Thermo-electrical performance of PEM fuel cell using Al_2O_3 nanofluids

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A B S T R A C T

Nanofluid adoption as an alternative coolant for Proton Exchange Membrane (PEM) fuel cell is a new embarkation which hybridizes the nanofluids and PEM fuel cell studies. In this paper, findings on the thermo-electrical performance of a liquid-cooled PEM fuel cell with the adoption of Al_2O_3 nanofluids were established. Thermo-physical properties of 0.1, 0.3 and 0.5% volume concentration of Al_2O_3 nanoparticles dispersed in water and water: Ethylene glycol (EG) mixtures of 60:40 were measured and then adopted in PEM fuel cell as cooling medium. The result shows that the cooling rate improved up to 187% with the addition of 0.5% volume concentration of Al_2O_3 nanofluids to the base fluid of water. This is due to the excellent thermal conductivity property of nanofluids as compared to the base fluid. However, there was a penalty of higher pressure drop and voltage drop experienced. Thermo electrical ratio (TER) and Advantage ratio (AR) were then established to evaluate the feasibility of Al_2O_3 nanofluid adoption in PEM fuel cells in terms of both electrical and thermo-fluid performance considering all aspects including heat transfer enhancement, fluid flow and PEM fuel cell performance. Upon analysis of these two ratios, 0.1% volume concentration of Al_2O_3 dispersed in water shows to be the most feasible nanofluid for adoption in a liquid-cooled PEM fuel cell.