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Abstract

Graphene Oxide (GO) is potentially a useful electrolyte material for polymer electrolyte membrane fuel cells due to its high strength, excellent hydrogen gas barrier properties, hydrophilicity, and proton conducting acidic functional groups. Here, GO paper is prepared from aqueous dispersion by vacuum-filtration, and the hydrogen permeability ($2x10^{-2}$ barrer) is measured to be 3 orders of magnitude lower than Nafion (30 barrer) at 30°C. The in-plane and through-plane conductivities are measured to be 49.9 and 0.3 mS cm^{-1}, respectively. This significant anisotropy is attributed to the lamellar structure of GO, and the physical anisotropy between the thickness and lateral size of the GO nanoplatelets. Interestingly, the in-plane conductivity of GO is comparable to the through-plane conductivity of Nafion. GO membrane fuel cells (GOMFCs) are fabricated. To compensate for the low in-plane conductivity of GO, whilst taking advantage of the excellent hydrogen gas barrier properties, extremely thin electrode-supported GOMFCs are prepared by spray painting GO directly onto the electrocatalyst layer. The effect of membrane thickness on cell performance is investigated. Decreasing membrane thickness by spray painting improves the power density from 3.7 mW cm^{-2} for a 50 μm-thick membrane-supported GOMFC, to 79 mW cm^{-2} for a 3 μm-thick, spray-painted membrane, electrode-supported GOMFC.

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