



# Design and Simulation of MEMS Micro Heater for DNA Amplification

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**INTRODUCTION:** Polymerase Chain Reaction is currently the best technique that can be used in order to amplify an amount of DNA. Temperature zone is obtained by natural heat conduction rather than making use of typical silicon thermal cycler. In this process, the DNA sample with reagents has to be heated and cooled in a controlled manner. By doing this, the two strands of the DNA are split and each strand becomes a template by itself which can be copied and replicated and thus the amplification of the DNA sample takes place. When the DNA samples are made to flow through the micro channel, the samples experiences three distinct temperature zones. Denaturation at a temperature variation of 90-98°C, Renaturing (annealing) at a temperature cooled down to 45-60°C, Extension over a temperature variation of 72°C. Interconnect that are based on polydimethylsioxane (PDMS) material is used for system integration. A Micromachining technique for fabrication of DNA chip is developed.

**DESIGN SPECIFICATION:** Models were designed and simulated using COMSOL tool.

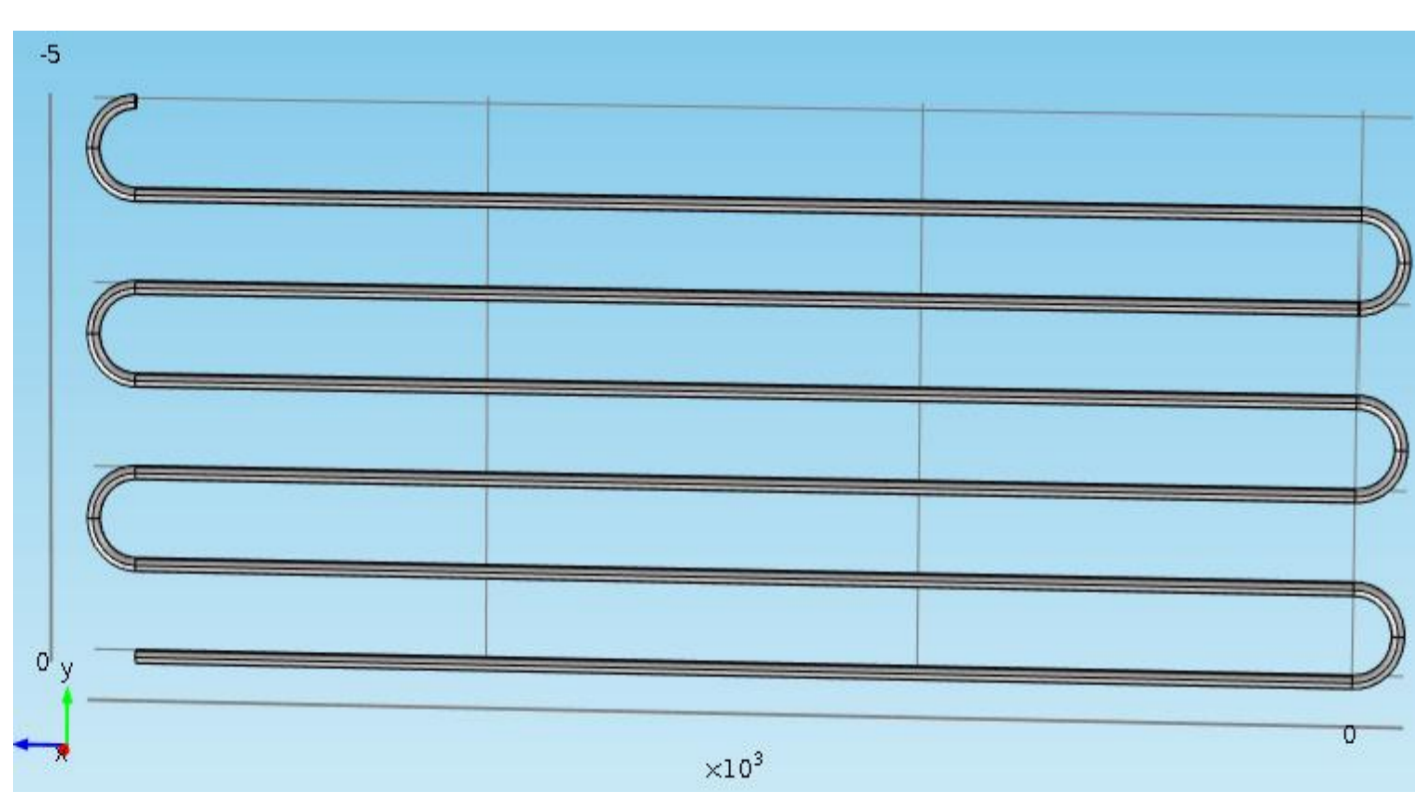


Figure 1. structure of micro heater

## DIMENSIONS:

Parameters	Major radius	Minor radius	Unit
Cylinder 1	5.5	1400	$\mu\text{m}$
Cylinder 2	7.5	1400	$\mu\text{m}$
Torus 1	50	5.5	$\mu\text{m}$
Torus 2	50	7.5	$\mu\text{m}$

## SOFTWARE REQUIRED:

- COMSOL MULTIPHYSICS
- SIMULATION TOOL VERSION 4.2

## SIMULATION RESULTS:

The simulation is carried out at an input pressure of 470kPa. Saliva and blood samples are used for DNA amplification. Three different temperature zones are maintained. The simulation result of temperature distribution is obtained for both the samples.

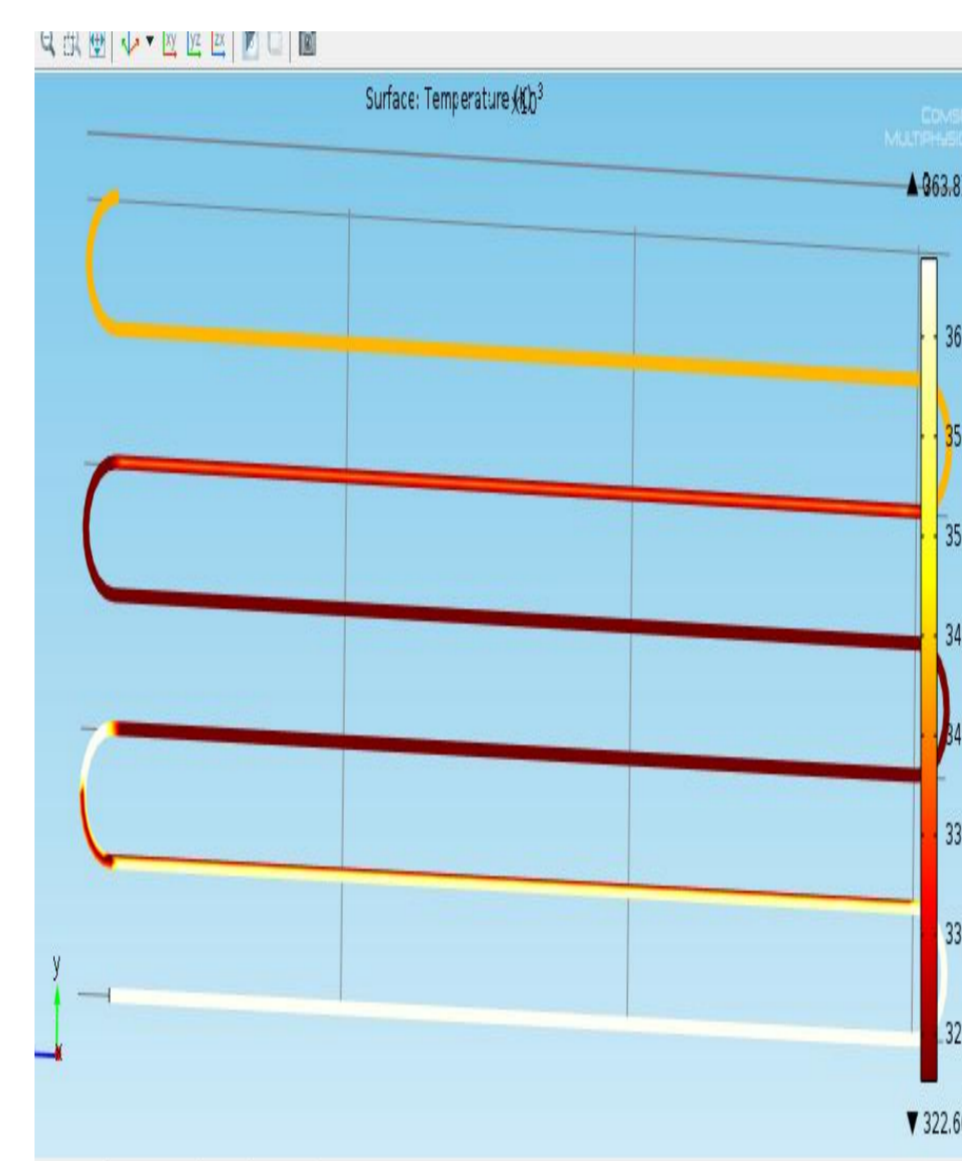


Figure 2: Simulation result obtained by using saliva as DNA sample



Figure 3: Simulation result obtained by using blood as DNA sample

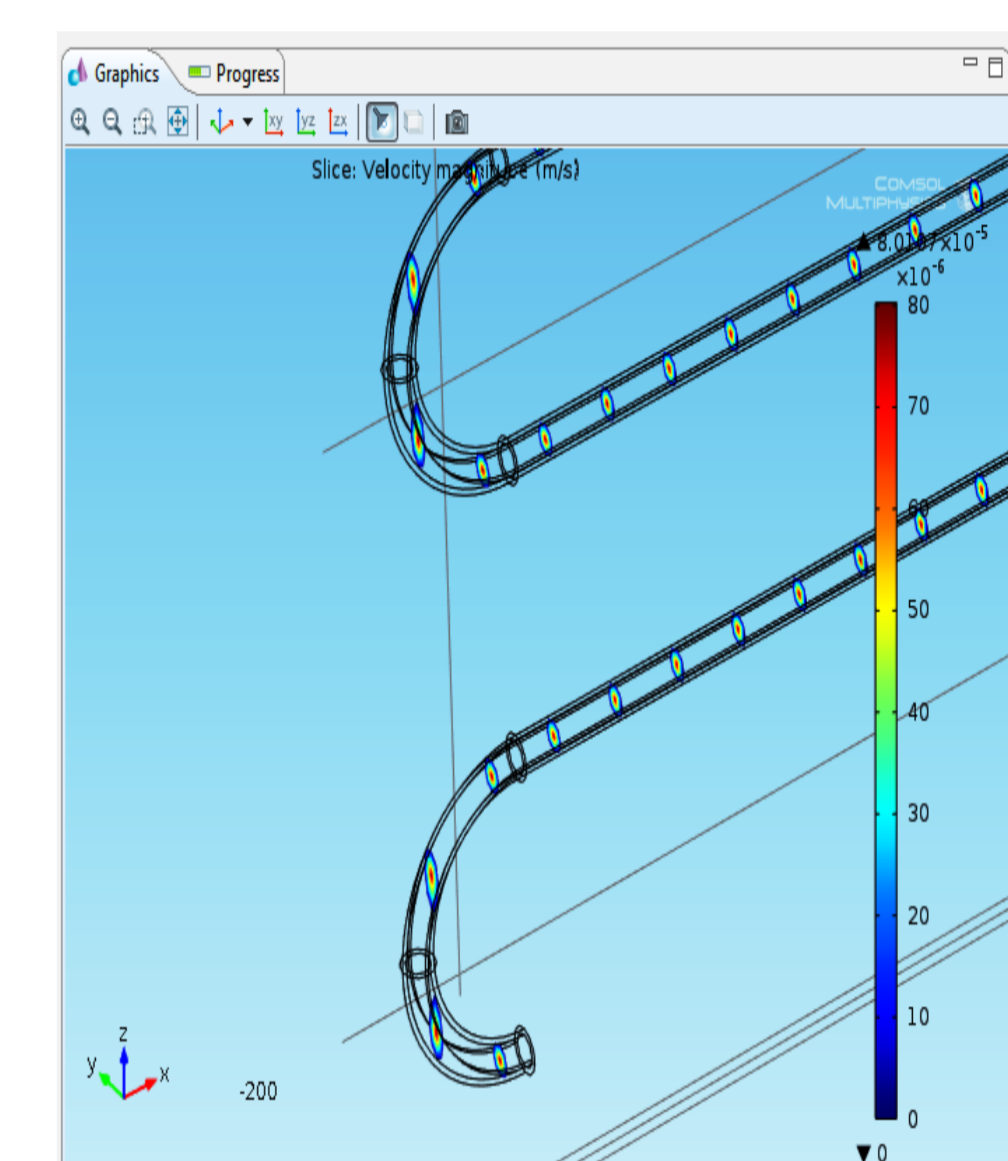


Figure 4: velocity gradient

## CONCLUSIONS:

A novel technique to carry out DNA amplification by the process of Polymerase Chain Reaction (PCR) has been designed. Using this process a single or a few strands of sample DNA can be multiplied in orders of thousands and billions. Considerably good results are obtained with flowing blood sample in the micro channels of the designed MEMS based heaters.

## REFERENCES:

- Hian H. Bau, Development of microfluidic reactor for lab on chip device, University of Puerto Rico.
- Development of simple and reliable PDMS interconnect of high throughput microfluidic application, C.J. Mu, Z.Y. Zhang, M. Lin, X.C. Cao, 17 december 2013.