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Convective Heat Transfer Performance of SiO_2/BN Hybrid Nanofluids in Minichannel

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Extended Abstract

As energy needs worldwide increase, higher emphasis is placed on research into maximizing efficiency in power conversion processes, with the end goal of extracting the highest possible performance out of existing technologies while novel concepts are developed and built. Nanofluids are a class of working heat transfer fluids that have been the subject of intensifying research due to their enhanced thermophysical properties and numerous applications [1]. Within nanofluids, hybrid nanofluids are synthetised by suspending two or more nanoparticles into a base fluid and offer the possibility of customizing the physical properties of a heat transfer fluid by combining multiple nanoparticles in a certain ratio. Research into hybrid nanofluids shows that while they do not outclass the thermophysical properties of mono nanofluids, they still offer an appreciable improvement to the thermophysical capabilities of heat transfer fluids [2]. However, the use of nanofluids in heat transfer systems and equipment is not without drawbacks, as nanofluids are inherently unstable and can cause sedimentation and corrosion in piping, as well as requiring higher pumping power to circulate due to higher viscosity.

This study reports the experimental evaluation of the convective heat transfer characteristics of SiO_2/BN hybrid nanofluids dispersed in a DW base fluid, with nanoparticle concentrations in the range of 0.01-0.05 vol.%. The heat transfer coefficient (HTC) and Darcy-Weisbach friction factor for this hybrid nanofluid are determined using data from tests conducted on an experimental rig. This data is used to perform a comparative analysis and to identify the optimal concentration and nanoparticle ratio for forced convective heat transfer applications. A maximum HTC enhancement of 51.3% was recorded for a hybrid nanofluid with 0.04 vol.% nanoparticle concentration and (50/50) SiO_2/BN nanoparticle ratio, with a 20.4% average HTC increase for a sample set of 15 samples. A friction factor increase of up to 14.9% was observed in a nanofluid with 0.05 vol.% nanoparticle concentration, with an average increase of 2.9% for all samples.

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