Effect of gas/electrolyte contact area and gas diffusion layer porosity on mass transport limit in polymer electrolyte fuel cells under non-water-flooding conditions

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Two-phase-based mathematical modeling of polymer electrolyte fuel cells is conducted to predict and analyze the effect of gas/electrolyte contact area and porosity of gas diffusion layer on cell performance under isothermal and non-water-flooding conditions. The model focuses on mass transport limit mainly by the dissolution limitation of oxygen gas into an electrolyte phase (ionomer) in cathode catalyst layer. The results from our simulation reveal that deficient gas/electrolyte contact area causes a considerable mass transport limit even if sufficient level of oxygen gas is maintained in the cathode catalyst layer. However, with increase of gas/electrolyte contact area, the effect of mass transport limit starts to be relieved, and from a certain level, considerable increase of cell performance does not appear. Interestingly, porosity of gas diffusion layer does not much affect mass transport limit under a sufficient level of gas/electrolyte contact area. It only plays an additional role for the mass transport limit under a deficient level of gas/electrolyte contact area.