Designing a Low-cost Data Acquisition device for a Portable Flow Cytometer

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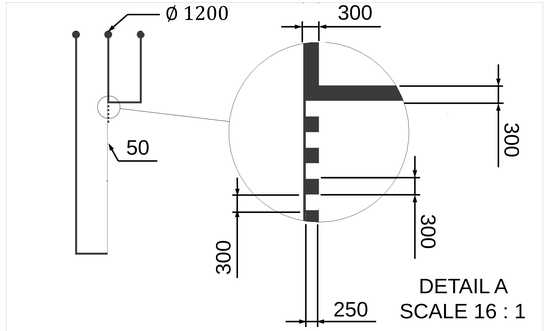
Research Objective

- Minimize cost and materials utilized in designing a portable flow cytometer
  - Integrate electronic circuit as data acquisition device.
  - Substitute LED as primary light source and excitation light.
  - Utilize shrinking thermoplastic as alternative material for fabricating the microchannel's mold.

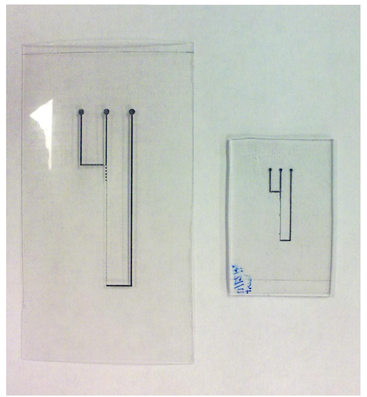
Microchannel Fabrication

- Creating a microchannel's mold using shrinking thermoplastic
  - A 3D microchannel's model was sketched in Solidworks.
  - The model was then exported to scale to a 2D drawing and printed onto shrinking thermoplastic using a standard laser jet printer with a resolution of 1200dpi.
  - Mold was formed by baking the material in an oven at 160℃ for approximately 7 minutes.



Dimensions of microchannel in micrometers.

All dimensions are in micrometers

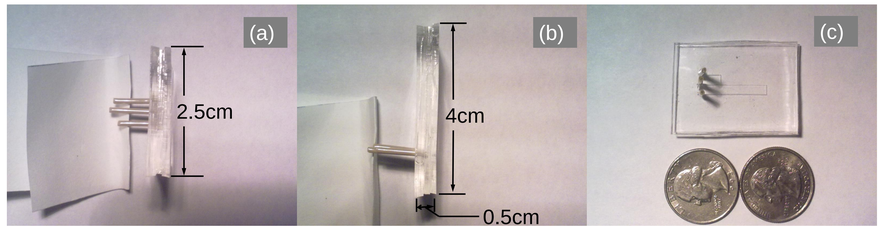


Comparison of shrinking thermoplastic: pre-heat treatment (left) and post heat-treatment (right) with an overall approximately 25% reduction in area.

Microchip Fabrication

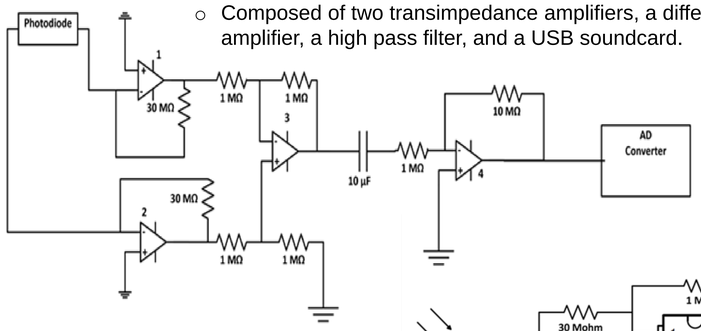
- Fabricating the microchip
  - A mixture of Polydimethlsiloxane (PDMS) and curing agent with 10:1 ratio was poured onto the shrunk mold.
  - It was then heat treated in the oven at 105℃ for approximately 15 minutes.
  - Approximately 5 grams of PDMS were used to create two to three layers of materials to fabricate the microchannel.

Approximate dimensions of the microchip in centimeters: (a) width of microchip, (b) height and thickness of microchip, (c) juxtaposition of the actual microchip and two quarters.



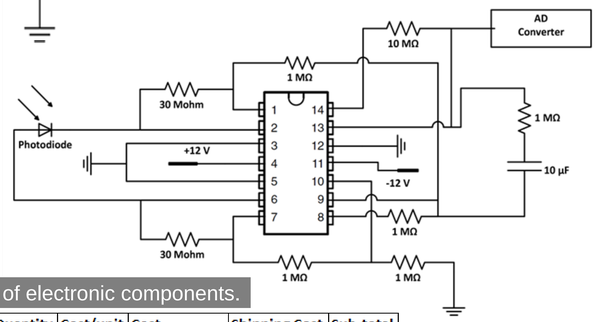
Circuit Configuration

- Simple circuit as data acquisition device
  - Composed of two transimpedance amplifiers, a differential amplifier, a high pass filter, and a USB soundcard.



Initial circuit design with four amplifiers.

A new improved circuit design with the TL074CN integrated circuit which replaces all four amplifiers.

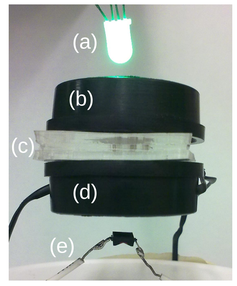


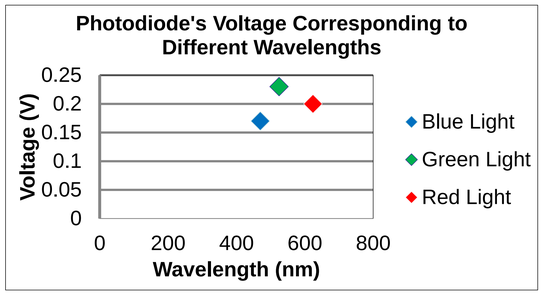
Final overall cost of electronic components.

Component	Supplier	Quantity	Cost/unit	Cost	Shipping Cost	Sub-total
10 µF Capacitor	Mouser	1	$ 0.79	$ 0.79	$ -	$ 0.79
1 µF Capacitor	Mouser	1	$ 0.74	$ 0.74	$ -	$ 0.74
900 Kohm Resistor	Mouser	1	$ 1.73	$ 1.73	$ -	$ 1.73
1 Mohm	Mouser	5	$ 0.30	$ 1.50	$ -	$ 1.50
10 Mohm	Mouser	1	$ 0.19	$ 0.19	$ -	$ 0.19
30 Mohm	Mouser	2	$ 2.18	$ 4.36	$ -	$ 4.36
Printed Circuit Board	Radio Shack	1	$ 2.19	$ 2.19	$ -	$ 2.19
Solder, 1 oz, 0.015" diameter	Radio Shack	1	$ 5.99	$ 5.99	$ -	$ 5.99
Soldering Iron 15-W	Radio Shack	1	$ 7.99	$ 7.99	$ -	$ 7.99
TL074CN Integrated Circuit	Amazon	1	$ 1.98	$ 1.98	$ 4.74	$ 6.72
Osram BPW34 Photodiode	Bonanza	1	$ 3.50	$ 3.50	$ 2.50	$ 6.00
USB Sound Card w/ CM108 chip	DinoDirect	1	$ 8.69	$ 8.69	$ -	$ 8.69
					Total	$ 46.89

Optics Set-up

- Basic set-up of optic section
  - Consisted of a 490nm excitation filter, a 575nm emission filter, a 4-pin LED, and a photodiode.





Configuration of optics: (a) LED, (b) excitation filter, (c) microchip, (d) Emission filter, (e) Pin photodiode.

Conclusions & Future Work

- Final accomplishments
  - Replaced an expensive DAQ device with an electronic circuit that is just well under $50.
  - Successfully fabricated a microchannel mold with a less complicated procedure and cheaper material.
  - Eliminated the usage of photomultiplier tubes and lasers.
  - Ultimately, minimized the overall design size, thus device is portable.
- Future work
  - Run fluorescence particles through the microchannel and acquire real-time data in LabVIEW.

Acknowledgement

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References

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