Paper ID: 59415
student

IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Fluid and Materials Sciences (2)

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INVESTIGATION OF GRAVITY EFFECTS ON ELECTRICALLY DRIVEN LIQUID FILM FLOW BOILING: A MICRO-GRAVITY FLIGHT CAMPAIGN IN PREPARATION OF ISS EXPERIMENT

Abstract

As modern electronics develop, electronic devices become smaller, more powerful, and they are expected to operate in increasingly complex configurations. Consequently, advanced thermal management technologies are required to meet the growing demand, especially in the environment of space where two-phase systems are limited by the absence of gravity. Electrohydrodynamic (EHD) and dielectrophoretic (DEP) forces can be used to sustain stable liquid film flow boiling in the absence of gravity, which is otherwise impractical, due to the lack of a required buoyancy force to initiate bubble departure. This study investigates the effect of EHD coupled with DEP on liquid film flow boiling during a microgravity parabolic flight, and it characterizes the future two-phase microgravity heat transport technology prior to testing on the International Space Station (ISS). The results of this study show that EHD raises critical heat flux, lowers heater operational surface temperature, and successfully sustains boiling in microgravity all at a cost of low power consumption. This study paves the way for future implementation of two-phase heat transport devices into space and aeronautical electronics applications.