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Simulation and Fabrication of Microfluidic Channels

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***Abstract:** This paper presents simulation and fabrication of microfluidic channels. Mixing is an important process in a microfluidic system. The aim of microfluidic mixing is to achieve a thorough and rapid mixing of multiple fluids in micro scale devices. In different microfluidic based biochemical analysis systems, mixing of liquid samples is considered as one of the most challenging processes to realize a suitable chemical reaction in a short time period. The basic design for a micro mixer is represented by Y shaped channel. We used LASER cutting method for fabrication of microfluidic channels. Simulation of different channels is done in CFD (Computational fluid dynamics) software.*

***Keywords:** Fluid mixing, mixing length, Y shape micro mixer, CFD analysis, LASER Cutting.*

I. INTRODUCTION

Micro mixing technology has experienced rapid development in the past few years. The micro and nano technologies were born in there realm of mechanical engineering and modern electronics. It is also considered to be a part of miniature and ultra-precision engineering. Over the past two decades, lab-on-a-chip (LOC) technologies have driven considerable progress in the development of microsystems, particularly for chemical, biological and medical applications LOC technology has been applied in a wide range of processes such as Nano particle crystallization, extraction, polymerization, organic synthesis, protein folding, biological screening, analytical assay, cell analysis, bioprocess optimization, clinical diagnostics and drug delivery studies.

II. DESIGN CALCULATIONS

We design this channel in CAD software and analyzed it in CFD software. Fig.1 shows the micro mixer geometry. It is a type of Y junction, circular chamber micro mixer with and without obstacles and rectangular chamber micro mixer with and without obstacles in the flow path. The obstacles in the channel flow can produce chaotic advection. The variables for the mixing studies are the flow rate corresponding to Re and the channel cross-section area.

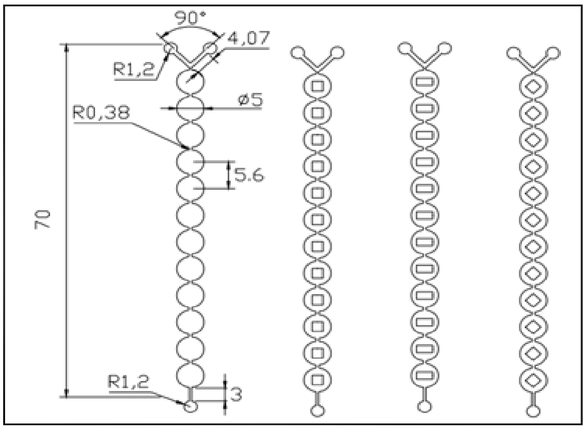

Figure 1. Geometries of Micro mixer with and without obstacles with Circular chamber, Rectangular chamber

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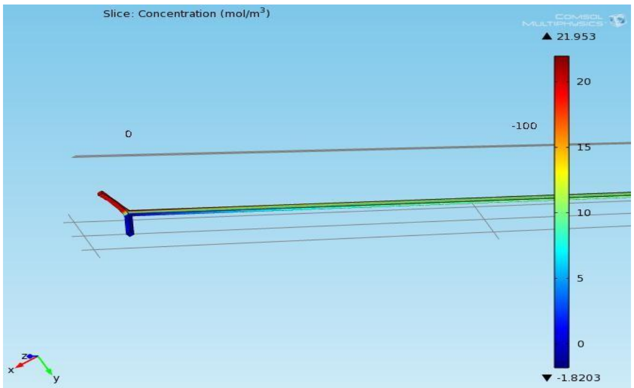

Figure 2.Mixing Behavior along Length of Y Shape Channel

Table No 1. Comparison of COMSOL Simulation Results with Analytical Results of Mixing Length for Y Shape Channel

Sr. No.	Width w (mm)	Height h (mm)	Diffusion Coeff. D (mm²/s)	Mixing Time t (s)	Avg. Vel. V_{avg} (mm/s)	Mixing Length by simulation (mm)	Mixing Length by analytical (mm)	Relative Error
1	0.050	0.1	0.001	25	1	27	25	0.080
2	0.075	0.1	0.001	56.25	1	58	56.25	0.031
3	0.100	0.1	0.001	100	1	97	100	0.030
4	0.125	0.1	0.001	156.25	1	157	156.25	0.004
5	0.150	0.1	0.001	225	1	226	225	0.004
6	0.200	0.1	0.001	400	1	396	400	0.01

III. FABRICATED MODEL OF MICROFLUDIC CHANNEL

Figure 3. Setup of Microfluidic Channels

CONCLUSION

Hence in we can conclude that The Performance of micro mixer depends upon diffusion coefficient, width and height of the channel, inlet velocities of the fluids, viscosity of fluids and geometry of micro mixer.

1. As the channel width decreases, mixing time and mixing length of micro mixer decreases.
2. Increase in diffusion coefficient results in decrease in mixing length of micro mixer.
3. Decrease in the inlet velocities of the incoming fluids gives minimum mixing length of micro mixer.

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