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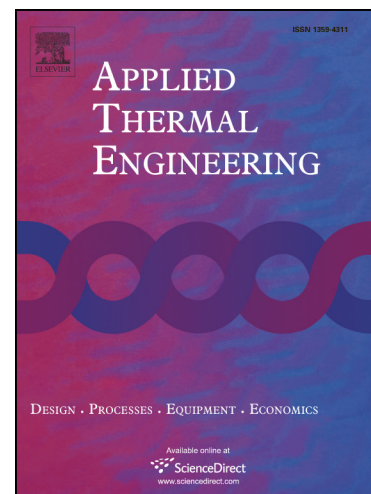
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Natural Convection in a Cross-Fin Heat Sink

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Abstract

A novel cross-fin heat sink consisting of a series of long fins and a series of perpendicularly arranged short fins was proposed to enhance natural convective heat transfer. The design principle of the cross-fin heat sink was based on overcoming internal thermal fluid-flow defects in a conventional plate-fin heat sink. The thermal performance of the proposed heat sink was compared with a reference plate-fin heat sink in horizontal orientation. A numerical model considering both natural convection and radiation heat transfer was developed to obtain thermal fluid-flow distributions and heat transfer coefficients of both the cross- and plate-fin heat sinks. Corresponding experiments were performed to validate the model predictions. It was demonstrated that, compared to the reference plate-fin heat sink, the cross-fin heat sink enhanced the overall (including natural convection and radiation) and convective (excluding radiation) heat transfer coefficients by 11% and 15%, respectively. Importantly, the enhancement was achieved without increasing the overall volume, material consumption, and too much extra cost. The proposed cross-fin heat sink provides a practical alternative to the widely adopted plate-fin heat sinks.

Keywords: plate-fin heat sink, cross-fin heat sink, natural convection, heat transfer enhancement

Nomenclature

A_{sub}	base area of substrate (m^2)
h_{ovl}	overall heat transfer coefficient (W/m^2K)
h_{con}	convective heat transfer coefficient (W/m^2K)
Q_{rad}	radiative heat transfer rate (W)

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