Thermal–electrical–hydraulic properties of Al_2O_3–SiO_2 hybrid nanofluids for advanced PEM fuel cell thermal management

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ABSTRACT

Hybrid nanofluid is a new revolutionized cooling liquid with improved thermo-physical properties as compared to conventional coolant. This paper presents the feasibility of hybrid Al_2O_3–SiO_2 nanofluids as an advanced coolant for PEM fuel cell application in terms of thermal–electrical–hydraulic thermo-physical properties. Nine mixture ratios of Al_2O_3–SiO_2 were used in this experiment, ranging from 10:90 to 90:10 mixture ratios. The result demonstrated that both thermal conductivity and electrical conductivity decreased as the percentage of Al_2O_3 was increased in the mixture. In contrast, the dynamic viscosity property increased as the Al_2O_3 percentage ratio was increased. In summary, property enhancement ratio (PER) of thermo-hydraulic ($PER_{t/v}$) and thermo-electrical ($PER_{t/e}$) was established. Both $PER_{t/v}$ and $PER_{t/e}$ analyses favor 10:90 ratio of Al_2O_3–SiO_2 hybrid as the most feasible ratio for the implementation in PEMFC. This is due to the dominant effect of thermal over viscosity and electrical conductivity.

KEYWORDS

Electrical conductivity; Hybrid nanofluids; PEMFC; Thermal conductivity; Viscosity

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