

# A Review Types of Enhancement Technique for Application and Effect in Design Microchannel Heat Sink

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**Abstract** - On today, the need of better cooling devices also keeps to further enhance the performance with continuous miniaturization of electronic components, then two techniques are used, active and passive methods.

The passive techniques do not depend on an external force or activation therefore; these technologies do not have no additional energy costs. Several active technologies have been identified as micro channel optimization possibilities. Require the force and power that must make a small system there is a difficulty in carrying it out.

These prompt a design procedure in various passive methods and their geometrical parameters, while at the same time maintaining the pressure drop at the desired level. Here are several parameters that analyzed in detail. Work for better heat transfer including nanoparticles,

Where it is very important to know the behavior of nanofluids at different concentrations has become a new coolant in the cooling system.

**Keywords:** microchannel heat sink, Active technical method, passive technical method, Heat transfer enhancement.

## I. Introduction

The improvement of heat transfer processes is one of the important conditions for achieving modern engineering research, as the rapid increase in research activities and manufacturing methods focuses on the use of new methods with high heat transfer efficiency.

When using a heat sink to increase the heat transfer area and cooling system in electronic chips.

So by using efficient technologies thus to get higher cooling this can be used in various applications to reduce the weight, size and cost of the heat exchanger.

Several things will be clarified, including basic concepts and terminology for understanding fluid flow, as several studies previously presented were considered in the same context as our research as well as the passive methods used and discussed in the paper on our topic and how they affect

the optimization technique for understanding flow behavior induced heat transfer and the value of the Reynolds number for any fluid, whether base fluids or nanofluids.

## II. Heat Transfer Enhancement Techniques in Microchannel

Microchannel heatsink performance with technologies It increased the cooling efficiency as it was classified into two groups, Positive and negative methods.

Much of the literature emphasizes passive rather than active style in increasing the performance of a small heatsink due to the large area and lower cost due to the simplicity in design [1]. Most researchers used the negative method heavily

Because there is no moving part compared to the active method and it does not need an external force [2].

(Fig. 1) illustrates the techniques in Active and a single-phase passive method in microchannels available in the open literature [3].

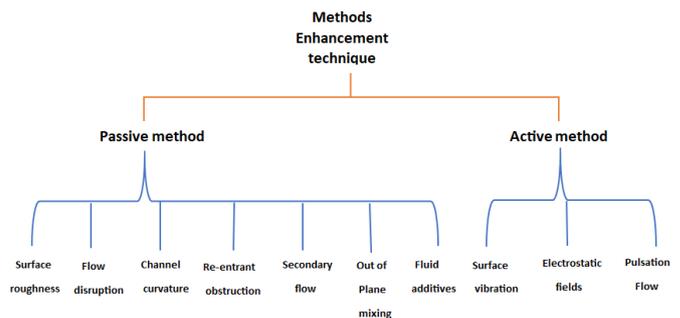


Figure 1: Different methods of Heat transfer enhancement techniques for MCHS [3]

### 2.1 Passive Enhancement Techniques for Microchannels

Often passive techniques method consists of modifying or adding structures to the inner duct to extend the surface or increase coolant flow [4].

#### 2.1.1 Surface roughness

Rough surface ducts are essential in the field of passive heat transfer enhancement technologies. The volume of vortex

flow formation is affected by its higher roughness, as the greater the volume of vortex flow generation, the worse heat transfer [5].

According to Moody's study [6], when the surface roughness of the channel wall is less than 5% (which is the ratio between the surface material roughness and the hydraulic diameter), there is no noticeable effect on the laminar flow in the channel. Rough surfaces increase heat transfer and so do fins' effects on the roughness scale. In large channels, the surface roughness has little effect on laminar flow. In fine channels, it has a good effect on laminar flow [7].

Dai et al. [8] performed a review of 33 papers and 5569 experimental data and determined that for relative roughness less than 1% and channel cross-section shapes, they do not affect the friction factor and Reynolds number.

The researcher [9] the experiment investigation on 2 simulation nuclear fuel rods with 2 different types of outer surfaces roughness. the first have two dimensions surface roughness [square transverse ribbed surface] and the second three-dimensional surface roughness [diamond shaped blocks], while the diamond shaped surface roughness have higher heat transfer coefficient than ribbed surface roughness.

Steinke and Kandlikar [10] revealed that the effect of surface roughness ( $\epsilon$ ) in their studies increased the Nusselt number, friction factor, and transmission rate.

Candlekar et al. [11] Two stainless steel tubes were used. The surface roughness of the inner tube with a diameter of 0.62 mm is changed by etching it with an acid solution. According to their findings, the effect of surface roughness on heat transfer and pressure drop for the outer tube diameter was 1.067 mm.

The heat transfer properties of rectangular [12] and circular [13] microchannels have been studied experimentally. Both of them agreed that the improvement of heat transfer in the small channels is better with the presence of roughness.

Lu et al. [14] conducted a study of the effect of a relative surface roughness of up to 2% on the flow and heat transfer properties. In their study, the Reynolds number was determined to be 500 and with a heat flux ( $q$ ) of 0.5 W/mm<sup>2</sup> supplied, pressure drop increased by 3%, 5.3%, 5.9%, Nusselt number increased by 10%, 6.5%, 19.8% in the channels square, corrugated and dimpled respectively.

### 2.1.2 Flow disruption

Several strategies to modify the flow channels instead of the straight channel have been proposed to enhance the instability of the flow and improve the forced convection

performance of the microchannels, including wavy, zigzag, cross-linked, and re-entrant microchannels.

The enhancement of heat transfer in MCHS was investigated by Xie et al. [15] The use of different straight meniscus protruding from the bottom wall, concave meniscus ribs in the direction of the stream, and convex meniscus ribs in the direction of the judicious stream to improve the thermal performance of the cooling channel. Ribs have been discovered to improve heat transfer performance by creating vortices.

Wang et al. [16] suggested a high-performance MCHS with bidirectional ribs that are made up of vertical and spanwise ribs, as shown in Fig. (2). and the results showed that the Nusselt number of the microchannel with bidirectional ribs is up to 1.4–2 and 1.2–1.42 times that of the microchannels with vertical and spanwise ribs, respectively.

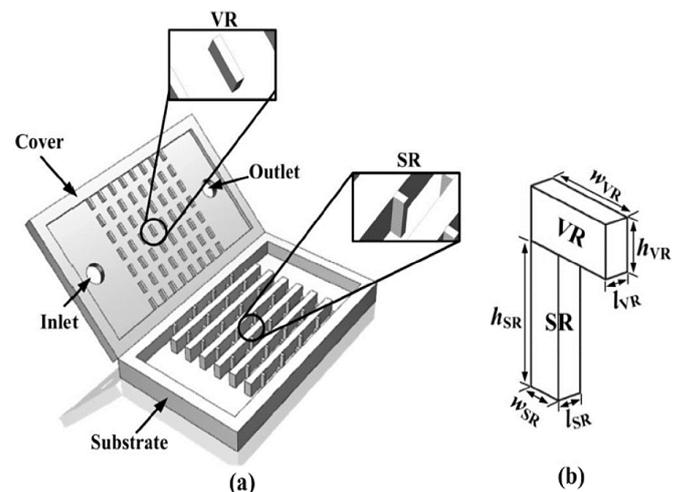


Figure 2: Schematic of (a) the MCHS with bidirectional ribs and (b) bidirectional rib geometry [16]

Wang et al. [17] performed parameter optimization for MCHS with single and double-row oblique rectangular polygons. The optimization result revealed that the MCHS with oblique rectangular ribs provided the best thermal performance with angle of 52.5°, a relative height of 0.3, a relative length of 1, and a relative width of 0.1.

Ali et al. [18] studied the thermo-hydraulic properties numerically of a MCHS with a trilobite rib. These ribs are fixed to the central line of the different walls of the small canal in three different configurations, namely the three-lobed ribs of the primary wall, the lateral trefoil ribs, and all three-lobed ribs, as shown in Fig. (3). The findings revealed that trefoil ribs at wall improved heat transfer characteristics at the expense of increasing the pressure drop with all wall trefoil ribs has superior heat transfer capability.

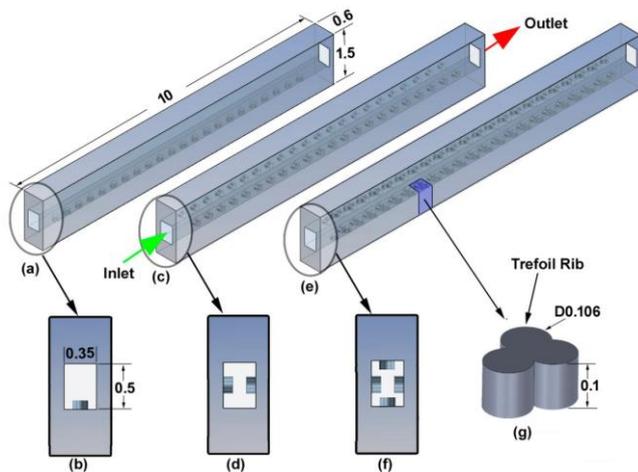


Figure 3: (a,b) base wall trefoil ribs, (c,d) sidewall trefoil ribs, (e,f) all wall trefoil ribs, and (g) geometric details of trefoil rib [18]

A novel cross-rib MCHS has been presented numerically by Chen et al. [19] to make fluid self-rotate, as shown in Fig. (4). Compared with the rectangular and horizontal ribs MCHS, the cross-rib MCHS improved cooling capability by 28.6 % and 14.3 %, respectively, expense of pressure drops.

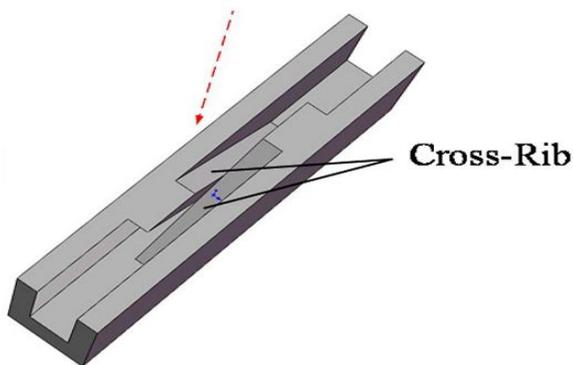


Figure 4: A basic unit model for the cross-rib MCHS [19]

Cavities or grooves are another technique in the MCHSs since they have significant effects on heat transfer enhancement. Ahmed and Ahmed [20] presented a 3\_Dimention numerical simulation of the effect of geometric parameters of triangular, trapezoidal, and rectangular grooves on laminar water flow and forced convection heat transfer characteristics in MCHS and the ones with trapezoidal grooves can offer the greatest Nu improvement of 51.59%.

Chai et al. [21–26] studied the effect of ribs on the heat dissipation capacity of the microchannel. The study found that both aligned and offset ribs can increase the heat transfer area and enhance fluid disturbance in the microchannel.

Datta et al. [27] conducted a computational study on trapezoidal grooves and various rib structures, and demonstrated that rib structure had a substantial impact on

overall thermal performance. Four rib structures were considered: rectangular, forward triangular, backward triangular and diamond. The predictions revealed that the diamond rib combination had superior thermal performance.

Zhu et al. [28] carried out numerical investigation of the influence of rectangular grooves in the sidewalls of different shaped ribs in MCHS. Four different rib configurations are explored, including rectangular, diamond, elliptic, and forward triangular ribs mounted in the centre of the microchannel. The results showed that combining grooves and ribs can significantly improve overall performance. The rectangular grooved channel with rectangular ribs provides the best performance.

### 2.1.3 Channel curvature

The Inertial dependence of particles in a curved channel has a great potential for on chip laboratory applications and here many studies have recently focused on curved microchannel due to these geometries' high thermal and improve heat transfer performance and flow performance. Flow passage curvature characteristics (such as wavy, zigzag, and serpentine MCHSs) the outperformed the straight MCHS in heat transfer. Improve heat transfer performance, Dai et al. [29] and Parlak [30] explored numerically the hydro-thermal characteristics of straight, zigzag, and wavy MCHSs. They noticed that the Nu for the wavy microchannel was 10% greater than that of the zigzag microchannel and 40% greater than that of the straight microchannel.

Lin et al. [31] examined numerically the hydro-thermal characteristics and the effect of the wavy microchannel aspect ratio with individually varying wavelength and amplitude along the working fluid flow direction. They noticed the same when the aspect ratio was reduced.

Kumar et al. [32] performed a numerical analysis of hydrothermal flow in an innovative circular wavy microchannel. They also performed numerical simulations at full amplitude (0.45 mm) a novel circular wavy microchannel ( $A = 0.45$  mm) has a 16.5% higher Nu and a lower  $\Delta P$ .

Clark et al. [33] found a new type of serpentine micromixer involving non-rectangular cross-sectional mixing units, as presented in Fig. (5). Both the new and standard serpentine micromixer designs were carried out numerically. The performance of the investigated mixers is found to outperform that of standard serpentine microchannels.

Al-Neama et al. [34] examined of three different serpentine MCHS designs using complementary experimental and numerical methods with single, double, and three path serpentine configurations. Serpentine channel curves play a

significant role in enhancing heat transport followed by the double and triple ones, both of which outperformed the conventional MCHS.

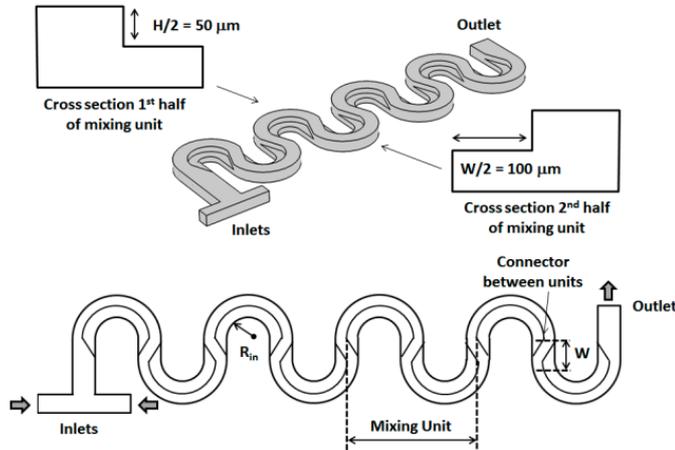


Figure 5: Three-dimensional and top views of the serpentine model with non-rectangular cross-sections. The orientation of the mixer's cross-section changes with each serpentine turn [33]

Al-Neema et al. [35] performed another experimental and numerical study using water-cooled. They optimized the serpentine MCHS using a permutation genetic algorithm to generate thirty-point Optimal Latin Hypercubes. To reduce hot spots, a 2 μm thick nanocrystalline diamond layer is placed on the top surface of the Gan HEMT and serves as a heat spreader.

Zhou and Chang [36] conducting study the hydrodynamic behavior and thermal performance flow in serpentine microchannel with various curvature ratios. The effect of sliding velocity on the hydrodynamic characteristics was performed numerically. The higher of sliding velocity, that is the greater the heat transfer.

### 2.1.4 Reentrants obstruction

[37] Investigated experimentally, triangular reentrant and fan-shaped cavities, as shown in Fig. (6). The MCHS in their study was composed of 10 parallel microchannels, when compared to the straight rectangular microchannel, the Nuavg for the suggested periodic expansion-constriction cross-sections MCHSs with triangular reentrant cavities increased by about 1.8 times with moderate ΔP.

A numerical and experimental study by Deng et al. [38] to explore the forced convective heat transfer of single-phase laminar flow on an innovative Ω-shaped re-entrant MCHS, as shown in Fig. (7). In comparison to the conventional MCHS, the suggested design improved heat transfer by 10-30%, reduced total thermal resistance (R-th) by 22%, and increased frictional factor ratios by 10% overall.

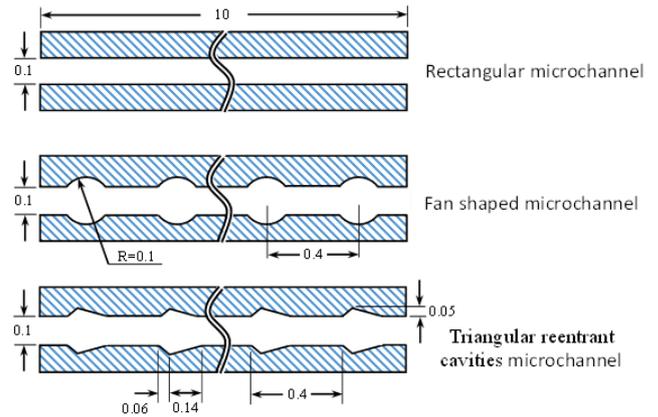


Figure (6) Straight rectangular, fan-shaped and triangular re-entrant cavities microchannels [37], all dimensions in mm

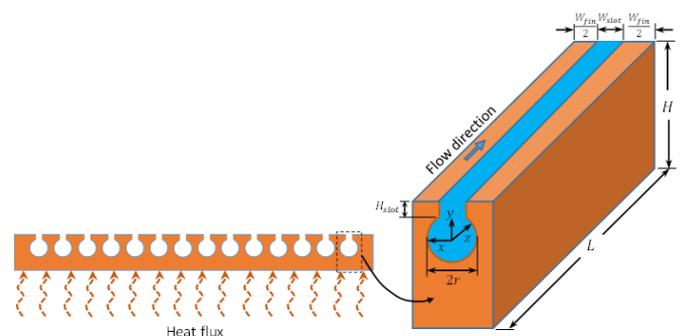


Figure 7: Schematic diagram for re-entrant microchannels [38]

MCHSs with three different re-entrant cavity shapes by Hou and Chen [39] (i.e. circular, trapezoidal, and rectangular). The MCHS with rectangular re-entrant cavities had the highest pressure drop, The Nusselt number of MCHSs was most significant for the circular re-entrant cavities this indicates performed the best heat performance followed by the trapezoidal and rectangular re-entrant cavities.

To fluid mixing and disrupt the normal development of thermal boundary layers, Chen et al. [40]. Very recently, the flow rate and concentration ratio effects on HCPV cell performance with serpentine re-entrant microchannel were explored. The serpentine re-entrant microchannel significantly reduced cell temperatures uniformity in the HCPV cell module, presenting cell temperatures of 25-31°C, much lower than the fin heat sink's 45-63°C.

A numerical study of heat transfer and fluid flow characteristics in a MCHS with double-layered staggered cavities (MCHS-DLSC) was performed by Liu et al. [41]. The results reveal that the MCHS-DLSC has a higher Nu and f than the straight channels (MCHS-SC). It has been demonstrated that the DLSC can enhance fluid mixing.

### 2.1.5 Secondary flow

Optimization of the geometric parameters of the (MCHS) with the secondary flow channel is made with the optimal goal of minimizing the pumping power and thermal resistance of the heat sink with a constant amount of water mass flow rate.

Where Saidur et al. [42], used the Secondary flow is employed (MCHS) by inserting an inclined passage in the channel wall between adjacent channels in alternate direction See fig. (8). This phenomenon reduces the average thickness of the thermal boundary layer, and thus enhances the heat transfer performance with slight pressure drop the data presented in (MCHS) simple comparison. The results showed that increases the overall performance of (MCHS) with alternating slanted passage (MASP) by 146% and increases secondary lane width thermal resistance reduced to 76.8% when compared with simple (MCHS).

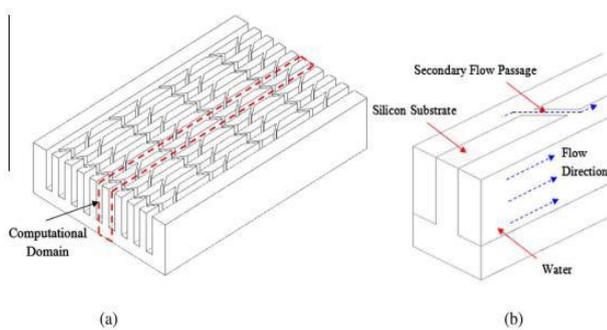


Figure 8: (a) schematic diagram and (b) detailed view of the computational domain

Ghani et al. [43], Effects of secondary channels and ribs analysis of the proposed was carried out design with related geometries such as micro channel with rectangular ribs (MC-RR) and micro channel with secondary oblique channels (MC-SOC). Alternating direction and rectangular ribs (MC-SOCRR). The Nusselt number has increased about 6–101%. The results illustrated that micro channel with forward triangular offset ribs achieved the highest performance with  $Re \leq 350$ . Meanwhile, the semi-circular ribs exhibited the maximum performance with  $Re \geq 400$  see fig. (9).

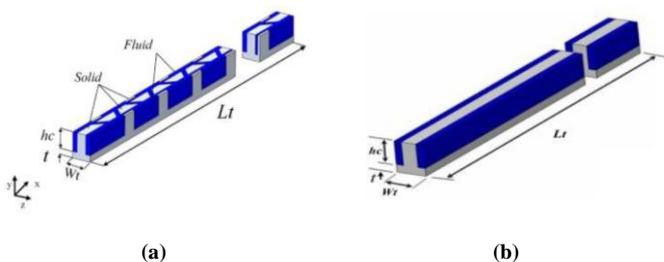


Figure 9: (a) Schematic diagram of (MC-SOCRR) and (b) Schematic diagrams of (MC-RC)

Jabar et al., [44], design of microchannel with hybrid feature such as secondary channel with the rib and triangular gravities, the result of study that added secondary mini channel with rib and gravities increases the hydrothermal performance.

Bahiraie et al. [45], This study aims to evaluate the thermos hydraulic properties of a hybrid nano fluid with the ribs and secondary channels the secondary channels increase the flow area, which decreases the pressure drop due to the presence of the ribs. Show results which combine the three methods, namely the use of nano fluids, ribs and secondary channels in the micro channel greatly improve the performance of the heat sink. A 17% enhancement happens in the convective heat transfer coefficient.

Bahiraie et al. [46], is taken an aqueous a hybrid water-based nanofluid within a micro channel heat sink with secondary channels and rectangular ribs see fig (10), while a 17% decrease in this parameter occurs as  $Re$  is raised from 100 to 500 at 0.06% concentration. Moreover, as the concentration grows and  $Re$  decreases. The lowest total entropy generation occurs at  $Re=300$  for the nano fluid and  $Re=400$  for the base fluid.

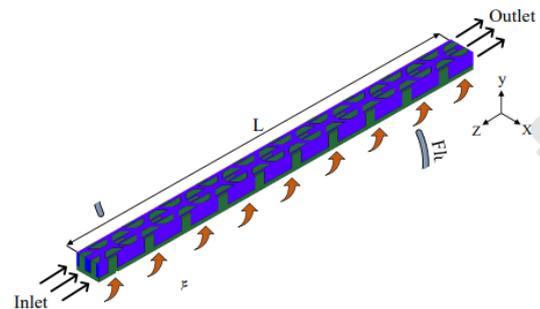


Figure 10: Schematic and geometric of secondary channels and ribs

### 2.1.6 Out of plane mixing

The fine channel that mixes liquids is called micromixer. In active mixing the fluid pumped in to the channel. In this way mixing takes place, which is also undesirable from a miniaturing point of view because the design includes moving part. In passive mixing, the shape of micromixer is designed to create flowing patterns that blend naturally. Channel walls that cause chaotic movements of fluid molecules. In this project passive mixing was studied [47].

Bondar et al., [48] studied that effect of extra\_ planar mixing of two-phase flows in microchannels they have achieved a high degree of fluid mixing this can save work. A technique being developed to increase binary fluid mixing could also be applied to the heat transfer enhancement in microchannel.

### 2.1.7 Fluid additives

The new engineering medium called nano fluid has touched upon a wide range of research on many cooling processes in applications, which are prepared by dispersing nano particles in the basic fluid. As it has a major role in enhancing heat transfer for more applications. There are several types of nano particles that differ according to their type in terms of conductivity, and examples can be taken of them.

Mohammed et al. [49], in This work discusses the effect of using different types of nanofluids such as  $Al_2O_3$ , CuO, Ag,  $SiO_2$ , diamond, and  $TiO_2$  with nanoparticle volume fraction of 2% on heat transfer and fluid flow characteristics in triangular shaped microchannel heat sink (MCHS) are made of aluminum. That it was concluded that diamond/ $H_2O$  nanofluid has the least temperature and the greatest heat transfer coefficient, reverse  $Al_2O_3/H_2O$ .  $SiO_2/H_2O$  nanofluid has the greatest pressure drop and wall shear stress.

Sivakumar et al. [50], In this experience the research the heat transfer performance of nano fluids of  $Al_2O_3$ /water and CuO/water were compared. An important feature of these fluids is the enhanced thermal conductivity, compared to the basic fluid without fundamental change in physical and chemical properties. The results also showed that CuO/water nano fluid had increased heat transfer coefficient (improved thermal benefits in MCHS) compared to  $Al_2O_3$ /water and base fluids. The experimental results also indicate an increase in forced heat transfer coefficient with the increase in nano particle concentration.

Ajeel et al. [51], Thermal and hydraulic properties with four types of nanofluids ( $Al_2O_3$ , CuO, ZnO and  $SiO_2$ ), with four different types nanoparticle volume fractions of (2%, 4%, 6% and 8%) using water as base fluid, Among the four types of nano powder tested, silicon dioxide ( $SiO_2$ ) recorded the best heat transfer enhancement followed by aluminum oxide ( $Al_2O_3$ ), copper oxide (CuO) finally zinc oxide (ZnO) nanofluids.

The nano particle behaves as an important factor in the heat transfer process, so its properties depend on it. And also, according to size, in terms of diameter, fine particles range between 100 and 2500 nm, while ultrafine particles are classified with size ranging between 1 and 100 nm in a similar way to the infinitesimal particles. The size related nano particles may vary significantly depending on the type of nano fluid although individual molecules are often not referred to as nano particles.

Mirmasoumi and Behzadmehr [52], used to study the effects of mean diameter nano particles on the flow

coefficient. Where, used for this fully developed, two phase mixture of liquid consisting of water and  $Al_2O_3$ . The calculated results showed that the heat transfer coefficient increasing significantly with decreasing the nano particles means diameter.

Lin and Violi [53], the heat transfer rates are investigated for the irregular nano particle size, mean nano particle diameter, nano particle size fraction. And the fluid flows filled with  $Al_2O_3$  Fluid can be enhanced by increasing the ratio of minimum to maximum nano particle diameter from 0.001 to 0.007 or average the diameter of the nano particles decreased from (250 to 5) nm.

Arani and Amani [54], an experimental study was carried out to investigate the characteristics of convective heat transfer in fully developed turbulent flow of  $TiO_2$ /water nano fluid.  $TiO_2$  The nano particles with diameters of (10, 20, 30 and 50) nm are dispersed in distilled water as base fluid. The results indicated a higher Nusselt number for nano fluid compared to the base fluid. It is observed that the Nusselt number does not increase by decreasing the diameter of nano particles in general.

Du et al. [55], In this study, CuO/water nano fluid 3-dimensional numerical model was used to study the effect of nano particle diameter the spherical heat performance of the geothermal heat exchangers. The numerical results showed that nano particles with a diameter of (5 and 50) nm are not recommended nano fluids used in geothermal heat exchangers due to the performance efficiency coefficient less than 1, and 40 nm was the optimum diameter and had the highest performance efficiency coefficient (1.00488).

A nano fluid with different nano particle shapes is affected on heat conduction processes in the (MCHS). M. Bahiraei et al [56], fluid is made in hydration research water- $Al_2O_3$  evaporation for five nano particle shapes (i.e., brick, platelet, oblate spheroid, cylinder and blade) shown fig. (11).

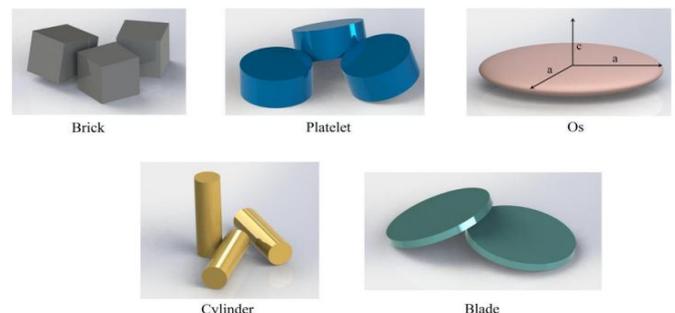


Figure 11: The nanoparticle shapes under investigation

The concentration is constant equal to 1% for all the modes of the nanoparticle shapes. Nano particles result in the

greatest entropy generation followed by brick, blade, cylinder, and platelet nanoparticle shapes, respectively. Using the cylindrical nano particles ineffective in reducing frictional entropy generation. In the nanofluid containing the platelet-shaped nanoparticles, the total entropy generation decreases by 17.4% by increasing Re from 300 to 1800.

Each nano fluid has its own limit in the size concentration of nano particles. The thermal conductivity of the nano fluid varies with its concentration, ranging from 1-5%, and it should not be more than 5% because excessive concentration of nano particle size will increase thermal resistance this leads to agglomeration. Therefore, the optimum size of the nano particle must be used to obtain less pressure and optimal performance of micro channel heat sink.

Shahsavari et al. [57], the objective of this experimental research is to evaluate the differences in thermal conductivity and viscosity of Al<sub>2</sub>O<sub>3</sub>/paraffin. The nano particles mass concentration of (1, 2.5 and 5) %, the surfactant/nano particle mass ratio 1:3, 2:3 and 3:3, the results are that the nano fluid that increasing the concentration of nano particles leads to an increase in thermal conductivity and viscosity, while an increase in temperature leads to a decrease in viscosity and increase in thermal conductivity.

Wajeeh et al. [58], the micro channel performance using CuO/H<sub>2</sub>O nanofluid as a coolant at different volume concentrations ranged from 0-5% are examined. The results showed that the nanofluids aid to improve the heat transfer coefficient of 11% when using CuO/H<sub>2</sub>O nanofluid was used. The concentration effect nanofluids with increasing the value of the Reynolds number leads to a rise in the Nusselt number and the lower the interface temperature and the velocity is discussed.

Al-Ali and Hamza [59], used in their study compared two cases with and without nano fluid (Water/TiO<sub>2</sub>) in concentrations of (0, 2 and 4%).

The presence of a nano fluid inside the channel in a continuous heat flow condition can lead to a significant improvement in heat transfer compared to if the fluid were only water. It was found that the Nusselt number increases in the presence of nano fluid the case with a nano fluid concentration of 2%.

## 2.2 Active Enhancement Techniques for Microchannels

Here are the active boosting techniques used in single-phase flux augmentation requires the addition of external technologies. The entry in the system is on the form of electricity, energy, radio frequency or external signals [60].

### 2.2.1 Surface vibration

Go [61] demonstrated that thermal performance can be increased by the displacement of vibration of the microfine. The micro fin's flow-induced vibration was characterized by microfine. The influence of flow-induced vibration on the improvement of heat, flow sensor, which revealed that it vibrates with natural frequency, irrespective of the velocity of air, with the increase of air velocity, vibration displacement of microfine was also found to be amplified.

The evaluated heat transfer rate was found to be an increase of 5.5 and 11.5% at air velocities of 4.4 and 5.5 m/s, respectively.

### 2.2.2 Electrostatic fields

An excellent paper by Allen et al.[62], presents a review of the literature on electrohydrodynamic enhancement. It is concluded that the corona wind and electrophoresis contribute the most to single-phase heat transfer enhancement. This technique could also be applied to microchannel. In a conventional application,

Small insert electrode is present in the flow field. Potential is applied between the insert probe and the channel surface. The electric field that results will provide a moving corona effect and enhance the heat transfer show figure (12). this arrangement for all three channel sizes: conventional, Mini channel and microchannel.

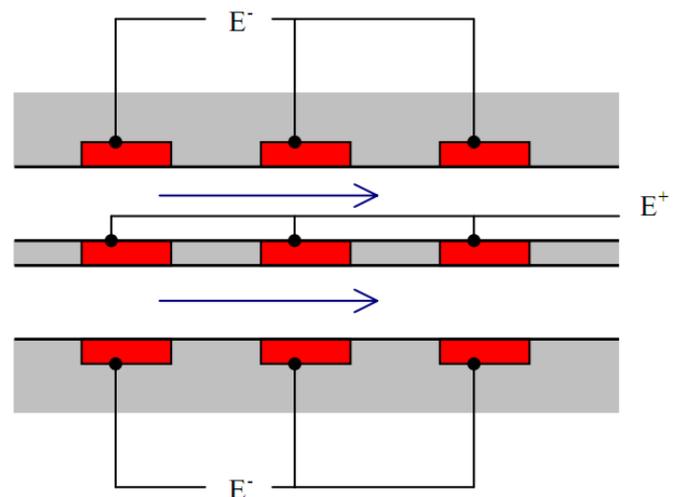


Figure 12: Electrostatic forces with wall integrated probes for a microchannel

### 2.2.3 Pulsation Flow

Narrein et al. [63] investigated a helical microchannel heat sink with nanofluids (Al<sub>2</sub>O<sub>3</sub>+water) numerically. The compare performance for steady and pulsatile flow. It was

observed that pulsatile flow has better heat transfer with reduced pressure drop.

Nusselt number rises with increase in frequency and amplitude at lower Reynolds numbers, while at higher Reynolds numbers, the fluctuation is not significant.

Nandi et al. [64] implemented pulsatile flow (sinusoidal profile) in a wavy microchannel. They found that flow pulsation was able to enhance heat transfer with reduced pressure drop and at low range of Re.

Xu et al. [65], proposes a novel microchannel heat sink where they implemented pulsatile flow. The novel microchannel design opted has two layers, were nano fluid (Graphene oxide particles) flowing through upper layer having pyramid pin fins while bottom layer has square pin with square waveform pulsatile flow. It was observed that pulsatile flow having frequency 6 Hz has shown maximum performance. They also observe substantial enhancement of 20-50% in Nusselt number compared to steady flow. Different pulsatile waveform used in microchannel heat sink.

### III. Discussions

From several previous studies and research considered in this current study, it can be concluded that passive enhancement has great capabilities to enhance heat transfer in a microchannel heat sink. These prompt a design procedure in various passive methods and their geometrical parameters, while at the same time maintaining the pressure drop at the desired level.

Here are several parameters that work for better heat transfer including nanoparticles, where it is very important to know the behavior of nanofluids at different concentrations has become a new cool antin the cooling system.

The passive techniques do not depend on an external force or activation therefore; these technologies do not have no additional energy costs. Several active technologies have been identified as micro channel optimization possibilities. Require the force and power that must make a small system there is a difficulty in carrying it out.

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