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Author: Mr. Haider Ali Khan
Khalifa University of Science and Technology (KUST), United Arab Emirates, 100059680@ku.ac.ae

Dr. Afshin Goharzadeh
Khalifa University of Science and Technology (KUST), United Arab Emirates, afshin.goharzadeh@ku.ac.ae
Dr. Firas Jarrar
Khalifa University of Science and Technology (KUST), United Arab Emirates, firas.jarrar@ku.ac.ae

DESIGN OF AN INNOVATIVE MAGNETIC-NANOFLUID HEAT PIPE FOR SPACE APPLICATIONS

Abstract

CubeSat power density is continuously growing, resulting in thermal hotspots that can be detrimental to the space mission. The magnetic-nanofluid heat pipe could be a passive solution to improve the heat transfer of electronic components working in harsh space environment. The objective of this study is to design an innovative heat exchanger to enhance the heat transfer in small satellites. The effect of a magnetic field on the heat transfer characteristics of magnetic-nanofluid flow, travelling in a heated copper pipe, is investigated both experimentally and numerically. A single-phase ferrofluid travels through the heated copper pipe under an applied magnetic field. For a constant Reynolds number of Re=73, the magnetic flux density varies from 0-1080G and the corresponding heat flux is quantified using temperature measurements. The experimental results are validated using a CFD model. It is observed that the use of external magnetic field enhances the heat transfer inside the copper pipe. The external magnetic field generates micro-vortices in the ferrofluid flow, which disturb the velocity distribution, improve the flow mixing, and therefore increase the convective heat transfer.