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Rapid and Low-cost Fabrication of Microfluidic Devices

LCD-based VPP 3D printing rapidly fabricates multilevel microfluidics with 100 µm channels at low cost.

Microfluidic devices have been extensively studied for their potential in various fields, particularly in bio-medicine, as they allow for manipulation of cells on a sub-micron scale. However, the traditional method of fabricating these devices using polydimethylsiloxane (PDMS) micro-molding (soft lithography) is costly and time-consuming due to the numerous steps involved and the need for high-end equipment and a cleanroom environment. Additive Manufacturing (AM), also known as 3D printing, offers an attractive alternative by building a three-dimensional object through layering. It is faster and simpler compared to the lithography process. Fused Filament Fabrication is a popular AM method but achieving smooth and narrow channels smaller than 500 microns in width is still a challenge. An alternative method, Vat Photopolymerization (VPP), allows for the direct fabrication of highly transparent microfluidics with a much higher resolution, allowing for channels as narrow as 100 microns. An emerging method within VPP is the use of liquid crystal display (LCD) technology, which uses UV light to facilitate the photopolymer solidification process.

Researchers at Purdue have developed a technology that utilizes a liquid crystal display VPP 3D printer to create an economical multi-level microfluidic device. Using a low-cost method for creating microchannels, researchers have developed a new LCD-based 3D printing technique. The technology employs an economical and rapid method to create microfluidic channels as narrow as 100 microns, with the capability of constructing features with a resolution of 35 microns horizontally and 10 microns vertically. Researchers have validated the technology by forming a single line of cancer cells within the microfluidic channels to demonstrate its application in cell diagnosis.

Technology Validation: Scanning Electron Microscopy imaging shows the formation of 100 micrometer wide channels in fabricated microfluidic

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devices.

Advantages:

-Low-cost method for creating microfluidic channels, which is a significant advantage over other fabrication methods that can be costly to implement.

-A quicker way to fabricate microfluidic channels, which can be useful for applications where quick turnaround time is critical.

-Smaller width (100 microns) of microfluidic channels

Applications:

-Microfluidic devices for many industries, with a direct application in cell diagnosis

Publications:

https://www.purdue.edu/newsroom/2025/Q1/purdue-printing-innovation-fabricates-multilevel-microfluidic-devices-as-small-as-10-microns-deep/

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