International Communications in Heat and Mass Transfer 61 (2015) 61–68

Contents lists available at ScienceDirect

International Communications in Heat and Mass Transfer

journal homepage: www.elsevier.com/locate/ichmt

Experimental Investigation of Thermal Conductivity and Electrical Conductivity of Al_2O_3 Nanofluid in Water - Ethylene Glycol Mixture for Proton Exchange Membrane Fuel Cell Application ☆

Irnie Zakaria [c], W.H. Azmi [a,*], W.A.N.W. Mohamed [c], Rizalman Mamat [a], G. Najafi [b]

[a] Faculty of Mechanical Engineering, Universiti Malaysia Pahang, 26600 Pekan, Pahang, Malaysia
[b] Tarbiat Modares University, Jalale-E-Aleahmad Highway, Tehran, Iran
[c] Faculty of Mechanical Engineering, Universiti Teknologi Mara (UiTM),40450 Shah Alam, Selangor, Malaysia

ARTICLE INFO

Available online 27 December 2014

Keywords:
Nanofluid
Aluminium oxide
Thermal conductivity
Eelectrical conductivity
Fuel cell
Thermo-electrical conductivity ratio

ABSTRACT

Nanofluid is an alternative promising cooling liquid with superior performance characteristic compared to conventional cooling liquid for Proton Exchange Membrane fuel cell (PEMFC). In this paper, new findings on ratio of thermal conductivities and electrical conductivities of nanofluids in water: ethylene glycol (EG) mixtures are established. Thermal conductivities and electrical conductivities of base fluids which are water: EG mixtures with concentration ranging from 0 % ethylene glycol up to 100 % ethylene glycol were measured. These base fluids are then dispersed with Al_2O_3 at 0.1, 0.3 and 0.5 % of volume concentration and thermal conductivities and electrical conductivities are then measured at temperature of 20 °C. The result demonstrates that thermal conductivities reduced as the EG content percentage increases in the water: EG mixture. Thermal conductivities for 0.5 % volume concentration of Al_2O_3 is 0.6478 W/m.K and 0.2816 W/m.K for 0 and 100 % EG content in water: EG mixture. However, at a specific EG percentage, thermal conductivities also increased as a function of volume concentration. Electrical conductivities measured in 0.1, 0.3 and 0.5 % volume concentration of Al_2O_3 in base fluid also observed to decrease as the EG concentration increased even though the base fluids' electrical conductivity behave differently. Thermo-electrical conductivity ratio (TEC) has also been established based on both thermal and electrical conductivity findings.