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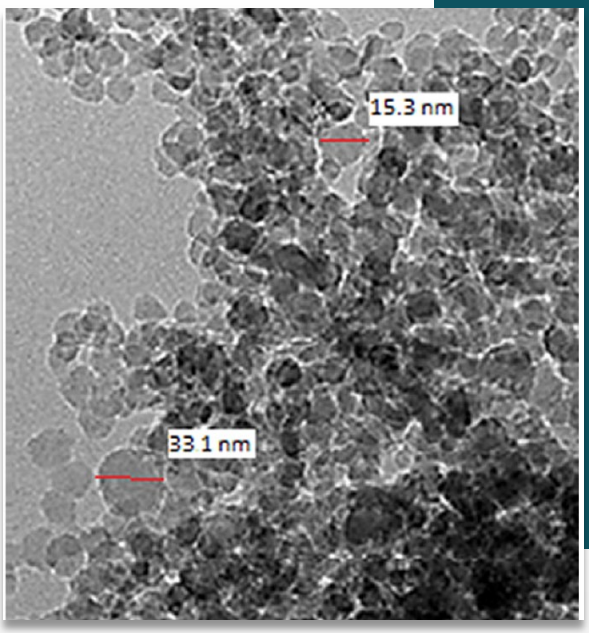
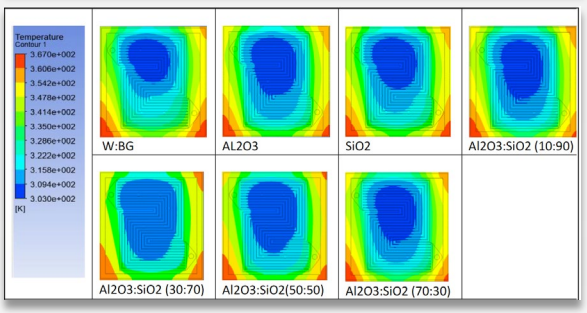
NANOFLUIDS ADOPTION AS AN ALTERNATIVE HEAT TRANSFER FLUIDS IN PEM FUEL CELL COOLING

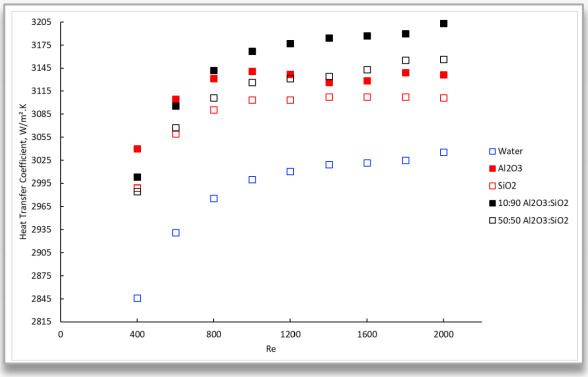


Heat transfer fluids play a crucial role in optimizing thermal management in various applications. The primary purpose of a heat transfer fluid is to facilitate the efficient transfer of heat from one location to another. Nanofluids are fluids consisting of base fluid and nano-sized particles with sizes less than 100 nm suspended within them. Base fluids can be water, ethylene glycol mixture, propylene glycol mixture, or engine oil. The engineered nanofluids significantly alter the base fluid's properties in terms of heat transfer enhancement.

Several thermo-physical properties works have been conducted on mono-Al_2O_3 and mono SiO_2 in various base fluids, including water, water: Ethylene Glycol, and water: BioGlycol. The reported properties are mainly thermal conductivity, dynamic viscosity, and electrical conductivity. The mono-Al_2O_3 and mono SiO_2 were then combined based on volume ratio to form hybrid Al_2O_3:SiO_2 nanofluids. The volume ratio of 10:90 in water showed the highest enhancement in thermal conductivity as compared to its Mono Al_2O_3 and SiO_2, with an enhancement percentage of 3.53% and 3.95%, respectively. In terms of electrical conductivity (EC), the addition of hybrid (Al_2O_3:SiO_2) nanofluids in BioGlycol, which is derived from corn, has suppressed the EC base fluid 60:40 W:BG by 24% lower. This is favourable for an electrically active heat transfer application, which requires a minimum value of electrical conductivity property.



Temperature Contour at Re 600 for Serpentine Cooling Plate



Effect of nanofluids to heat transfer performance

Various research studies have been conducted to adopt the technology of nanofluids as a cooling medium. The Proton Exchange Membrane Fuel Cell (PEMFC) is among the applications studied. The PEMFC is a greener alternative to internal combustion engines (ICE) due to its higher efficiency of up to 60 % compared to ICE of 25 %. The PEMFC utilizes electrochemical reactions of pure hydrogen and oxygen from the air to produce electricity to power vehicles and machinery. Aside from electricity, the PEMFC output is merely heat and water. It contributes to global climate change by reducing greenhouse gas emissions and promoting environmental sustainability. Hybridizing 10:90 Al_2O_3:SiO_2 nanoparticles in a PEMFC single cooling plate can increase the heat transfer by 5.52 % compared to the base fluid. However, further work needs to be done mainly on the effect of an increase in viscosity value, which in turn increases the pumping power requirement and also the compliance to the strict limit of 5 µS/cm for its electrical conductivity value.

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