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Abstract
A new technique for bonding of polymer micro-fluidic devices was developed in this study. This method can easily bond biochips with complex patterns. By using a patterned Ni mold, the micro-channel structures on Poly-Methyl Meth-Acrylate (PMMA) substrates were generated by one-step hot embossing procedure at low temperature.
This thesis researched on different designs such as different actuating phases: 3, 4 and 6 phases; with and without diffuser valve; square and circular actuators (the experiment results were verified by Ansys simulation) to define the optimum design for plastic peristaltic micropumps. From the results, the design of pump with square actuator and without diffuser valve performed highest flow rate but low back pressure. Both experiment and simulation showed that the design with the combination of diffuser valve and square actuator gives the best performances such as high flow rate and large back pressure. The experiment results of this design are as following: exciting voltage is 100 Vpp, maximum flow rate is 114.8 l/min at 400 Hz, and back pressure is 9.2 kPa.
Self-priming performance is considered to be the most important breakthrough in this research. This property is one of the most difficult to obtain for micropumps and just a few labs can reach. Plastic based micropumps used in this research are very cheap and easily fabricated; therefore, they can be mass-produced. PMMA is much cheaper than silicon which is used in almost all micropumps applications. The pressure and temperature used to bond two PMMA wafers are much lower than for two silicon wafers or silicon and pyrex glass wafer.
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