3D Printing Microfluidics with PolyJet Technology

Overview

Microfluidics is the study of systems that process or manipulate small quantities of fluids using miniscule channels. A multidisciplinary field, microfluidics has applications in analytical chemistry, engineering, and the medical field. Recent research in microfluidics has helped develop microsystems called lab-on-chip (LOC) devices. LOCs integrate several laboratory functions onto a single device, which can range from just millimeters to a few square centimeters in size. Partially due to microfluidic channels, these microsystems provide a range of benefits, such as allowing extensive analysis on limited samples of fluid.

The traditional fabrication process for these microfluidic devices is costly and requires several complex steps. Typically, the process begins with a silicon wafer patterned with photoresist, which then needs to be cured with UV light and covered with a polymer like PDMS. This process can take around 8 hours, and makes it difficult to create multiple identical chips. Traditionally fabricated chips are also highly delicate and are susceptible to chipping and peeling.

Application Outline

Researchers with the Department of Chemistry at Saint Louis University and the Department of Biomedical Engineering at Michigan State University see promise in using PolyJet Technology™ to help manufacture microfluidic devices.

Compared to the labor-intensive and time-consuming traditional methods, 3D printing microfluidics devices is faster, easily customizable, and allows for better reproducibility.

A major benefit of PolyJet technology is freedom from conventional fabrication constraints. The high-resolution capabilities of PolyJet 3D printers make creating the complex geometries required by microfluidics, such as small, enclosed channels, faster and less labor-intensive. PolyJet technology replaces several processes that are typically required for creating microfluidics devices, removing the need for UV curing and layering. With a PolyJet 3D printer, the team could produce a microfluidic chip in less than half an hour.

While 3D printing microfluidic devices has traditionally come with serious drawbacks, PolyJet technology offers a solution for issues like surface quality, optical transparency, and material choice. The high resolution of PolyJet 3D printers allows the fabrication of truly microfluidic channels (125 x 54 µm), with complex geometries such as serpentine channels.

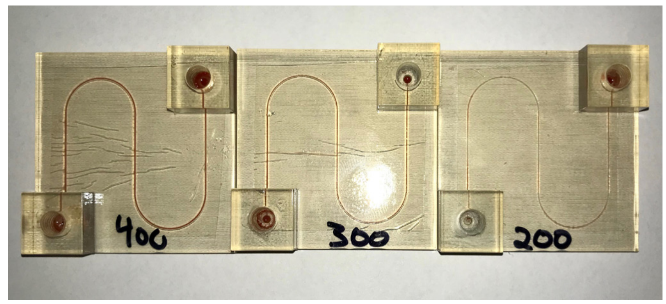
PolyJet 3D printers also provide multi-material capabilities, and materials that range in texture and transparency. Many microfluidics devices require transparency for optical detection. For the cover layer of their microfluidic chip, the team used translucent acrylic-simulating VeroClear™. For ports and world-to-chip connections, the team used rubberlike Tango+, which enabled the construction of crucial pressure-based sealing and connecting tubing.

Application is a Best Fit For:

- Optical analysis

Benefits Over Traditional Methods:

- More easily reproduceable
- More durable
- Flexible materials allow for pressure-based sealing



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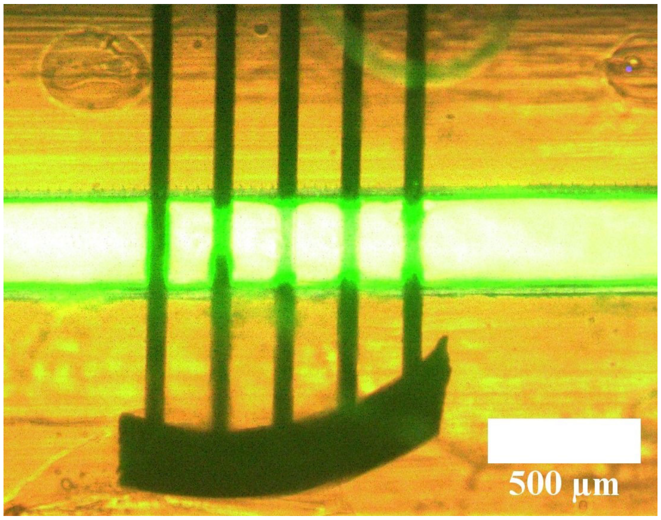
The team found that PolyJet materials were well-suited for both analyzing complex biological samples and the optical analysis of small molecules. Utilizing PolyJet technology allows for the creation of microfluidic devices that are more durable, more easily reproduced, and more efficiently produced than those created via traditional means.

The team's research on 3D printing and microfluidics is published in the journals Analytical Chemistry and Analyst, both available online.



Stratasys Headquarters

7665 Commerce Way,
Eden Prairie, MN 55344
+1 800 801 6491 (US Toll Free)
+1 952 937-3000 (Intl)
+1 952 937-0070 (Fax)

1 Holtzman St., Science Park,
PO Box 2496
Rehovot 76124, Israel
+972 74 745 4000
+972 74 745 5000 (Fax)

stratasys.com
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