Analysis on the Rapid Voltage Drop Based on a New Air-Cooled PEMFC Stack Design

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A new structure called Membrane-Electrode-Assembly-Plate unit with lateral hydrogen tube is developed, which binding the periphery of the anode face of a bipolar plate with the periphery of the anode side of a membrane electrode assembly by using silicone adhesive. An air-cooled proton exchange membrane fuel cell stack is assembled through stacking forty Membrane-Electrode-Assembly-Plate units and mounting two hydrogen external manifolds. Consequently, the possibility of hydrogen leakage to the cathode side is excluded completely. The maximum power can temporarily reach 351.60 W at 20.0 A. Eight-hour stack stability is tested at a constant current of 4.77 A, i.e., 100 mAcm⁻². The average voltage drop rate of single cell is calculated as 0.852 mVh⁻¹. It is explained that the rapid stack voltage drop during eight-hour operation is caused by the formation, accumulation and spread of liquid water inside both the anode and cathode gas diffusion layers and is reversible.

Keywords: air-cooled PEMFC stack; open-cathode; sealing; voltage drop; flooding

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