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Fabrication of Microfluidic Sensors Using a 3D Printer

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Abstract
In this project we built-up a 3D printer aiming the fabrication of microfluidic devices. It is based on the technology of Fused Deposition Modelling, cheaper and simpler than conventional photolithographic methods to manufacture microchannels, adding flexibility on the development and integration of sensors and devices. In this case we present a complete sealing case, permitting future developments of 'lab-on-a-chip' devices. We also optimize printing parameters for ABS and PLA microchannels.

Key words: Microfluidics, Sensors, 3D printer

Introduction

Microfluidics devices represent the next generation of sensors due to their speed of analysis and small waste of fluids [1]. With the aim of constructing these devices in a cheaper and faster way, along with the option of adding flexibility in the allowed designs, we have studied the viability of using a 3D printer. Therefore, we built one based on the model Mendel90 from the open-project RepRap [2]. Besides optimizing the printing parameters for ABS (acrylonitrile butadiene styrene) and PLA (polylactic acid) – two materials we worked with, due to its easiness of manipulation, in the first case, and its flexibility and transparency, in the second case - we have also verified which sealing techniques were more appropriate.

Results and Discussion

In order to construct microchannels with appropriate dimensions to allow laminar flow, we have used step motors NEMA, model 17HS8401 and threaded rods M8. To melt the plastics, we used hot end model E3D-v6, which could reach temperatures up to 300ºC. On this early stage of research we could fabricate microchannels with minimal thickness 0.5mm, which could be reduced later. Using the open software *OpenScad* we were able to design a digital model of the microchannel and with the softwares *Slic3r* and *Repetier-Host* we sent all printing instructions to the 3D printer.

After configuring the 3D printer and successfully printing ABS channels, we could print PLA channels with 0.5 mm width, 1 cm length and 0.4 mm depth. We also tried different ways of manual sealing and eventually we managed to print an already sealed microchannel with 0.5 mm width, 20 mm length, 1.6 mm depth and a 0.2 mm cover.

Conclusions

By printing sealed microchannels we got a step closer to prove the viability of using a 3D printer in the production of microfluidic devices. Although more tests are needed in order to check its usefulness, we believe that we have overcame the most relevant obstacle: good sealing.

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