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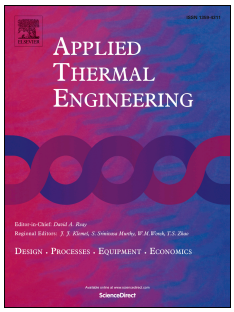


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# Stepwise varying width microchannel cooling device for uniform wall temperature: Experimental and numerical study

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## Abstract
Within the high heat extraction cooling technologies, stepwise varying width microchannel cooling schemes have demonstrated their capacity to provide high temperature uniformities with low pressure drops. In this study, a method to tailor the design of this kind of cooling device to the needs on an application is developed. The resulting geometry is experimentally tested. A global thermal resistance coefficient of $2.35 \cdot 10^{-5}$ $m^2 \cdot K/W$ has been found, improving near three-fold the performance in a millimetrical scale for the same flow rate. The temperature profile of the wall temperature is quite uniform, validating the design of the cooling device. A numerical model is developed and validated through comparison with experimental results. It shows the smoothing effect of the Thermal Interface Material (TIM) on the temperature profile and the improvement of both the thermal resistance coefficient and the temperature uniformity with the increase of the flow velocity.

## Keywords
Microchannel; temperature uniformity; cooling device; CFD modelling

## Highlights
- A design procedure of a cooling device in micrometrical scale has been developed.
- Thermal resistance coefficient is near three times lower than at millimetre scale.
- The stepwise varying width microchannel scheme provides high temperature uniformity.
- The TIM layer causes a smoothing of the temperature distribution.

## 1. Introduction

The operation of most semiconductor devices is sensitive to temperature, so thermal management strategies are of increasing importance as chips achieve higher power