

Research Proposal

1. **Title of the Research Proposal:** Fluid and thermal analysis on flow boiling in micro channel coated with diamond micro particle.
2. **Broad Subject area/field of classification:** Flow Boiling in micro channels
3. **Broad objectives of the project:** Develop an experimental setup capable of estimating the heat transfer coefficient and flow visualization in a micro channel coated with diamond micro particles.
4. **Applications/Socioeconomic importance:** There is an ever-growing need for high heat flux removal for thermal management of electronic devices or chips. Flow boiling in micro channels is one of the promising liquid cooling technique for high heat flux removal
5. **Abstract**

In electronics industry due to miniaturization of the components with faster processing there is a need to design heat transfer equipments which can transfer large amount of heat within small area. In such situations micro heat exchangers comes into play. In this field micro channels are gaining popularity due to its high convective heat transfer coefficient (Typical values ranges from 5000 to 20000 W/m²k) without using much amount of space. In this Phd project work I am planning to manufacture a micro channel which is coated diamond micro particles and its performance is compared with that of ordinary micro heat exchanger. Diamond micro particles has high thermal conductivity and increased area for heat transfer which helps to increase the net heat transfer rate when compared to that of ordinary micro channel.

6. Literature Review

Although the heat transfer coefficients are quite high in single phase flow with small diameter channels, flow boiling yields much higher values. For example, the single-phase heat transfer coefficient under laminar flow of water in a 200 μ m square channel is around 10,000 W/m²°c, whereas the flow boiling heat transfer coefficients can exceed 100,000 W/m²°c (Steinke and Kandlikar, 2004) [1]. In other words, larger channel diameters can be implemented with flow boiling at comparable or even higher heat transfer coefficients than single-phase systems. This feature becomes especially important in view of the filtration requirements to keep the channels clean. Qu and Mudawar showed that by using two phase flow mechanism for cooling purpose it is able to maintain uniform temperature throughout the surface and also enhances the heat transfer rate [2]. Vikash Khanikar et al. coated carbon nano tubes on the micro channel surface due to its high thermal conductivity and its ability to initiate and maintain the nucleate boiling process [3]. They also observed a higher heat transfer coefficient and reduction in incipient of boiling superheat temperature.

References

1. *Mudawar and D. E. Maddox, Critical heat flux in subcooled flow boiling of fluorocarbon liquid on a simulated electronic chip in a vertical rectangular channel, hl. 1. Heal MQSS Transfer, Vol. 32, No. 2, pp. 379-394, 1989*
2. *W. Qu, I. Mudawar, Measurement and correlation of critical heat flux in twophase micro-channel heat sinks, Int. J. Heat Mass Transfer 47 (2004) 2045–2059.*
3. *Vikash Khanikar, Issam Mudawar , Timothy Fisher, Effects of carbon nanotube coating on flow boiling in a micro-channel, International Journal of Heat and Mass Transfer 52 (2009) 3805–3817.*

12. Particulars of equipment required

SL NO	FACILITY	REMARKS
1	Pressure sensor	2.set (inlet and outlet)
2	Micro channel test cell (with and without diamond micro particle coating) , Glass cover slip, piping, pump, thermocouples & insulation	Test cell to be fabricated according to required dimension
3	Water Bath	1.nos
4	Cartridge heater	3 Nos
5	Thermocouple	10 Nos
6	Flow meter	1 Nos
7	Digital wattmeter, voltmeter, ammeter	1no (1 each)