Design and Simulation of Optimal Microfluidic Design for Effective Fluid Mixing

Microfluidic devices are commonly used in the medical field to test blood samples, bacterial cell suspensions, protein or antibody solutions, or even various buffers. Microfluidics is a constantly growing area of research that wants to improve the quality of human life. Microfluidic devices can be used for obtaining measurements including molecular diffusion coefficients, fluid viscosity, pH, and chemical binding coefficients [1]. Sometimes, experimenting with different fluid flows, due to the scale of the microfluidic system, the flow behavior can be laminar. Laminar flow creates smooth paths and layers, and with low velocities the fluid tends to flow without lateral mixing, to create seamless mixing. With higher velocities the flow can be turbulent. Creating a more effective mixing flow, the channel width of the microchannel should decrease as the velocity of the fluid increases [2]. In this study, COMSOL Multiphysics software is used to model different microfluidic designs to simulate the effects of diffusion and the efficiency of mixing. The results of the simulation show that there are several parameters that affect the mixing of fluids in a microfluidic channel. The results are used to determine the optimal microchannel geometry for any reaction. The research will lead to the production of a prototype efficient microfluidic device for fluid mixing.