

**INSIGHTS**

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Designing Microfluidic Devices for 3D Printing

By: Nita Vaidya-Zannino

Microfluidic-based devices (MFDs) are already used in many healthcare, biological, and medical applications. They also have growing uses in environmental analysis and food and agriculture research. MFDs provide a quick, safe, and cost-effective way to handle fluid samples of one part per million (ppm) or less. Lab-on-a-chip (LOC) technology makes automation and high-throughput screening possible with extremely small fluid volumes. When it comes to designing microfluidic devices for 3D printing, there are still challenges to overcome.

Design Freedom and Manufacturing Complexity

As researchers continue to find new uses for MFDs, they are also working to reduce the time it takes to produce microfluidic devices. Today, building an MFD by hand requires several hours of intensive labor.

Injection molding can produce high volumes of LOCs for testing, but the tooling is expensive and takes weeks or even months to arrive. Researchers want to accelerate the design and manufacturing process. They also want to add greater freedom when designing MFDs to support greater complexity, especially with the tiny channels through which fluids are injected and evacuated.

Channel Design and Material Selection

Current fabrication methods limit the ability to create complex 3D channels in microfluidics. As new uses for MFDs continue to develop, when designing microfluidic devices, engineers want the ability to design channels with diameters less than 100 microns and with high aspect ratios. To achieve both greater complexity and smaller channel sizes, researchers need advanced manufacturing solutions.

Polymers are used in many microfluidic devices because of their good biochemical performance, low cost, and support for rapid fabrication. Yet designers need application-specific polymers that resist high temperatures and are biocompatible. Additive manufacturing, or 3D printing, is an option but specific technologies differ.

3D Printing for Microfluidics

To achieve both greater complexity and smaller channel sizes, researchers need advanced solutions. 3D printing can produce intricate parts, but not all 3D printers can create small components with fine features and tight tolerances at the required resolution and desired speed.

Projection micro-stereolithography (PμSL) is a form of micro-precision stereolithography (SLA) that increases freedom when designing MFDs and supports greater device complexity. With PμSL technology, a flash of ultraviolet (UV) light causes the rapid photopolymerization of an entire layer of liquid polymer resin. PμSL technology supports continuous exposure for faster processing, too. Importantly, designers can 3D-print small parts with 2 μm resolution and ± 10 μm accuracy at scale.

The Power of PμSL Technology

PμSL technology supports the production of high precision micro-tooling for molding materials like polydimethylsiloxane (PDMS), the most commonly used material in soft lithography. Compared to other 3D printing platforms, PμSL technology also offers a better surface finish of 0.4 – 2.5 rA.

In order to meet the specific demands of microfluidic devices, PμSL technology can print 3D channels that are as small as 10 μm and that have high aspect ratios. To learn more about using PμSL technology for microfluidics, visit our microfluidics applications page or request a benchmark part.