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Numerical Analysis of Real-Scale Polymer Electrolyte Fuel Cells with Cathode Metal Foam Design

Authors : Jaeseung Lee, Muhammad Faizan Chinannai, Mohamed Hassan Gundu, Hyunchul Ju

Abstract : In this paper, we numerically investigated the effect of metal foams on a real scale 242.57cm2 (19.1 cm × 12.7 cm) polymer electrolyte membrane fuel cell (PEFCs) using a three-dimensional two-phase PEFC model to substantiate design approach for PEFCs using metal foam as the flow distributor. The simulations were conducted under the practical low humidity hydrogen, and air gases conditions in order to observe the detailed operation result in the PEFCs using the serpentine flow channel in the anode and metal foam design in the cathode. The three-dimensional contours of flow distribution in the channel, current density distribution in the membrane and hydrogen and oxygen concentration distribution are provided. The simulation results revealed that the use of highly porous and permeable metal foam can be beneficial to achieve a more uniform current density distribution and better hydration in the membrane under low inlet humidity conditions. This study offers basic directions to design channel for optimal water management of PEFCs.

Keywords : polymer electrolyte fuel cells, metal foam, real-scale, numerical model
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