

New microfluidic platform for life sciences in South Africa

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INTRODUCTION

Microfluidic systems provide the ideal platform on which to develop point-of-care (POC) diagnostic devices. A new microfluidic platform, based on centrifugal microfluidic principles, is currently being developed at the CSIR, with the aim of providing an integrated lab-on-a-disc solution for point-of-care health.

LAB-ON-A-DISC PLATFORM

The platform consists of two main components: a microfluidic disc device and a system for controlling fluid flow on the device and recording the results obtained.

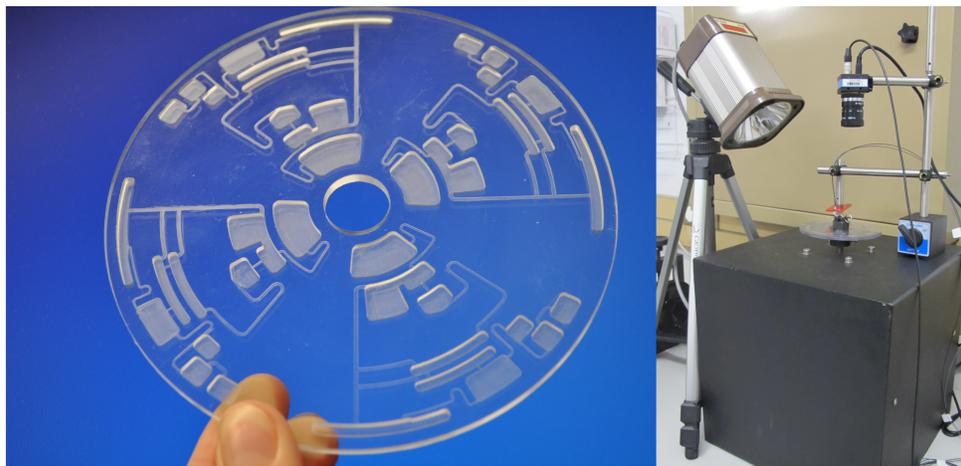


Fig 1: Components of the lab-on-a-disc platform: microfluidic device and control and testing system

Microfluidic device

The microfluidic discs are made from polycarbonate and pressure sensitive adhesive (PSA) layers. The channels and chambers of the device are designed using software, and are then machined using different pieces of equipment. Individual pieces are then assembled to produce the finished microfluidic disc device.

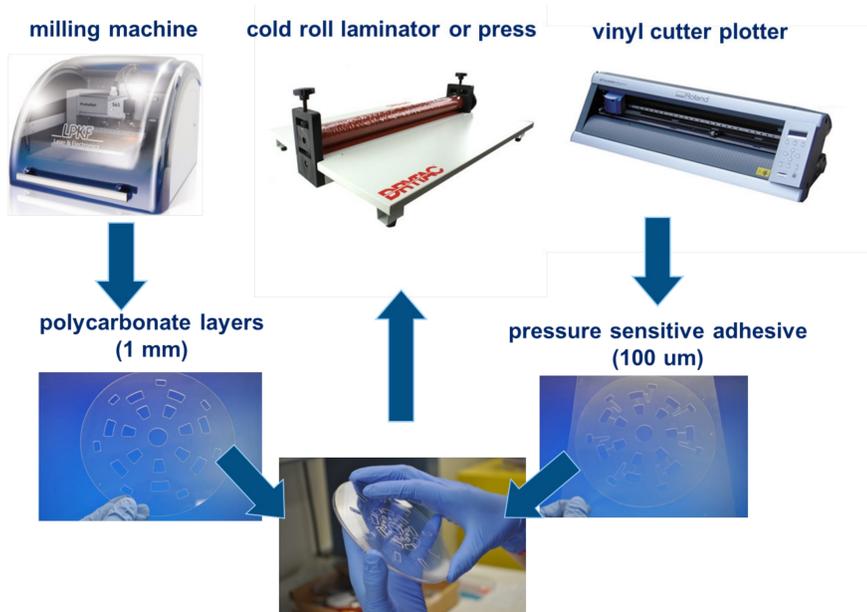


Fig 2: Microfluidic disc manufacturing and assembly process

Device control and testing

After assembly of the device, the disc is controlled and tested using a system that consists of a motor to rotate the disc, as well as an image capturing unit that allows for a picture of an area of interest to be captured for each revolution of the disc. Different rotational speeds and timing cycles are used to implement various fluidic functions, including valving, mixing, sedimentation, separation, etc. by exploiting centrifugal forces.

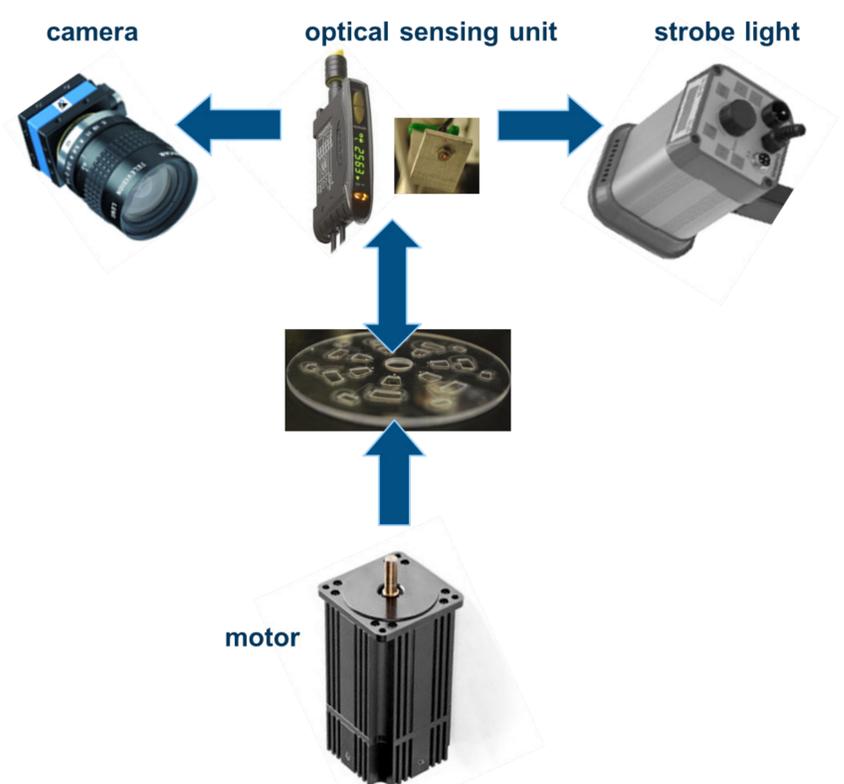


Fig 3: System for microfluidic device control and testing

The addition of external peripherals and electronics to achieve functions such as heating, cooling and precise control of the sample will be implemented as required.

ADVANTAGES AND APPLICATIONS

The lab-on-a-disc platform is advantageous as it eliminates the need for active elements – a common challenge in microfluidic systems. Pumps, valves and other fluidic functions are achieved using centrifugal forces, with only a small motor required to power the system. A high degree of parallelisation is also offered as numerous devices can be implemented on one disc. A variety of components from sample preparation through to detection can be implemented simply and effectively into an integrated microfluidic solution for life sciences.

The lab-on-a-disc platform is a first of its kind in South Africa and has the potential to provide new diagnostic solutions for point-of-care in health-related areas. This paves the way for providing resource limited areas with improved, decentralised healthcare access and reduced diagnosis times at a low cost.

Acknowledgements

This platform forms part of a collaborative effort with Prof. Marc Madou and his BioMEMS group at the University of California Irvine (UCI) in the USA, who have shared their expertise in the field of centrifugal microfluidics.