**INTRODUCTION**

Microfluidic devices can reduce consumable use while increasing experimental sensitivity, repeatability and throughput all in an automated fashion. In light of these benefits, the fact that many labs do not incorporate microfluidics could point to fundamental problems that eclipse any potential benefits. The lack of a coherent workflow environment coupled with high barriers to entry could be what is keeping microfluidic technology out of the hands of researchers.

Towards the goal of making microfluidics easily accessible we explore a coherent, interoperable, cost-effective workflow for designing, fabricating and controlling microfluidic devices. Our workflow does not require expensive software licenses, clean room facilities or specialized equipment; we fabricate our chips using only a desktop Computer Numerical Control (CNC) milling machine and double-sided tape.

**WHY MAKERFLUIDICS IS AWESOME**

**Free Software**

CIDAR Lab’s 3DμF is a free, web-based application that enables the creation of microfluidic components and exports design files in SVG or STL format for fabrication.

OtherPlan is a free Computer-Aided Manufacturing (CAM) program that is used to convert design files from 3DμF into controls for the milling machine.

<table>
<thead>
<tr>
<th>Photolithography</th>
<th>Fabricate Mold</th>
<th>Prepare Substrate</th>
<th>Align Layers and Bond</th>
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<tbody>
<tr>
<td><strong>Spin Coater</strong></td>
<td><strong>$4,000</strong></td>
<td><strong>$1,500</strong></td>
<td><strong>$1,500</strong></td>
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<td><strong>Mask Aligner</strong></td>
<td><strong>$65,000</strong></td>
<td><strong>$300</strong></td>
<td><strong>$6,600</strong></td>
</tr>
</tbody>
</table>

**REFERENCES**

3. Images of microfluidic equipment by Princeton University. Cost estimates based on company quotes.

**CONCLUSION AND FUTURE WORK**

MakerFluidics removes the significant barriers of cost, time and expertise from the microfluidic fabrication process thus providing a better avenue for the synthetic biology community to capitalize on the benefits of microfluidics. Additionally, we demonstrate the power of our simplified, cost-effective process by designing, fabricating and controlling a novel microfluidic primitive.

We are currently working on developing a maker-friendly environment for controlling microfluidic operations using automated microvalves. 3D printed hardware will take the place of expensive solenoid arrays. Software will facilitate the creation of valve control sequences and seamlessly integrate with our chip design software, thus enabling a total solution for designing, fabricating and controlling microfluidic devices.

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