

High-resolution 3D printing fabrication of a microfluidic platform for plasma separation

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Supplementary Information.

Table SI-1. Devices 1 – 3: design and specifications of the 3D printed devices.

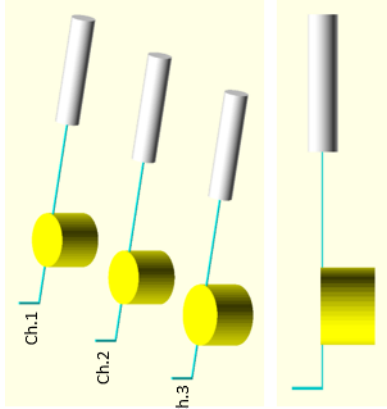
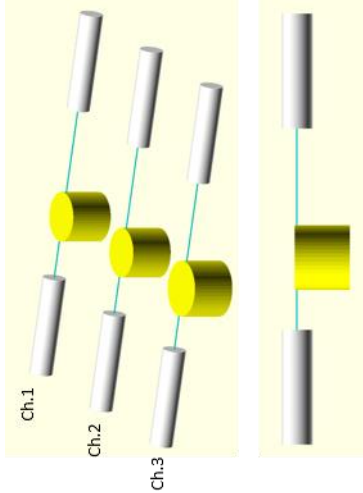
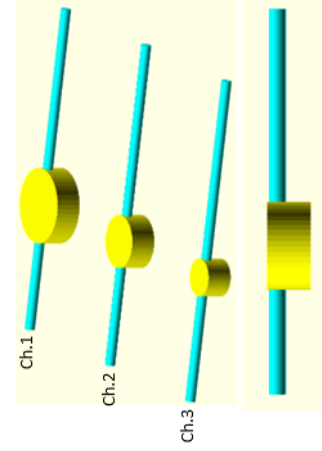
Designs	Design 1	Design 2	Design 3
			
	Dimensions	19.45 mm x 12.0 mm x 3.0 mm	19.45 mm x 12.0 mm x 1.25 mm
	Channel	90 mm x 0.05 mm	d = 0.4 mm
	Sedimentation trench	(Ch. 1,2) d = 1.23 mm, h = 2 mm (Ch. 3) d = 1.40 mm, h = 2 mm	(ch. 1) d = 1.47 mm, h = 1 mm (ch. 2) d = 1.04 mm, h = 1 mm (ch. 3) d = 0.74 mm, h = 1 mm
Printing time	10 min	10 min	6 min
Resin formulation	97% PEGDA + 2% NPS + 1% Irgacure819	97% PEGDA + 2% NPS + 1% Irgacure819	97% PEGDA + 2% NPS + 1% Irgacure819

Table SI-2. Devices 4 – 6: design and specifications of the 3D printed devices.

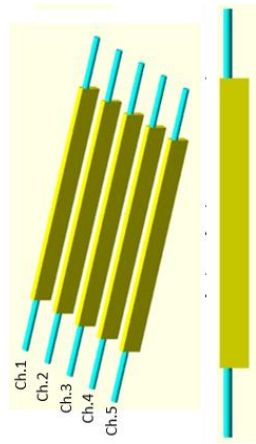
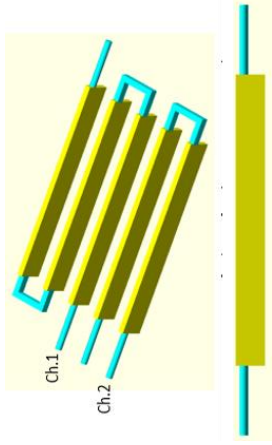
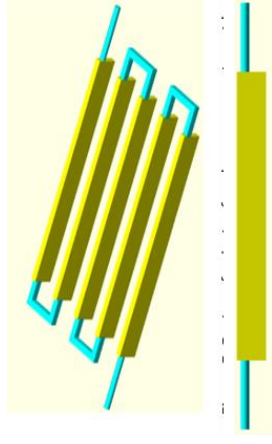
Designs	Design 4	Design 5	Design 6
			
	Dimensions	19,45 mm x 12,0 mm x 1,8 mm	19,45 mm x 12,0 mm x 1,8 mm
	Channel	d = 0,4 mm	d = 0,4 mm
	Sedimentation trench	Two channels with 3 and 2 connected trenches, respectively l = 13,68 mm, w = 0,4 mm, h = 1,4 mm	Five connected trenches l = 13,68 mm, w = 0,4 mm, h = 1,4 mm
Printing time	7 min	7 min	6 min
Resin formulation	97% PEGDA + 2% NPS + 1% Irgacure819	97% PEGDA + 2% NPS + 1% Irgacure819	97% PEGDA + 2% NPS + 1% Irgacure819

Table SI-3. Devices 7 – 9: design and specifications of the 3D printed devices.

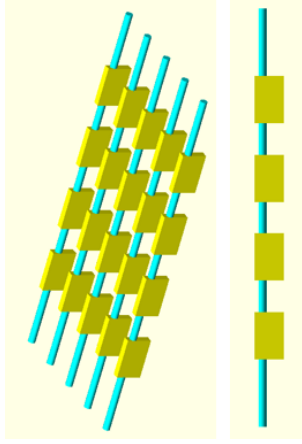
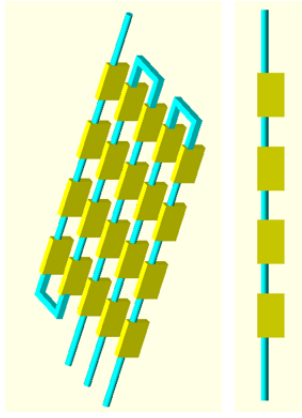
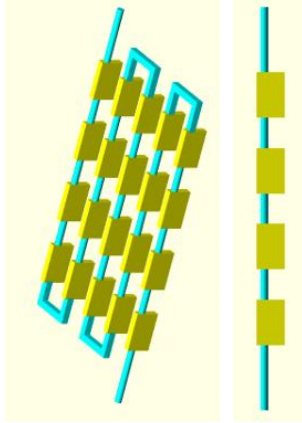
Designs	Design 7	Design 8	Design 9
			
Dimensions	19,45 mm x 12,0 mm x 1,8 mm	19,45 mm x 12,0 mm x 1,8 mm	19,45 mm x 12,0 mm x 1,8 mm
Channel	d = 0,4 mm	d = 0,4 mm	d = 0,4 mm
Sedimentation trench	Five separated channels. Multitrench l = 13,68 mm, w = 0,4 mm, h = 1,4	Two channels with 3 and 2 connected trenches, respectively. Multitrench. l = 13,68 mm, w = 0,4 mm, h = 1,4	Five connected trenches. Multitrench l = 13,68 mm, w = 0,4 mm, h = 1,4 mm
Printing time	7 min	6 min	7 min
Resin formulation	97% PEGDA + 2% NPS + 1% Irgacure819	97% PEGDA + 2% NPS + 1% Irgacure819	97% PEGDA + 2% NPS + 1% Irgacure819

Table SI-4. Devices 10 – 12: design and specifications of the 3D printed devices.

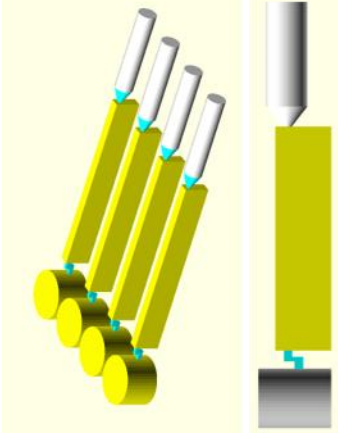
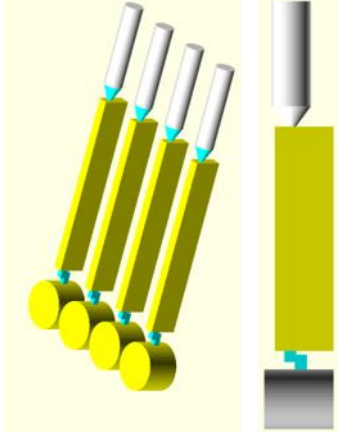
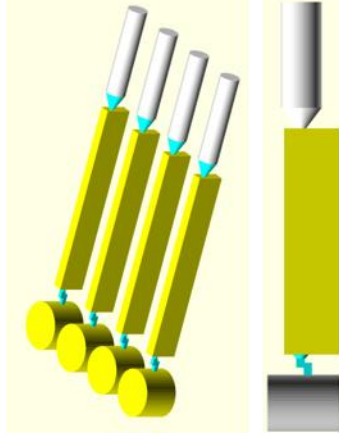
Designs	Design 10	Design 11	Design 12
			
	Dimensions	19.45 mm x 12.0 mm x 2.0 mm	19.45 mm x 12.0 mm x 2.0 mm
	Channel	0.225 mm x 0.230 mm	0.375 mm x 0.345 mm, truncated cylinder connection
	Sedimentation trench	l = 10.54 mm, w = 0.60 mm, h = 1.50 mm	l = 10.54 mm, w = 0.60 mm, h = 1.50 mm
Printing time	9 min	9 min	9 min
Resin formulation	97% PEGDA + 2% NPS + 1% Irgacure819	97% PEGDA + 2% NPS + 1% Irgacure819	97% PEGDA + 2% NPS + 1% Irgacure819

Table SI-5. Devices 13 – 15: design and specifications of the 3D printed devices.

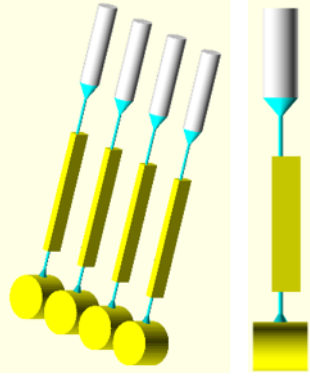
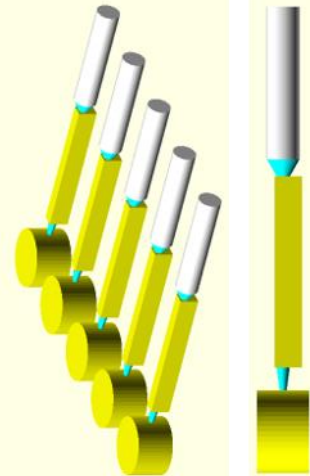
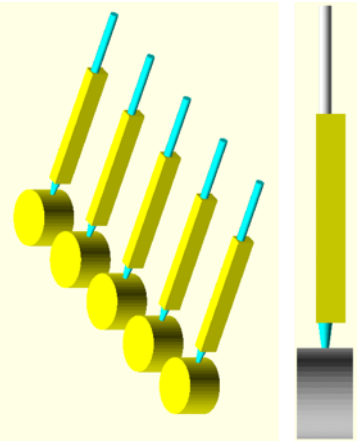
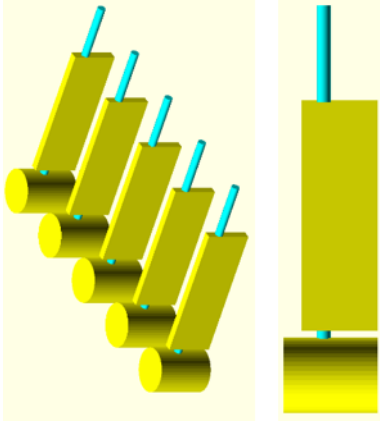
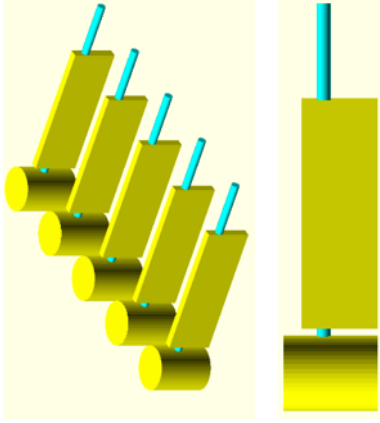
Designs	Design 13	Design 14	Design 15
			
Dimensions	19,45 mm x 12,0 mm x 1,8 mm	19,45 mm x 12,0 mm x 1,8 mm	19,45 mm x 12,0 mm x 1,8 mm
Channel	d = 0,15 mm	d = 0,15 mm	d = 0,15 mm
Sedimentation trench	l = 6,18 mm, w = 0,60 mm, h = 0,90 mm	l = 6,18 mm, w = 0,60 mm, h = 0,90 mm	l = 7,25 mm, w = 0,60 mm, h = 1,20 mm
Printing time	8 min	8 min	8 min
Resin formulation	97% PEGDA + 2% NPS + 1% Irgacure819	98,6% PEGDA + 0,38% Avo + 1% Irgacure819	97% PEGDA + 2% NPS + 1% Irgacure819

Table SI-6. Devices 16 – 17: design and specifications of the 3D printed devices.

Designs	Design 16	Design 17
		
Dimensions	19.45 mm x 12.0 mm x 2.8 mm	19.45 mm x 12.0 mm x 1.8 mm
Channel	d = 0.4 mm	d = 0.4 mm
Sedimentation trench	l = 6.58 mm, w = 0.4 mm, h = 2.20 mm	l = 6.84 mm, w = 5.7 mm, h = 1.3 mm
Printing time	11 min	9 min
Resin formulation	98.6% PEGDA + 0.38% Avo + 1% Irgacure819	98.6% HDDA + 0.38% Avo + 1% Irgacure819

SI-7. Other microfluidic devices for plasma separation

In an effort to improve the separation process, two additional resin formulations were investigated. These, two alternative microfluidic devices were tested, which had different material properties from Device 15, but with a similar structure (see Table SI-6). The first approach involved the fabrication of a transparent device to overcome the need for the collection of the separated plasma for colorimetric analysis in Device 15 (see Section 3.6). A transparent device should allow *in situ* colorimetric analysis of the separated plasma in the device. For this purpose, Device 16 was successfully fabricated, see Table SI-6, with resin B. However, during the evaluation of this device, whole blood did not enter the sedimentation trench and plasma separation was not achieved. A possible explanation for this fact could be the chemical difference between the UV absorbers, Avo and NPS, which could give the resin different surface chemistry properties. Another possibility is that the change in UV absorber resulted in small variations in 3D printed feature dimensions or surface roughness, which could also affect flow.

For Device 17, a hydrophobic resin (resin C) was developed in the pursuit of mimicking the hydrophobic character of the barrier used in Device 15. Because this feature was important for successful sedimentation, we fabricated a hydrophobic device to test this feature for the entire device. However, we found that the blood sample did not flow into Device 17. Therefore, we concluded that, the same feature that allowed the blood cells not to stick to the top surface of the sedimentation trench and thus, a successful plasma separation, acted as an obstacle for the entrance of the whole blood to this chamber. The highly hydrophobic character of Device 17 could be the reason behind that, which hindered the blood flow, making impossible the separation of the plasma.