

Use of Metallic Antibacterial Coating in Glaucoma Treatment Device

Logan Stowe, Dr. Carl Frick

University of Wyoming

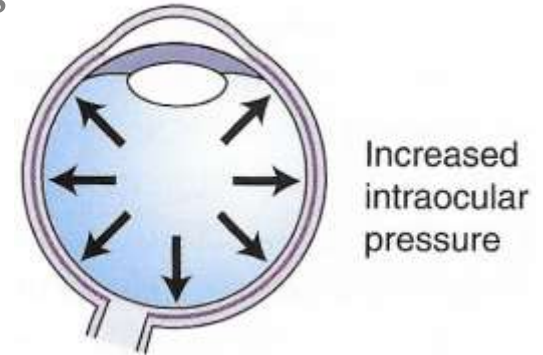
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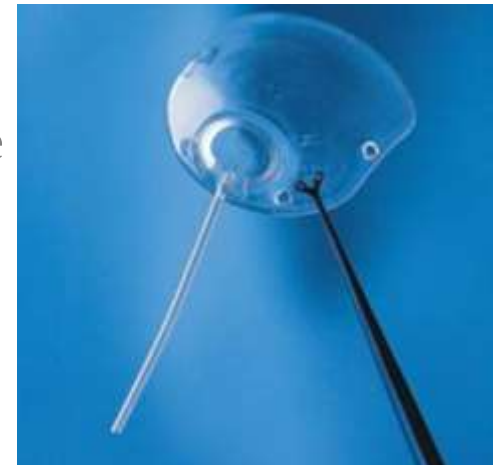
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Background: Glaucoma

- Group of eye diseases affecting 2.7 million Americans
 - Characterized by the inability of the eye to maintain healthy intraocular pressure (IOP)
 - *National Eye Institute, 2014*
- Current treatments focus on reduction of IOP
 - Topical eye drops, laser surgery
 - No effective long-term treatment
- Advanced glaucoma treated with implanted drainage device
 - Prone to failure due to bacterial infection
 - S. Gedde, et al; *American Journal of Ophthalmology*, 2012



K. McCance, et al; *Pathophysiology 7E*, 2014



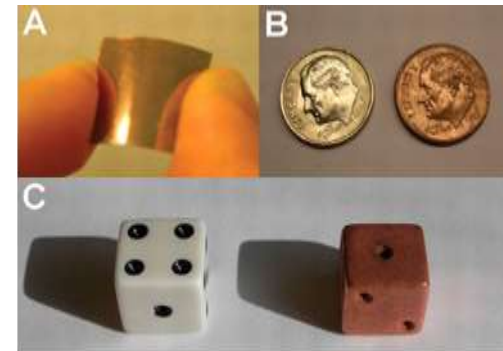
American Academy of Ophthalmology

Metallic Coating

- Copper possesses well documented antibacterial properties
 - “Contact killing” of most bacteria ranges from minutes to hours
 - G. Grass, C. Rensing, M. Solioz, *American Society for Microbiology*, 2010
- Copper coated, microporous device can potentially alleviate bacterial infection failures in glaucoma drainage devices
 - Adhesion between metallic material and flexible, porous material
- Coated via wet dip coating process involving intermediate polydopamine layer



CopperBioHealth

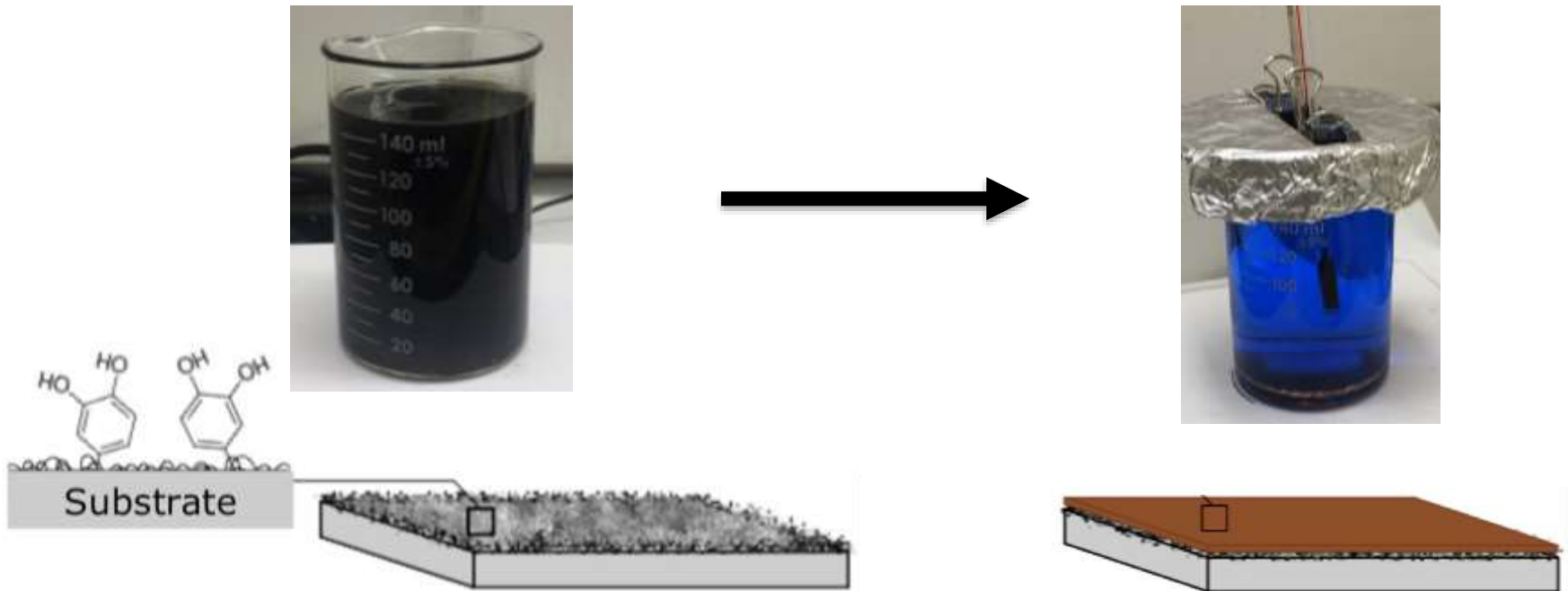


H. Lee, et al; *Science*, 2007



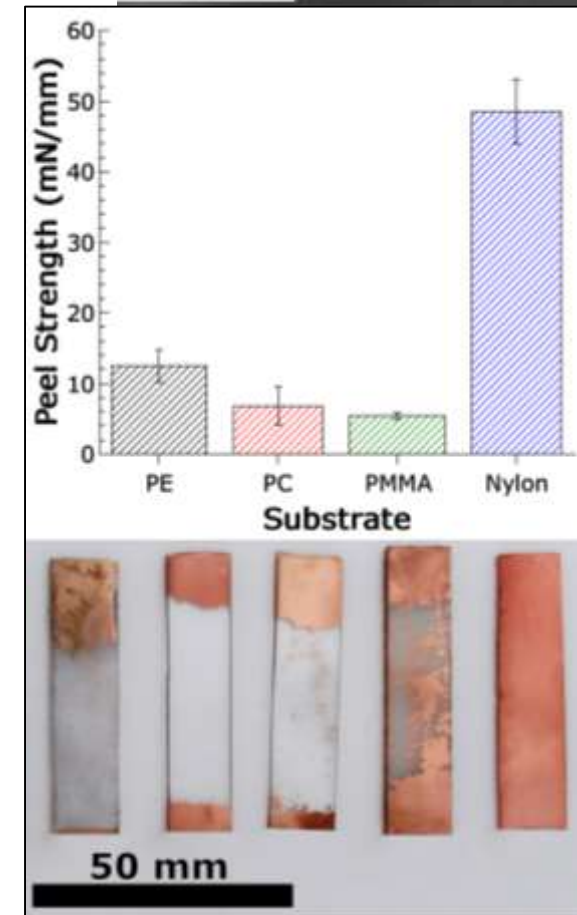
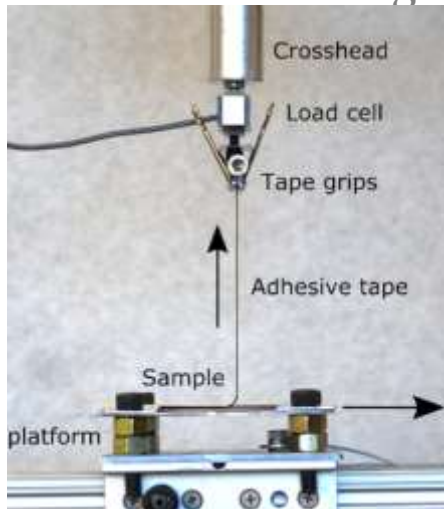
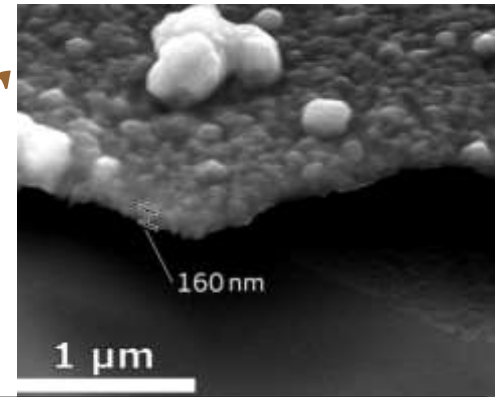
Dopamine adhesive

- Synthetic molecule designed to mimic aquatic mussel adhesive proteins
- Acts as an intermediate bonding layer between plastic substrate and metallic (copper) coating
 - Hydrogen and covalent interactions with polymer substrates
 - Coordination bonding with metal species



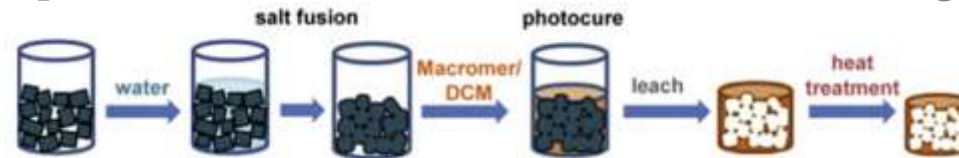
Electroless Copper

- Wet chemical process used to deposit copper film on substrate surface
 - Tested on a variety of substrates
 - 160 nanometer copper film thickness
- 90 degree peel test utilized to test adhesive strength
 - ASTM D6862
 - Surface roughening increases adhesion

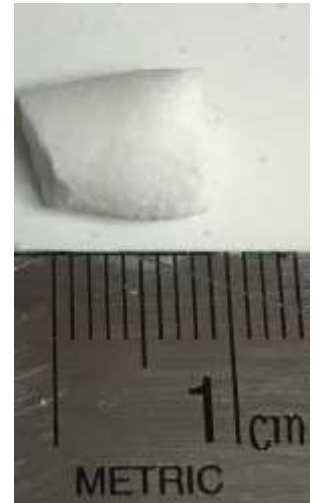


Liquid Crystalline Elastomer

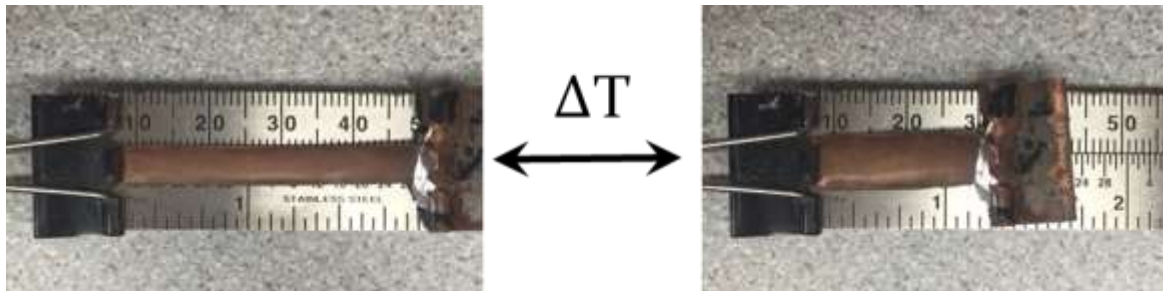
- Current research involves developing porous LCEs for potential use as an easy to remove glaucoma treatment device
 - Involves casting semi-viscous LCE into porous salt structure
 - Ease of replacement combats certain failures such as clogging



D. Zang, et al; 2012



- Exhibits large shape changes in response to stimuli
 - Copper coating remains intact



- LCE flexibility makes adhesion testing difficult
 - Substrates with similar surface chemistry show promising results

Conclusions

- A copper coated glaucoma treatment device could alleviate complications due to bacterial infection
- The copper coating process utilizing a mediating polydopamine layer successfully bonded copper to a range of substrates
 - Evaluated with 90 degree peel test
 - Surface roughness has a direct correlation to copper adhesion
- LCEs possess unique abilities favorable in biomedical application
 - Promising compatibility with copper coating

References

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Advanced Materials Lab

Faculty Advisor: Dr. Carl Frick

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