MODULAR MICROPUMPS FABRICATED BY 3D PRINTING TECHNOLOGIES

Yara Alvarez-Braña[1,2], Fernando Benito-Lopez[2,3,4,*] and Lourdes Basabe-Desmonts[1,3,4,5,*]

[1]Microfluidics Cluster UPV/EHU, BIOMICs microfluidics Group, Vitoria-Gasteiz, Spain.
[2]Microfluidics Cluster UPV/EHU, Analytical Microsystems & Materials for Lab-on-a-Chip (AMMa-LOAC) Group, University of the Basque Country UPV/EHU, Spain.
[3]Bioaraba Health Research Institute, Vitoria-Gasteiz, Spain.
[4]BCMaterials, Basque Center for Materials, Applications and Nanostructures, Leioa, Spain.
[5]Basque Foundation of Science, IKERBASQUE, Spain.

Contact: lourdes.basabe@ehu.eus

INTRODUCTION

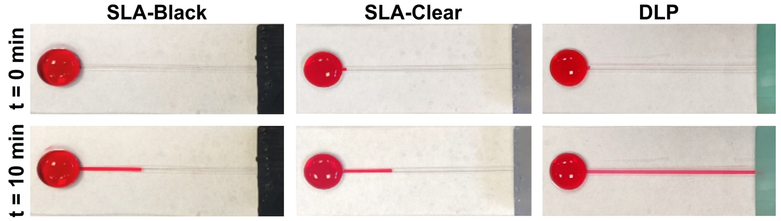
With the idea of having modular universal architectures for self-powered microfluidics devices, several reports demonstrated the possibility of manufacturing modular polymeric micropumps based on the concept of degas driven flow. Inspired by our previous work on PDMS micropumps[1], we have evaluated how 3D printing would enable fast prototyping of modular, degas driven flow and polymeric micropumps using different materials, fabrication techniques and geometries.

OBJECTIVE

In this work, we present the fabrication of self-powered modular micropumps by three different 3D-printing techniques and their integration into portable and low cost microfluidic cartridges[2].

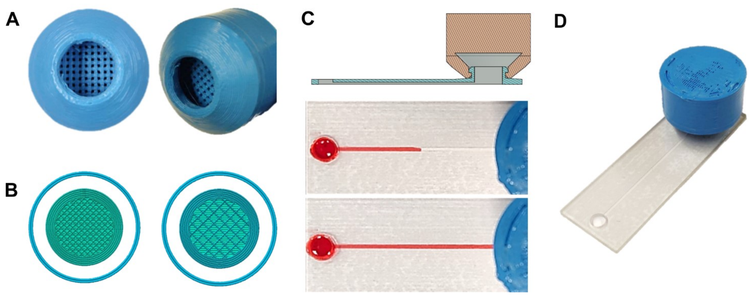
STEREOLITHOGRAPHY (SLA) AND DIGITAL LIGHT PROCESSSING (DLP) MANUFACTURE

Scheme of the 3Dp-µPumps fabrication (SLA and DLP) and actuation principle.



Pictures of a multilayer PMMA thermolaminated device connected to a SLA-black, SLA-clear and DLP 3Dp-µPumps at 10 min after loading the sample.

FUSED DEPOSITION MODELING (FDM) MANUFACTURE



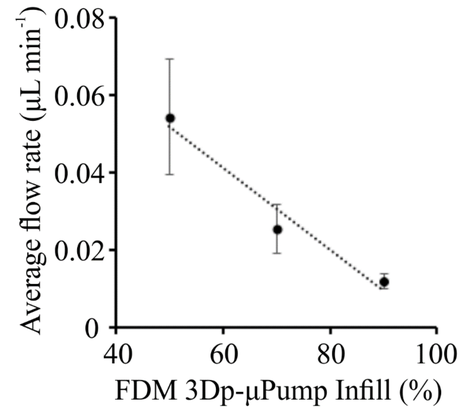
FDM 3Dp-µPumps manufactured with a different internal infill were connected directly to a 3D printed device without the use of a PSA layer.

(A) Bottom and side view pictures of the FDM 3Dp-µPumps. (B) Scheme of 90 and 50 % of internal infill. (C) Scheme of the FDM 3Dp-µPump assembled with the 3D printed device (top) and performance of the FDM 3Dp-µPump prior degassed (bottom). (D) 3D printed microfluidic device with integrated FDM 3Dp-µPump, connected without the use of any PSA piece.

FDM PUMPS RESULTS

Flow generated by the FDM 3Dp-µPumps can be tuned by:

a. Changing the internal structure of the filament forming the cavities.
b. Modifying the surface area of polymer exposed to the channel.



FDM 3Dp-µPumps flow rates characterization using increasing percentage of internal infill.

CONCLUSION

Since there are a wide variety of 3D printing methods, designs and materials that can be used, this strategy enables the manufacturing of customized micropumps according to the needs of the application. In addition, for the first time, we showed an alternative to create geometries that cannot be manufactured with normal fabrication techniques, by presenting an improved strategy for direct assembly of micropumps and microfluidic cartridges.

[1] J. Etxebarria-Elezgarai *et al.*, *Ind. Eng. Chem. Res.*, 59, 22485–22491, 2020.
[2] Y. Alvarez-Braña *et al.*, *Sens. Actuators B Chem.*, 342, 129991, 2021.

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