EFFECT OF DIFFERENT SHAPES AND SIZES OF PLANAR CELL ON THE PERFORMANCE OF PROTON CERAMIC FUEL CELLS: A STUDY VIA COMPUTATIONAL FLUID DYNAMICS

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ABSTRACT

EFFECT OF DIFFERENT SHAPES AND SIZES OF PLANAR CELL ON THE PERFORMANCE OF PROTON CERAMIC FUEL CELLS: A STUDY VIA COMPUTATIONAL FLUID DYNAMICS

A conventional solid oxide fuel cells (SOFCs) have been recognised as a potential technology for producing clean and efficient energy production. However, because of SOFC high operating temperature (800^0C-1000^0C), it can cause material failure and degradation. Thus, proton ceramic fuel cell (PCFC) that can operate in intermediate temperature (400^0C-700^0C) is introduced. Even though PCFC is a relatively efficient energy source, the performance may still be enhanced by optimising its design. This study examined the performance of the planar type of PCFC with two different shapes (button and rectangular) and sizes (135 mm^2 and 500 mm^2) of the model. Investigation of the PCFC's power density was done by a computational fluid dynamic (CFD) using ANSYS R2 software. In this study, the three objectives listed were carried out which are; i) To quantify the impact of PCFC shape and size variations on power density by conducting computational fluid dynamics (CFD) simulations. ii) To measure the temperature distribution across different PCFC shapes through CFD, and iii) To evaluate the fuel utilization efficiency for various PCFC geometries and its effect on power density operating at 700ºC under 60% hydrogen fuel. Both models are design with nearly identical active for a fair performance comparison. The single channel rectangular cell demonstrates the highest fuel utilisation efficiency of 71.19% for A_{R2} = 500 mm^2 and highest value of peak power density with 0.539 W/cm^2 at 0.5V for A_{R1} = 135 mm^2 compared to planar button cell. The single channel rectangular cell with the bigger cell showed high fuel utilisation efficiency while the smaller cell for high peak power density.

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