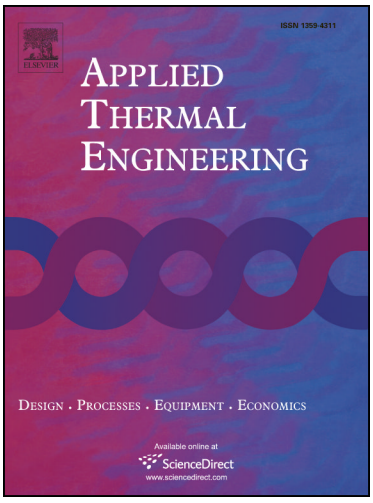

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Enhanced thermal performance of micro heat pipes through optimization of wettability gradient

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Abstract

The use of wettability gradients has emerged as a promising method of enhancing the heat transfer capacity of micro heat pipes (MHPs). In this approach, a wettability gradient is created on the inner surface of an MHP such that the contact angle increases from the evaporator to the condenser section. Previous studies have shown upto 30% enhancement of thermal performance of MHPs by considering step-wise and linearly varying wettability gradient. However, previously chosen wettability gradient did not give the best possible performance as these wettability gradients were chosen arbitrarily. In this work, we perform a formal mathematical optimization of wettability gradient to show over 90% enhancement in the heat transfer capacity of the MHP under the constraints of maximum and minimum value of the contact angle. The MHP with optimal wettability gradient has uniformly high wetting evaporator and uniformly low wetting condenser. The primary gradient in wettability lies in the adiabatic section. We also show that the optimal wettability gradient is almost independent of the fluid charge. Lastly, we explain the physical mechanism underlying the enhanced thermal performance of the MHP with optimal wettability gradient.

Keywords: micro heat pipe, mixed wettability, optimization, surface treatment, heat transfer enhancement.

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