Fabrication of Nanopatterns on an Artificial Cornea Device

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Introduction

Cornea Afflictions

- Are the second leading cause of blindness.
- Treatment is limited due to a limited supply of cornea donors.

Current Artificial Cornea Devices

- Surface is susceptible to biofilm formation. and contamination.

Nanopatterns

- Nano-lines promote cell adhesion and cell growth.
- Nano-pillars rupture bacteria when they come in contact.

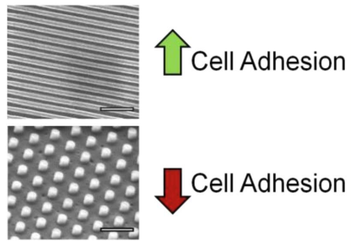
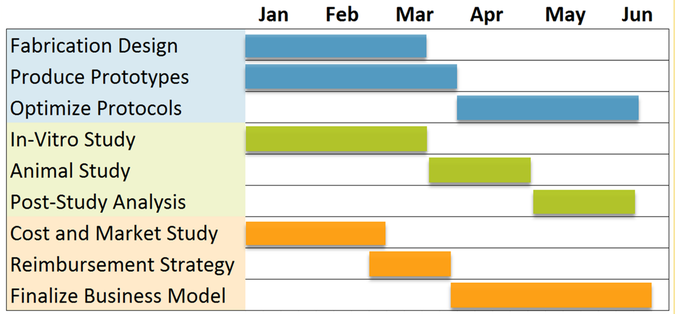


Figure 1. Surface effects of nanopatterns [4]

Project Timeline



Project Goals

- **Optimize the fabrication methods for imprinting nano-patterns onto the device.**
- **Create a device that is biocompatible with the host while retaining its bactericidal properties.**

Project Design

Fabrication and Validation

- Redesign fabrication apparatus
- Manufacture artificial cornea implants, then use specialized nano-imprint method to create patterns
- Characterization with SEM for verify nanopattern formation and FEA to test the durability.

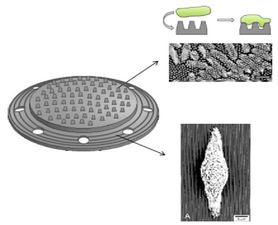


Figure 2. Implant design and nanopattern implementation [4].

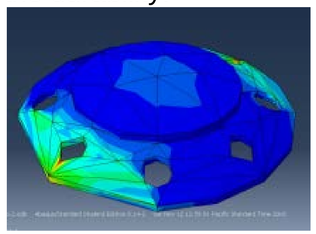


Figure 3. FEA to test stress similar to those experienced during implantation with tweezers [3].

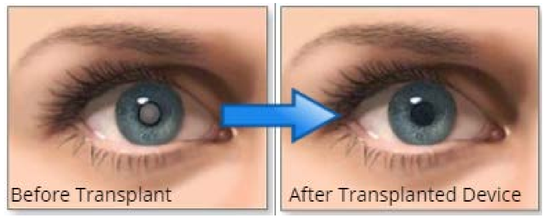


Figure 5. Representation of an eye before and after transplantation [2].

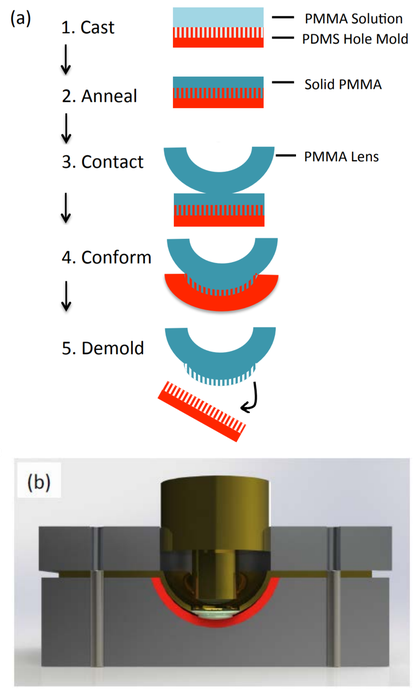


Figure 4. Reverse nanoimprint lithography (r-NIL) is used. (a) Imprinting process (b) and the holder device for alignment and pressing [3].

Team Roles

Fabrication Design

Cesar D. Ramales
Biomedical Engineer
Brendon B. Tran
Biomedical Engineer

- Fabricated cornea lens from low-crosslink PMMA sheets
- Optimized imprinting alignment to improve the success rate for properly printing the nano-patterns onto the lens surface.

Animal Study

Mai T. Yang
Material Science Engineer

- Conducted in vitro study using cell cultures to observe potential of nano-grooves in improving cell interaction.
- Preparing second trial of animal study using Albino New Zealand rabbit to observe any potential biocompatibility issues.

Market Analysis

Heejun Chough
Material Science Engineer
Calvin Li
Material Science Engineer

- Analyzed the marketability of our artificial cornea device in a global market,
- Researched for various avenues that can help further improve the marketability of our product.

In Vitro & In Vivo Study

In Vitro

- Observing cell to cell interaction and rate of wound enclosure

In Vivo

- Implant device into rabbits with a vacuum pick up system
- Weekly OCT imaging and slit lamp exams

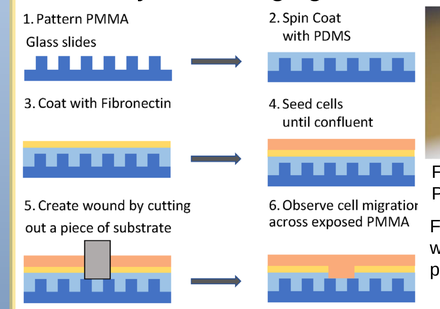


Figure 6. (Left) In-Vitro wound experiment procedure

Figure 7. (Top)Ted Pella vacuum [3]

References

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[4] Wu, Yumeng, et al. (2016). *Incorporation of Nanopatterns onto Curved Artificial Cornea Devices and Testing of Durability.* University of California, Irvine.

Acknowledgements

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