Flow-channel Design Modification and Manufacturing Strategy for Carbon Graphite Bipolar Plate in PEMFC Application

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ABSTRACT

A Proton Exchange Membrane Fuel Cell (PEMFC) is an electrochemical device that converts the chemical energy in fuel into electrical energy. The bipolar plate is the principal component of the PEMFC, and it plays a crucial role in enhancing energy conversion performance. This study proposes a modified straight-flow channel design with pressure gradients and Lung channels with rounded edges for both the anode and cathode sides of the bipolar plate. A fluid flow simulation is performed to evaluate the channel design appropriateness, then cut applying a CNC milling machining. The simulation results indicate that the modified straight flow design with pressure gradients within the channels is more advantageous concerning the pressure contour and mass flow rate consistency. In contrast, a modified Lung channel with rounded edges is recommended, considering the consistency in pressure contour, mass flow rate, and velocity contour. A carbon graphite GE-04 was chosen as the material since it satisfies the essential prerequisites for bipolar plates. The manufacturing process results indicate that dimensional precision, uniformity, and surface roughness at the channel's base are satisfactory. Finally, it confirms that the manufactured bipolar plate can be utilized in constructing a fuel cell stack.

Kata Kunci: *Bipolar Plate; Bipolar Plate Manufacturing; Carbon Graphite; Flow Channel Design; Proton Exchange Membrane Fuel Cells*