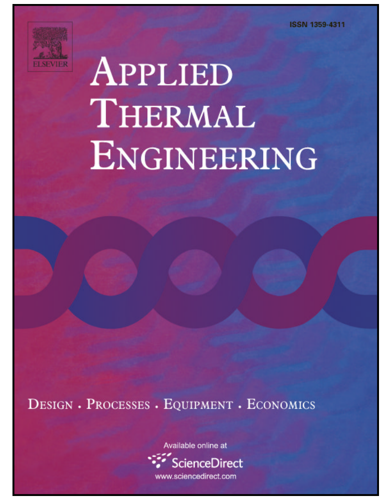

Combined Effects of Heat Input Power and Filling Fluid Charge on the Thermal Performance of an Electrohydrodynamic Axially Grooved Flat Miniature Heat Pipe

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Abstract

A numerical model for an ElectroHyDrodynamic (EHD) axially grooved Flat Miniature Heat Pipe (FMHP) is developed. The mass, momentum and energy balance equations as well as the Laplace-Young equation, which is modified in order to take into account the action of the electric field on the liquid-vapor interface, are written. The model is able to predict the liquid evolution along the FMHP as well as the velocity and the pressure variations in the liquid and vapor phases. Under the action of the electrical forces, the liquid is removed from the condenser to the evaporator preventing the flooding and the dry-out phenomena, respectively in theses sections. Also, it is found that the electric field decreases the liquid velocity and it hardly affects the vapor velocity. Moreover, it increases the vapor pressure drop, and it decreases the liquid pressure drop. The capillary driving pressure is also diminished since the EHD pumping becomes responsible of the condensate flow back to the evaporator. The dimensions of the grooves and the fluid charge affect considerably the hydrodynamic parameters in the presence and the absence of the electric field. The optimum dimensions and the fluid fill charges are identified. The analysis of the electrical forces shows that the dielectrophoretic forces which act on the liquid–vapor interface are predominant and their order of magnitude is much higher than the Coulomb forces.

Key Words: Flat miniature heat Pipe, Electrohydrodynamic (EHD), Capillary pumping, Grooves, Electric field, Electronics Cooling

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