

Thermal Analysis on Heat Transfer Enhancement and Fluid Flow for Al₂O₃ Water-Ethylene Glycol Nano Fluid in Single PEMFC Mini Channel

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Abstract : Thermal enhancement of a single mini channel in Proton Exchange Membrane Fuel Cell (PEMFC) cooling plate is numerically investigated. In this study, low concentration of Al₂O₃ in Water - Ethylene Glycol mixtures is used as coolant in mini channel of carbon graphite plate to mimic the PEMFC cooling plate. A steady and incompressible flow with constant heat flux is assumed in the channel of 1mm x 5mm x 100mm. Nano particle of Al₂O₃ used ranges from 0.1, 0.3 and 0.5 vol % concentration and then dispersed in 60:40 (water: Ethylene Glycol) mixture. The effect of different flow rates to fluid flow and heat transfer enhancement in Re number range of 20 to 140 was observed. The result showed that heat transfer coefficient was improved by 18.11%, 9.86% and 5.37% for 0.5, 0.3 and 0.1 vol % Al₂O₃ in 60:40 (water: EG) as compared to base fluid of 60:40 (water: EG). It is also showed that the higher vol % concentration of Al₂O₃ performed better in term of thermal enhancement but at the expense of higher pumping power required due to increase in pressure drop experienced. Maximum additional pumping power of 0.0012W was required for 0.5 vol % Al₂O₃ in 60:40 (water: EG) at Re number 140.

Keywords : heat transfer, mini channel, nanofluid, PEMFC

Conference Title : ICFTE 2015 : International Conference on Fluids and Thermal Engineering

Conference Location : Los Angeles, United States

Conference Dates : September 28-29, 2015