Rapid and low-cost prototyping of lab-on-a-chip devices for inertial microfluidic applications

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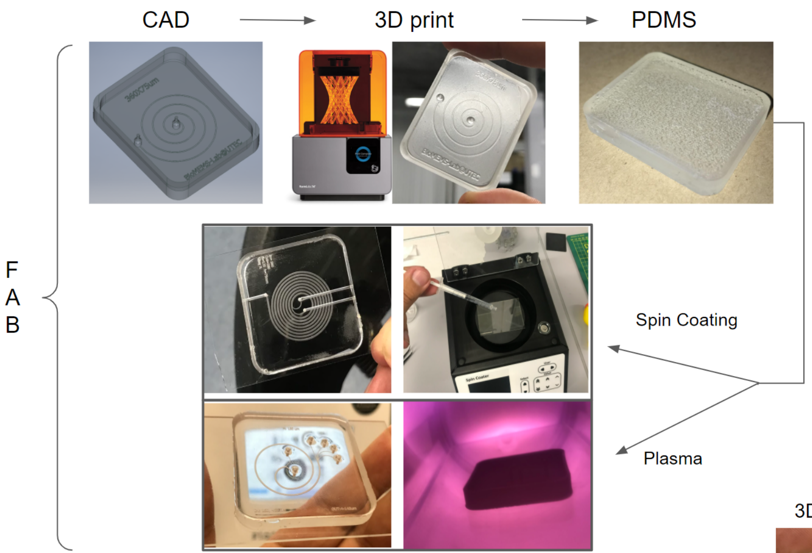
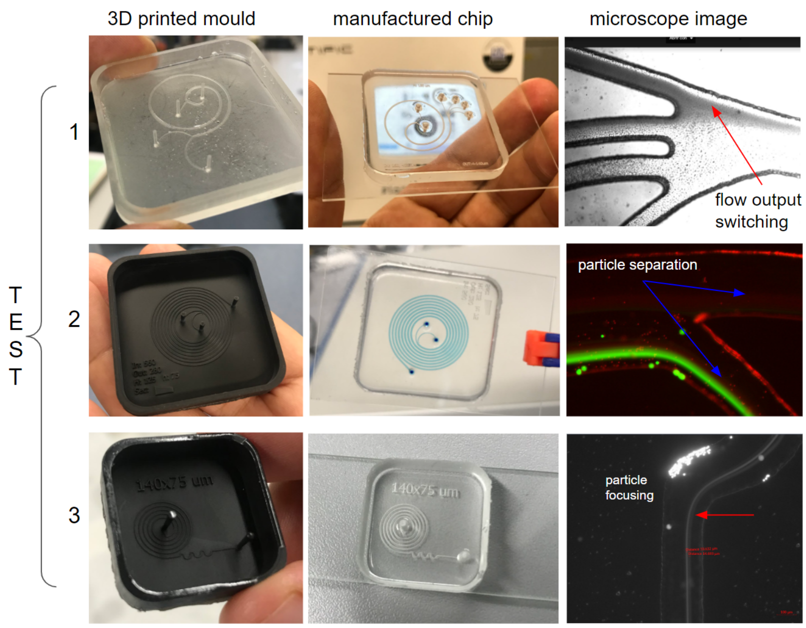
INTRODUCTION

Microfluidic and Lab-on-a-Chip devices are revolutionizing the field of biomedical engineering, especially disease diagnosis by providing new methods and tools for analyzing diseases at cell resolution. In this work, three inertial microfluidic devices were developed with rapid and low-cost prototyping techniques (rapid soft lithography) for future diagnostic applications of diseases such as Peruvian malaria.



METHODS

The moulds were printed with a desktop 3D-SLA printer with two types of resin.: clear and black
The chips were manufactured by pouring PDMS in the 3D-printed moulds, and then, dried in an oven at 80 °C @90'.
Once the PDMS part was removed from the mould, two types of bonding with a flat surface counterpart were tested: plasma and spin coating.
Computational simulations of laminar flow and particle trajectories were performed using COMSOL Multiphysics.
These simulations were used to identify the steady state flow of particles of different sizes and diameters.



RESULTS

The devices were tested with distilled water with Sodium dodecyl sulfate (SDS) containing fluorescent PS microparticles of 5 and 10 um in diameter. During the tests we observed: flow output switching control(1); size based particle separation(2), and a single line of microparticles focused in the center of the microchannel due to inertial effects(3). The devices were tested at different flow rates between 10-100 ul/s . Plasma bonded chips withstood flow rates up to 45 ul/sec while spin coating bonded chips withstood flow rates up to 80 ul/sec. Simulations of the steady state flows have so far been 100% in agreement with the experimental results. .

CONCLUSION

- Rapid soft lithography allows the fabrication of functional inertial microfluidic devices
- 3d printed molds have advantages such as the incorporation of pillars (eliminates the need for a biopsy-puncher), repeated use of a single mould without damaging the microchannels' walls, and the possibility of easily manufacturing lateral tubing interfaces
- Printing with clear resin is better for plasma bonding
- Spin coat bonding was 40% stronger than plasma bonding

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