Public Abstract
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Graduation Term:FS 2016
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Degree:MS
Title:Enhancement of the cooling performance of microchannel heat sinks

In this report, four different strategies to enhance the cooling performance of a micro pin fin heat sink are investigated and their effect to improve its cooling efficiency are examined. The employment of nanoparticles and nano encapsulated phase change materials (NEPCM) suspensions, as advanced coolant slurries, are the first and second strategies which are investigated. Cooling systems that are improved by utilization of these advanced coolants (individually or combination of the advanced coolants in a two layer contourflow micro-channel heat sink) are modeled and examined and based on the obtained results, a significant potential to improve the cooling performance of the heatsinks is observed. Introducing tip clearance to the fins of a heatsink is the third considered technique in which a range of tip clearance values are introduced to a heatsink and the cooling performance enhancements are compared. Based on the results of the modeling of the heatsinks with different tip clearances, if the tip clearance value is selected and designed appropriately, it can boosts up the cooling efficiency of the system, potentially. The last part of this thesis is about investigation of the possibility of using carbon nanotubes (CNTs), as one of the most thermally conductive materials, as the solid body of the heatsink. Using CNTs, one can build very hydrophobic surfaces which may be used as the coolants flow path. However, one of the main obstacles, which needs to be tackled, is the limitations on generating accurate 3D shape structures from CNTs. In this thesis, a new electron beam irradiation based technique to control the final shape of the CNT arrays is proposed and characterized and the effective parameters such as chamber pressure, irradiation current and etc. are investigated and the most efficient setting to provide the best cutting rate is realized. In introduction section, an overview of the thesis report is given and then in each of the chapters 2-5, one of the above mentioned techniques including: using NEPCM slurry advanced coolants, using pin tip clearance, using nanoparticles suspensions, an accurate machining techniques for CNT arrays, are investigated and presented. The three first chapters are based on the 3D conjugated heat transfer models of the heat sinks and the last part of the thesis reports the experimental results of the proposed technique. Results obtained and reported in each of the chapters 2-5 of this thesis are submitted to accredited journals and until now, one is published and three are still under review.