 1/20 Pt usage. Furthermore, the catalyst shows outstanding performance with 51 kW per gram of Pt (kW/g_{Pt}) after 30,000 cycles in H_2/air flow, which is the highest performance reported to date. The channel structure and large D_{ch} of the porous particles are the key to enhancing the power density by improving the proton and mass transport.