Introduction

- The objective of this research project is to fabricate a lab-on-a-chip device, that will integrate serval labs into a single circuit.
- LOC is a miniaturized device that will integrate nanofabrication and microfluidics to conduct complex biochemical analyses (Sivilich, 2020).
- This microfluidics process of conducting labs can be useful in conserving reagents and causing shorter reaction time, which will enable multiplexed assaying.
- Through the utilization of various pneumatic -, and hydraulic systems which will actuate the flow of the micro-fluids through the LOC device. The purpose of this research is also to eventually produce a reusable format.

Implementation

The LOC serves the purpose of delivering controlled volumes of the testing reagents to the test subject within the reaction zone. The fluid actuation will be conducted by the implementation of the micro-pump and micro-valve mechanisms. However, the operations of the mechanism will be orchestrated by a programmable microprocessor that powers a linear motion actuator which will pressurize the PDMS layers to control the fluid flow along the microchannels.

Principal Concepts

- The fluidic flow actuation will be controlled by micro-pump and microvalve mechanisms, that will be constructed into the LOC device, which is made up of the polymer, Polydimethylsiloxane (PDMS). The fabrication process of this LOC will incorporate a variety of rapid prototyping techniques like photolithography, hot embossing, replica molding.
  1. Micro-pump - Pressuring PDMS bumper by roller bar deforms the PDMS structure and sealing the cavity. The roller bar moves in the direction that increase the volume of the inner cavity, generating a negative pressure, pulling the fluids further into the microfluidic channel and to the reaction chamber. Roller motion in the opposite direction, causes positive pressure to extract fluid from the chamber.
  2. Microvalve - Microfluidic slides are covered with bump patterns, when the roller sits on the bumper it presses down on the PDMS bumper which closes our channel cavity causing high fluidic resistivity. However, channel without the bumper opens up, allowing an influx of fluidic flow into the channel. Therefore, operation of the microvalve mechanism is dependent on the position of the roller on the microchannel.

Methodology

The fabrication process of this LOC will be conducted by a programmable microprocessor that powers a linear motion actuator which will pressurize the PDMS layers to control the fluid flow along the microchannels.

Constraints

- While spin coating one of recurring errors in fabrication are due to edge bead formation on the edges of the coated wafer. Edge bead formation is due to low spin speeds or high viscosity of the photoresists, this produces higher surface tension which restricts the centrifugal forces to accelerate in a uniform manner across the surface of the wafer, producing a “bulge” at the wafer edge.
- Wafer thickness measurement, due to the scale thickness measurement using microscopy tends to be the best viable option. However due to the opacity of the sample microscopy has been difficult.

Conclusion

This LOC platform can open up many different approaches to conducting polymerase chain reactions (PCR), microarray analysis, and protein separation.

With the successful completion of the fabrication of the LOC device, it can provide as a sustainable system for conducting virus detection PCR test. This can extremely beneficial especially now, with the presence of the COVID-19 virus spreading at an expeditious rate.

Literature cited


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For further information

Manav Menon – mmomen@uw.edu
Alice Lecus – alecusu@uw.edu
Marcia Silva – msvil@uw.edu