Implantable Light Source

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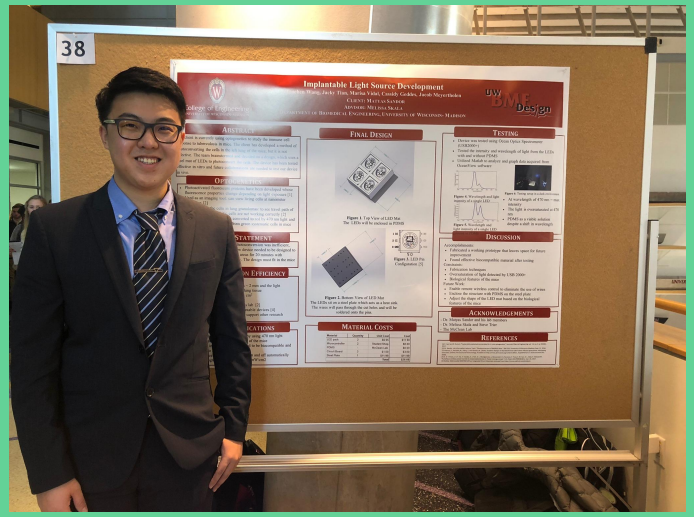
The Team

Lisa Xiong



Jacky Tian

Richard Wang

Hanna Rainiero

Overview

- Background
- Problem Statement
- Product Design Specification
- Previous Prototype
- Previous Prototype Testing Results
- Circuit Schematic
- Electronic Circuit Design & Biomaterial Selection
- Future Work
- Acknowledgements
- References

Background

- Dr. Sandor and his team are investigating immune trafficking in mice infected with tuberculosis and multiple sclerosis to identify potential therapeutic targets
  - Photoconversion of cells to identify the rate of immune cell recruitment (405 nm)
  - Optogenetic activation of cells (480 nm)

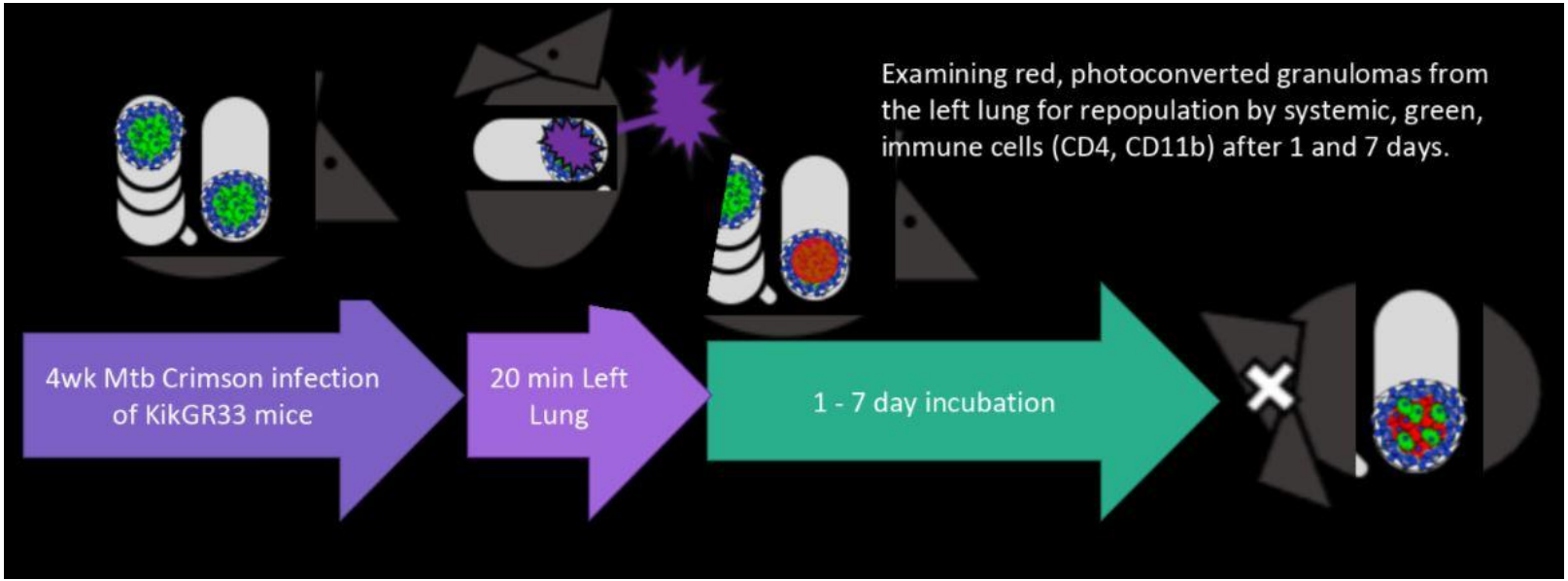


Fig 1.

From Sandor's Lab

Problem Statement

- Current photoconversion methods are ineffective
  - Not all photoconversion sites can be found
  - Fiber optic light can only reach a small area of the lungs
- Needs a more efficient method that will photoconvert larger area (Fig. 2)

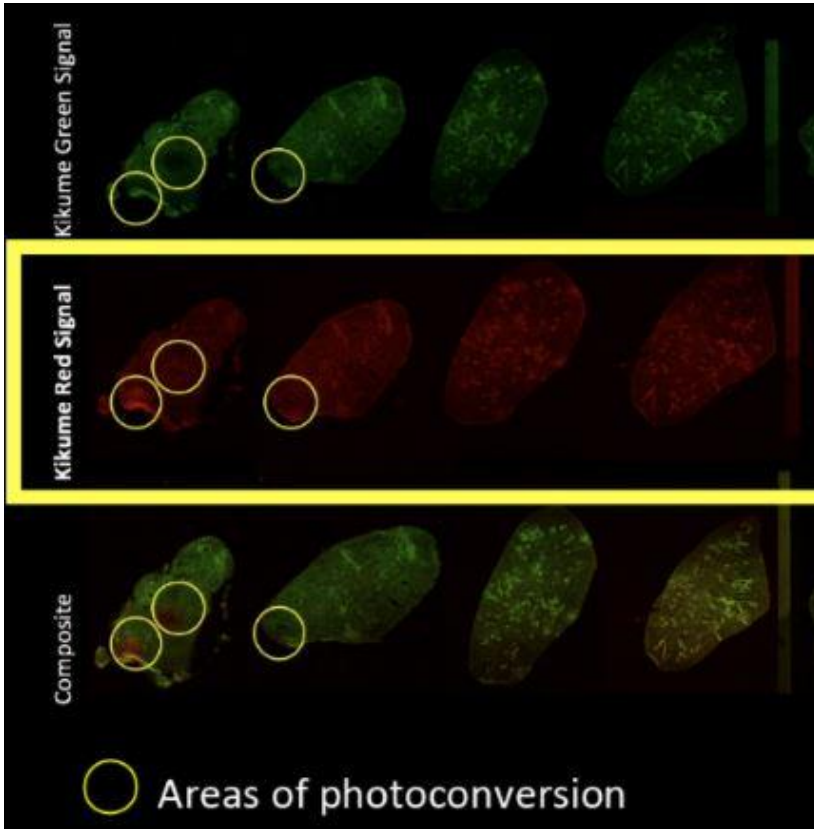


Fig. 2: Red cells after the photoconversion shows that the cells responded to the infection

Product Design Specifications (PDS)

- Size
  - Less than 1 cm^2
- Light Source
  - 405nm and 480nm
  - 95 mw/cm^2 for photoconversion
- Safe
  - Limited heat emission
  - Biocompatible material
  - User-friendly
- Budget
  - We are trying to keep it under $25 per implant
  - Reusable (sterilizable with ethanol)

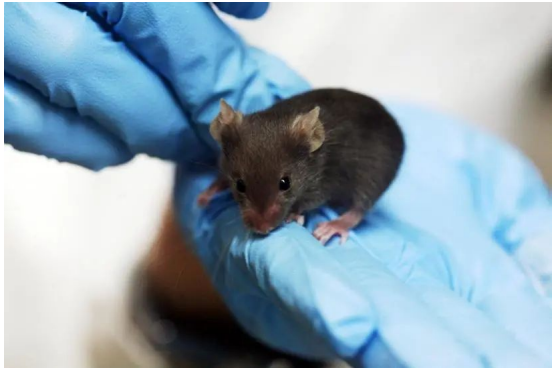


Fig. 3: Example of lab mouse that would have the implant

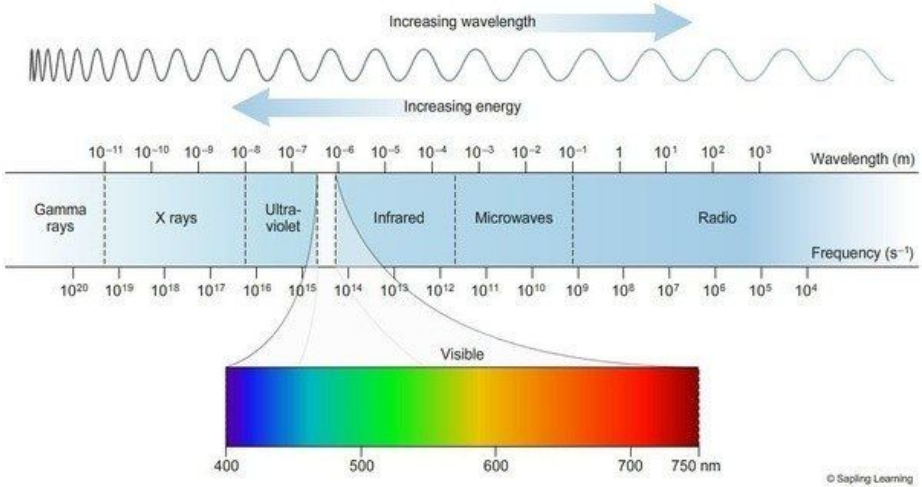


Fig. 4: Our implant will emit at 405 nm and 480 nm

Previous Prototype

- 4 LEDs connected in parallel
- Microcontroller for coding and power supply
- Disadvantages:
  - Too much wiring
  - Manufacturing is difficult
  - Hard for maintenance

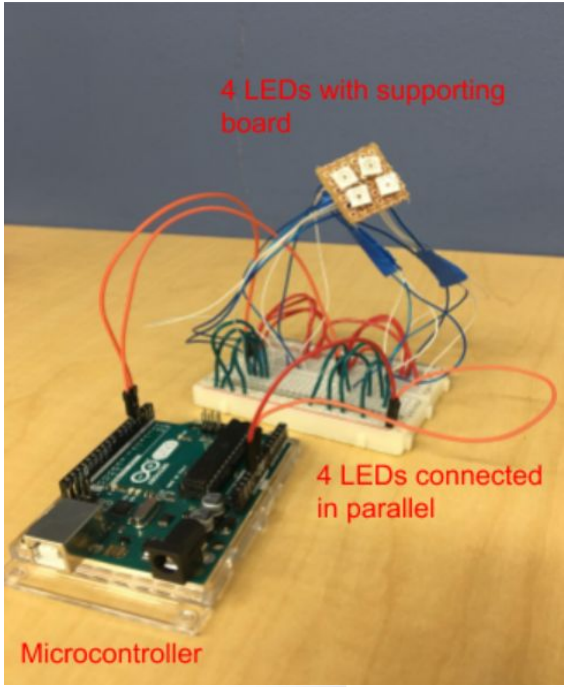
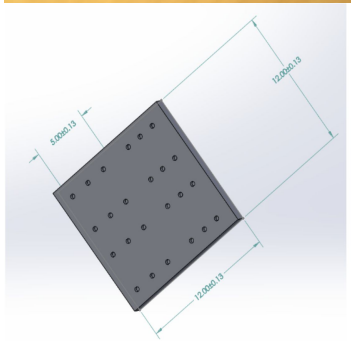
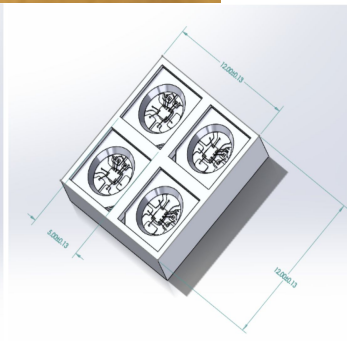


Fig. 5, 6: The image to the left is the previously developed prototype. The image below is a CAD sketch of the 4 LEDs and perf board in the back





Previous Prototype Testing Results

- The LED mat design could reach a light intensity of over 800 mW/cm2 with covered biomaterial, which shows it is capable of the light conversion.

Figure 8: Spectrum of light emitted by LED

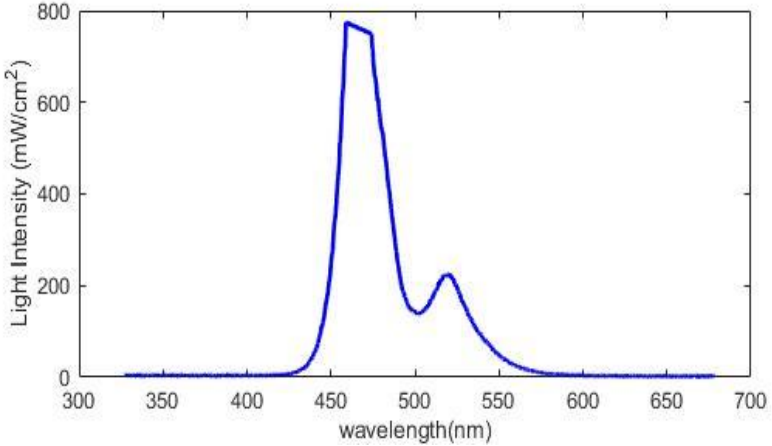
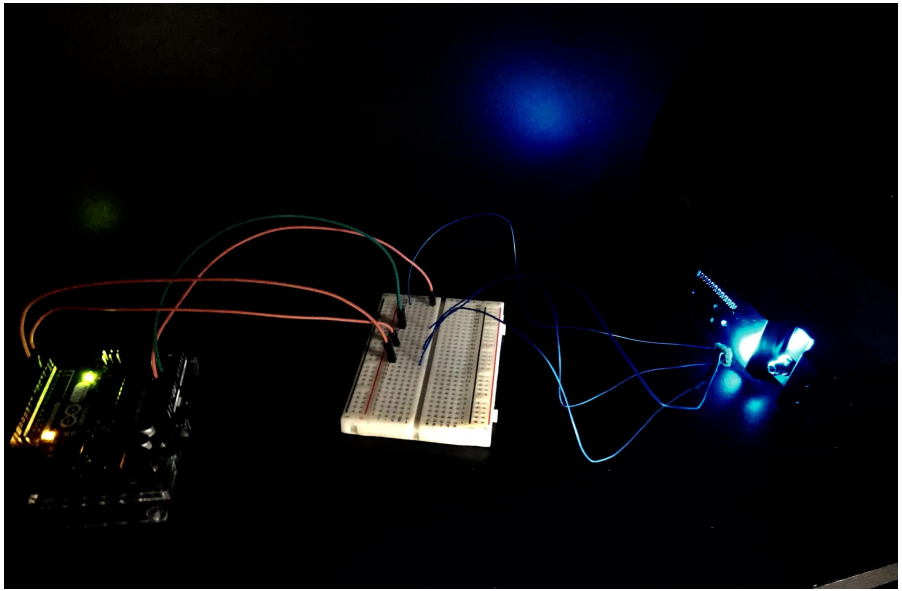


Figure 7: Testing environment



Circuit Schematic for New Prototype

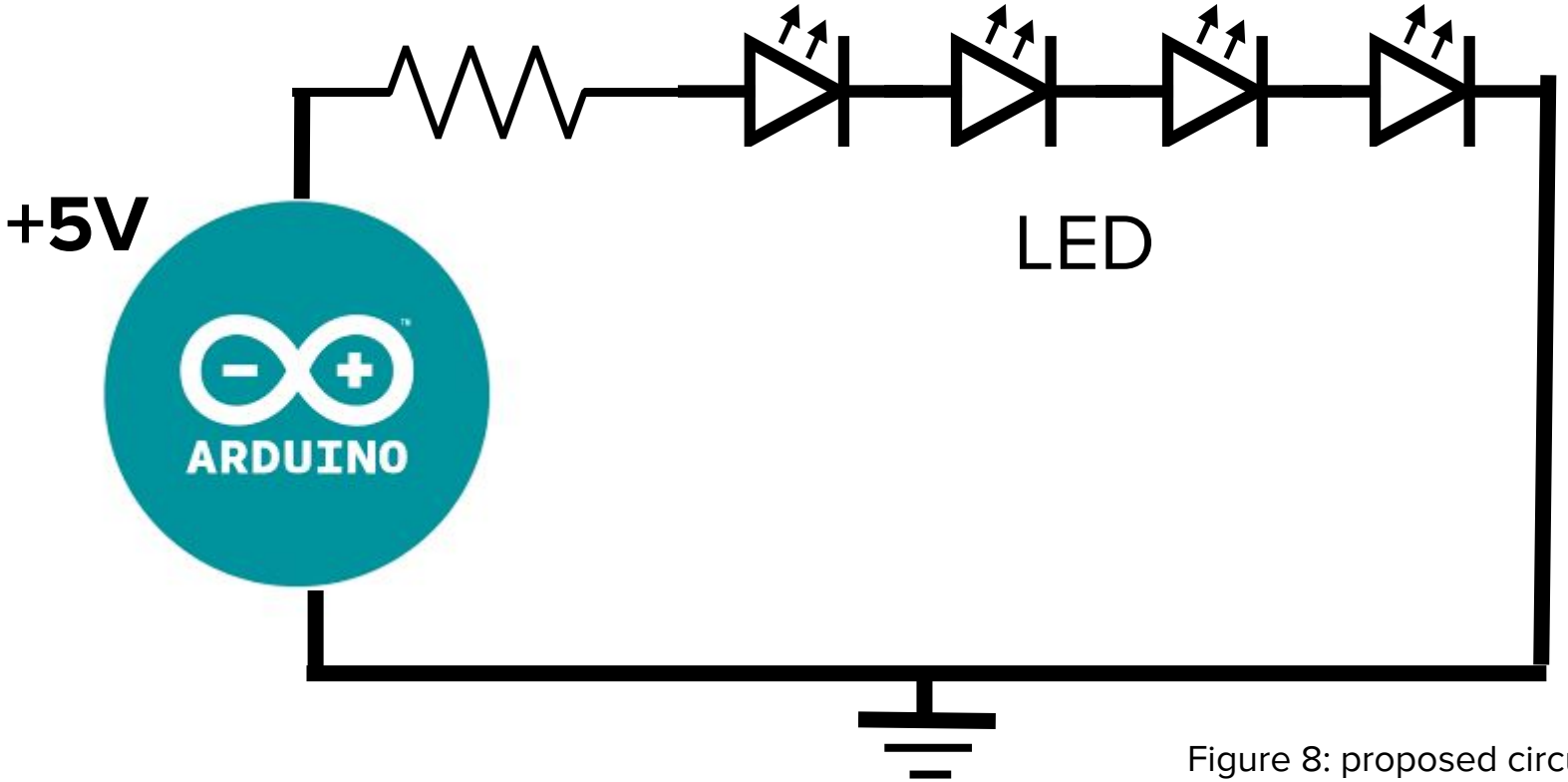


Figure 8: proposed circuit schematic

Design Matrix for Electronic Circuit Design

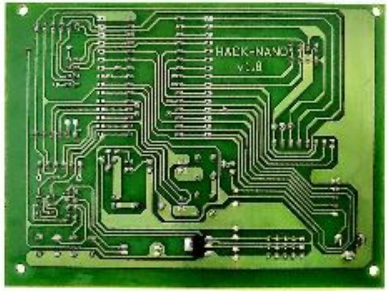
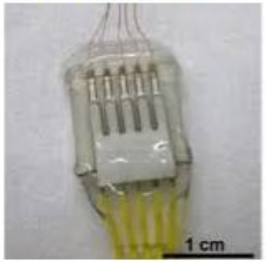
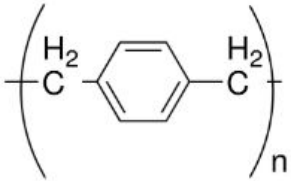
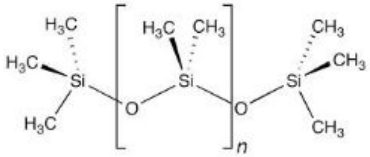
Criteria (weight)	Pin and wire 	PCB integration 	Implantable connectors 
Safety (30)	3/5	4/5	5/5
Ease of Use (30)	2/5	4/5	2/5
Stability (20)	2/5	5/5	4/5
Ease of Fabrication (15)	2/5	4/5	3/5
Cost(5)	5/5	4/5	3/5
Total (100)	49	84	70

Table 1: Design Matrix Electronic Circuit Design

Design Matrix for Biocompatible Coating

Criteria (weight)	Parylene 	PDMS 	Mastersil 151 Med 
Biocompatibility (40)	5/5	3/5	4/5
Ease of Fabrication (25)	3/5	4/5	5/5
Permeability (13)	5/5	2/5	4/5
Optical Clarity (10)	5/5	4/5	4/5
Flexibility (7)	3/5	4/5	5/5
Cost (5)	5/5*	5/5*	4/5
Total (100)	87.2	67.8	86.4

*available with campus resources

Table 2: Design Matrix Biomaterials

Future Work

- Electric Circuit Design
- Biomaterial research
- Heat Diffusion testing
- Spectrophotometry testing
- *In vivo* testing by client's lab members

Acknowledgement

Our team would like to thank Dr. Williams for his guidance and thank Dr. Sandor’s Lab for providing us the opportunity to work on this project.

Sources

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- Dr. Sandor and team

Questions?