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Heat Transfer Analysis of Microchannel using Fluids

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Abstract **- In recent time due to high performance of electronic component the heat generation is increasing drastically. Due to this scenario heat dissipation becomes a major issue in efficiency promation and stable operation.**

Silicon based microchannel heat sink fabricated using semiconductor production technique plays important role in cooling devices. The effect of the thermophysical properties of working fluids on the performance of microchannel is tested or we can say investigated. For this purpose the different working fluids are selected. water, hepthane, ammonia, methanol, and ethanol.

Keywords- Heat transfer, Micro channel, different coolents, natural convection, heat transfer, heat sink, , cooling, micro heat sinks.

I.INTRODUCTION

Now a days the electronic devices become compact. Due to compactness of this devices there is huge heat generation in this devices. Hence for the safety purpose heat should be remove from this devices continuosly.so the purpose of cooling system is to maintain the temperature in certain limit such as

1) Natural cooled heat sink
2) Forced cooled heat sink
3) Superconducting Radiators.

All these conventional cooling systems are usefull when heat dissipation rate isbellow 100w/cm² but when this rate becomes more than 100w/cm²then these conventional cooling system fails to cool the devices. For cooling purpose of this devices. Micro channel heat sink are used.

Microchannel heat sink was first introduced by Tuckerman and Pease in 1981 later on lots of research work has been carried out on micro channel. a specially to increses performance of microchannel heat sink. microchannel has high heat transfer co-efficient and less thermal resistance this is the main advantage of the microchannel heat sink. Microchannel heat sinks are widely regarded as being among the most effective heat removal techniques for space-constrained electronic devices.

II..LITERATURE REVIEW

Aly M. A. Soliman et all state that In the study, an experimental investigation to the performance of the solar cells coupled with heat sink is presented. Indoor experimental setup was designed and assembled to investigate the impact of using heat sink cooling system on the performance of solar cells. Halogen lamps used to simulate the solar radiation and the study is carried out at different solar radiation values. Moreover, the study is carried out at natural and forced air to cool the heat sink. The results show that using heat sink cooling system enhances the performance of the solar cell. Temperature of solar cell decreased by about 5.4 % and 11 % by using heat sink cooling system at natural and forced air over the heatsink, respectively. Moreover, the efficiency and power of the solar cell system increase by about 16 % when heat sink cooling system is used.[1]

Mushtaq I. Hasan et all state that In this paper using of the phase change materials (PCMs) in a micro-channel heat sink (MCHS) is numerically investigated. The air is first used in heat sink and then four phase change materials (paraffin wax, n- eicosane, p116 and RT41) have been used as cooling mediums in different types and different configurations at different ambient temperatures. Constant heat flux is applied on the base of heat sink and mixed (convection and radiation) boundary condition is applied at the top surfaces of heat sink. The results showed that, using of the phase change materials in micro-channels heat sink with different configurations lead to enhance the cooling performance of micro heat sink. The phase change material should be selected according to its melting temperature according to the certain application as different phase change martials caused different values of reduction in heat sink temperature in range of ambient temperature due to difference in melting temperatures of PCMs. The cost of materials depends on the classification of the PCM (organic and inorganic) and quantity of PCMs used in a certain application.[2]

Afzal Husain, Kwang-Yong Kim et all state that The present study deals with the numerical optimization of microchannel heat sink with the help of surrogate analysis and evolution- ary algorithm. Two design variables related to the microchannel depth, width and fin width are chosen and their ranges are decided through preliminary calculations of three-dimensional Navier–Stokes and energy equations. Objective functions related to the heat transfer and pressure drop i.e,thermal resistance and pumping power are formulated to analyze the performance of the heat sink. Water with temperature dependent thermal properties is used as coolant for steady, laminar fully developed flow in the silicon microchannels. Using the numerically evaluated objective function, polynomial response surface is constructed for each objective function. Evolutionary algorithm for multi objective optimization is performed to obtain global Pareto optimal solutions. Trade off between objectives is found and analyzed with the design variables and flow constraints.[3]

Sunil Kumar et all state that The nanofluids have increased interest in many engineering fields due to its excellent thermophysical properties, which can be easily used in microchannel heat sinks by many roles for performance

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improvement. The purpose of this review summarizes the important published articles on the enhancement of the convective heat transfer in microchannel heat sinks using nanofluids. Numerous studies have been done to find the effect of different nanofluids flow through micro channel heat sinks on thermal performance. In this work a comparative study is also carried out to select be micro channel heat sink shapes for maximum heat transfer and minimum friction losses.[4]

III.WORKING PROCEDURE.

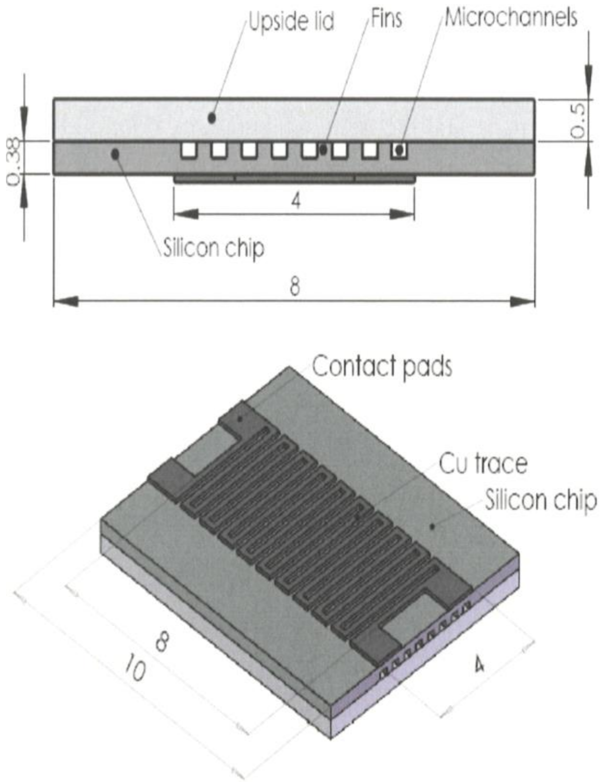


FIG. Geometrical dimensions of the microchannel

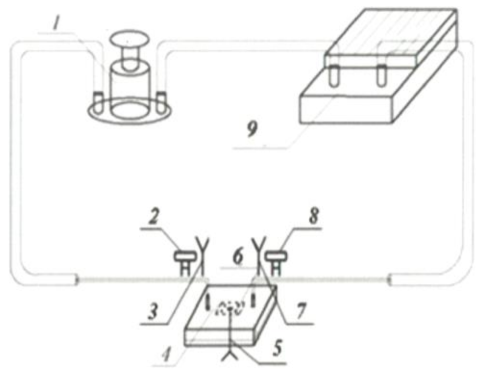


FIG. Schematic view of the experimental facility: 1minipump, 2-inlet pressure Gauge, 3- inlet thermocouple, 4,5,6-test module, 7-outlet thermocouple, 8-outlet pressure gauge, 9-fan system.

It consist of following devices mini pump, inlet pressure gauge, inlet thermocouple, test module, outlet thermocouple, outlet pressure gauge and the fan system.

- First we have to turn on the heater.
- After turning on the heater we have to set a measurement of current and voltage by using the multimeter.
- The working fluids which are stored in reservoir are allowed to pass through a microchannel one by one.
- Then the reading are taken through a test module.

IV. PROPERTIES OF WORKING FLUIDS.

1.WATER

- Warm water vibrates longer than cold water.
- The thermal conductivity of water is high and rises to a maximum at about 130°C.
- Water has unusually high viscosity.

2. ETHANOL

- Ethanol is colourless liquid with the pleasent smell.
- It is completely miscible with water and organic solvents and is very hydroscopic.

3. METHANOL.

- Methanol appears as a colorless fairly volatile liquid with a faintly sweet pungent **odor** like that of ethyl alcohol.
- Completely mixes with **water**. The vapors are slightly heavier than air and may travel some distance to a source of ignition and flash back.

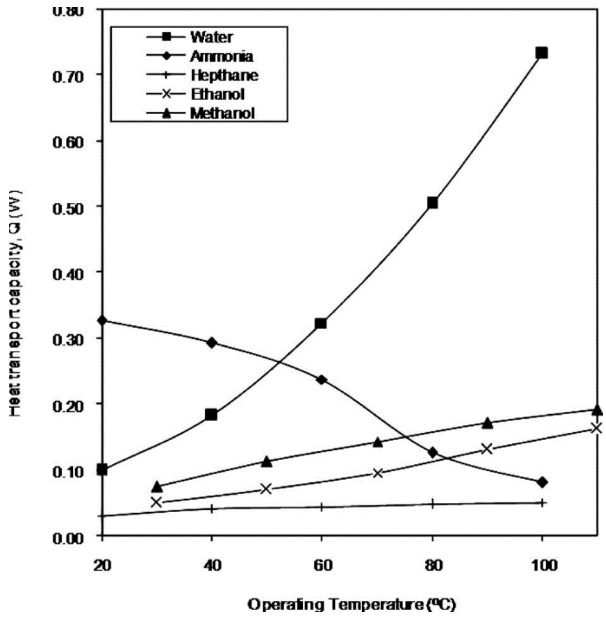
4. AMMONIA.

- Ammonia is a **colourless** gas with a characteristically pungent **smell**.
- It is lighter than air, its **density** being 0.589 times that of air.

V.RESULT & DISCUSSION.

The heat transfer capacity as the function of the operating temperature and the test module is filled with the different working fluids.

And they observed the heat transfer capacity of these different working fluids. We also observed that except the water other four working fluids shows that, when the operating temperature increases in the heat transfer capacity also increased. And in case of water as the operating temperature increases the heat transfer capacity is rapidly increases. So we can say that the water can gives the best result than the other working fluids. The following graph can shows the operating temperature varies with the heat transfer capacity.



VI.CONCLUSION

Microchannels are capable of removing heat up to 1000w/cm^2 due to their high thermal conductivity.

It is clearly seen that for operating temperatures below 50°C, it is more advantageous to use ammonia as the working fluid to maximize the heat transport capacity.

When we used water as fluid we can conclude that ,as the temperature increased the heat transfer capacity of water is increased.

water is preferable if the operating temperature is higher than 50°C. According to that we can say water can gives good or better result than any other working fluids.

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