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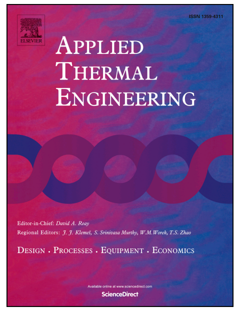

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A model-based approach for analysis of working fluids in heat pipes

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Abstract

Heat pipes (HP) are efficient heat transfer devices, utilizing a working fluid to transfer heat based on evaporation and condensation. To make HPs even more efficient, one viable approach is to modify the utilized working fluid thermophysical properties. In this paper, a simple yet effective method based on dimensional analysis, leading to a reduced-order model, is proposed to analyse and modify working fluids thermophysical properties and to predict the impact of working fluid modification on thermal resistance of a trapezoidal micro-grooved heat pipe. A validated one dimensional mathematical model based on a semi-analytical hydraulic approach is used to estimate the reduced-order model parameters. Alternatively, experimental data can be used for estimation of the reduced-order model parameters. The reduce model is further used to analyse and quantify contribution of each of the thermophysical properties of working fluid on heat pipe thermal resistance. The simplified reduced-order model yielded a dimensionally reduced form of the numerical model which revealed constant thermal resistance contours. In addition, the reduced-order model successfully predicted the performance of the heat pipe when filled with different working fluids. It is also found that high thermal conductivity, low surface tension, low latent heat of evaporation, high viscosity, and low liquid density are the most favourable thermophysical properties of the working fluid leading to improvement of heat pipe thermal resistance, respectively. The proposed method for working fluid

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