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Investigation of Particle Size Effect on Thermal Conductivity Enhancement of Distilled Water-Al2o3 Nano Fluids

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Abstract

Nano fluids are dispersions of high thermal conductivity nano particles during a base fluid, and offer potential to enhance thermal conductivity of it. Literature data on the effect of particle size on the thermal conductivity enhancement of nano fluids are inconsistent and limited. Hence within the present study, the effect of particle size on thermal conductivity enhancement of distilled water- Al_2O_3 nano fluid has been investigated experimentally using transient hot wire apparatus. The particle volume concentration of Al_2O_3 nano particles for mean diameter of 15 nm and 60 nm are varied between 0.1 and 3%. The enhancement within the thermal conductivity is approximately 22% and 17% for 15 nm and 60 nm particle size respectively, at 3% particle volume concentration at 30°C. These experimental results are according to the predictions from the Brownian movement based model, show that the enhancement within the thermal conductivity of the distilled water- Al_2O_3 nano fluid decreases with a rise within the particle size.

Keywords: Transportation • Power • Generation • Defense • Nuclear • Space • Microelectronics • Biomedical Devices

Introduction

Nano fluids are a replacement generation fluids synthesized by suspending nanometer-sized materials (nano particles, nano fibers, nano tubes, nano wires, nano rods, nano sheet) within the conventional base fluids. Nano fluids possess immense potential to enhance the warmth transfer rate and energy efficiency in several thermal engineering application areas including vehicular cooling in transportation, power generation, defense, nuclear, space, microelectronics and biomedical devices.

Several researchers have studied the effect of particle size on the thermal conductivity enhancement of nano fluids. A number of the investigations are briefly summarized here. Xie et al., Measured enhancement within the thermal conductivity of ethylene glycol-Al_2O_3 and pump oil-Al_2O_3 nano fluids employing a transient hot wire method. Five different sizes of Al_2O_3 particles (~12-302 nm) are utilized in the study. Timofeeva et al., Have observed that the water–SiC nano fluids with larger particles of an equivalent volume concentration provides higher thermal conductivity enhancement than those with smaller particles thanks to smaller solid/liquid interfacial area of larger particles. In contrast, several theoretical and experimental studies have shown significant increase within the thermal conductivity enhancement with decrease within the particle size, attributed to Brownian movement. It shows inconsistency within the literature data. Hence within the present study, effect of particle size on thermal conductivity enhancement of water-Al_2O_3 nano fluid is investigated experimentally.

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