BIOGRAPHICAL SKETCH

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NAME: David Myung

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POSITION TITLE: Assistant Professor of Ophthalmology

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	MM/YY	FIELD OF STUDY
Yale University	B.A., B.A.	05/00	Molecular Biology, History
Stanford University School of Engineering	M.S.	06/06	Chemical Engineering
Stanford University School of Engineering	Ph.D.	01/08	Chemical Engineering
Stanford University School of Medicine	M.D.	06/11	Medicine
Kaiser Permanente (Santa Clara, CA)	Internship	06/12	Internal Medicine
Byers Eye Institute at Stanford	Residency	06/15	Ophthalmology

A. Personal Statement

I am a clinician-scientist with appointments at both the VA Palo Alto Health Care System (VAPAHCS) Division of Ophthalmology and the Byers Eye Institute at Stanford University School of Medicine (BEIS). My primary research focus within regenerative medicine and drug delivery has been on the therapeutic applications of engineered biomaterials through novel, *in situ* applications of biocompatible chemical modalities. Through my interdisciplinary scientific background in molecular & cellular biology, medicine, and chemical engineering, I have garnered specific skills and knowledge in methods of modifying the mechanical and biointerfacial properties of polymers and living tissues. I was recently awarded a K08 Career Development Award from the National Eye Institute (NEI) as well as a grant from the Stanford SPARK Translational Research program to study the localized delivery of recombinant growth factors to enhance wound healing in the eye. My research group also utilizes biomolecular engineering techniques to create microenvironments for human mesenchymal stem cells and delivery vehicles for their resulting secreted factors for the purpose of promoting corneal and ocular surface wound healing.

B. Positions and Honors

Employment:

2017-present *Assistant Professor,* Department of Ophthalmology
VA Palo Alto Health Care System
Byers Eye Institute at Stanford University School of Medicine

2016-present *Co-Director*, Ophthalmic Innovation Program, Byers Eye Institute at Stanford

2015-present *Attending Physician*, VA Palo Alto Health Care System

2015-2016 *Instructor (Affiliated)*, Byers Eye Institute at Stanford University School of Medicine

Other Positions:

2016-present *Section Editor,* Regenerative Medicine in Ophthalmology
Current Ophthalmology Reports (a Springer journal)

2008-present *Guest Lecturer*, Stanford University School of Engineering, Departments of Chemical Engineering and Bioengineering and Stanford Biodesign (Courses: BioE273: Biodesign for Mobile Health, ChemE260: Polymer Science and Engineering, BioE361: Biomaterials in Regenerative Medicine).

Honors:

2017 *Faculty Fellow*, Stanford Chemistry, Engineering, and Medicine for Human

	Health (CHeM-H) Institute
2017	*Awardee,* Stanford SPARK Translational Research Grant Program (Principal Investigator)
2014	*Awardee,* Stanford SPECTRUM/Biodesign Translational Research Grant Program (Co-Investigator)
2013-present	*Member,* Stanford Society of Physician Scholars, Stanford University School of Medicine
2012	Professionalism Award (Kaiser Permanente Medical Center)
2005-2007	Bio-X Graduate Fellow (Stanford University)
2007	Runner-Up, Stanford Entrepreneur's Challenge (E-Challenge) Business Plan Competition
2007	Selected Participant, Stanford Emerging Entrepreneurs Workshop
2007	Recipient, Stanford Office of Technology Licensing Seed Grant
2006	Outstanding Teaching Assistant in Chemical Engineering (Stanford University)
2004	Stanford Medical Scientist Scholarship
2004	Fight For Sight Foundation Summer Research Fellowship
2002-2003	Stanford Arts & Humanities in Medicine Scholarship
2001-2003	Research Associate/Web Manager, Curriculum Web Project, Stanford University Medical Media & Information Technologies (SUMMIT) Program
2001	Voice over IP User Interface Designer, Applisys, Inc., Bedford, MA (Summer Intern)
2000	Phi Beta Kappa (Yale University)
2000	Berkeley College Class Marshall (Yale University)
2000	Cum Laude Graduate (Yale University)
1999-2000	Berkeley College Residential Freshman Counselor (Yale University)
2000	Honors in History Major (Yale University)
1999	Paul Mellon Research Grant for Historical Studies (Yale University)
1999	Robin Berlin Memorial Prize for Interdisciplinary Research in Science and Humanities (Yale University)

C. Contributions to Science

1. Novel hydrogel development and characterization. My early publications were focused on the development, characterization, and surface modification of hydrogel polymer alloys for corneal applications. The work centered on the rational design of an interpenetrating polymer network (IPN) of two otherwise fragile hydrogel polymers to form a mechanically superior combination that maintained a high level of solute permeability. The two polymers we used were end-functionalized poly(ethylene glycol) and crosslinked poly(acrylic acid). The IPN was engineered to match both the glucose permeability and tensile modulus of the cornea based on benchtop *in vitro* experiments. A second facet of this work was the surface modification of this otherwise poorly cell-adhesive material with collagen type I through azide-active-ester photochemical crosslinking. *In vitro* cell culture work demonstrated successful growth of corneal epithelial and fibroblast cells on the modified material. This work laid the foundation for a multi-departmental collaboration that garnered funding from both the NIH and the Singapore Eye Research Institute.

a. **Myung D**, Derr K, Huie P, Noolandi J, Ta KP, and Ta CN. Glucose permeability of human, bovine, and porcine corneas *in vitro*. *Ophthalmic Research*, 38(3), 2006: p. 158-163.
b. **Myung D**, Waters D, Wiseman M, Duhamel P-E, Noolandi J, Ta CN, and Frank CW. Progress in the development of interpenetrating polymer network hydrogels. *Polymers for Advanced Technologies,* 19, 2008: pp. 647–657.
c. **Myung D**, Koh W, Bakri A, Zhang F, Marshall A, Ko J, Noolandi J, Carrasco M, Cochran JR, Frank CW, and Ta CN. Design and fabrication of an artificial cornea based on a photolithographically patterned hydrogel construct. *Biomedical Microdevices,* 9(6), 2007: pp. 911-922.
d. **Myung D**, Kourtis L, Noolandi J, Cochran JR, Ta CN, Frank CW. Handbook of Biofunctional Surfaces. Knoll W editor. Boca Raton, FL: CRC Press, Taylor & Francis Group; 2012. Chapter 10, Surface

Modification of High-Strength Interpenetrating Network Hydrogels for Biomedical Device Applications; p.407-446. 1184 pages

2. Hydrogel *In Vivo* Implantation Studies. Later work focused on animal studies of the IPN hydrogel as both an epithelialization-supporting corneal onlay and an intrastromal corneal inlay. The corneal onlay was surface-modified using azide-active-ester photocrosslinking chemistry, which enabled the tethering of collagen type I directly to the surface of the hydrogels. Hydrogel implants were positioned under a LASIK flap with and without a central button-hole, which was re-positioned to allow wound healing over the polymer. Subsequent experiments focused on the corneal inlay approach alone, and revealed that deep stromal implantation provided the most favorable results.

a. Tan XW, Hartmann L, Tan KP, Poh R, **Myung D**, Zheng LL, Waters D, Noolandi J, Beuerman R, Frank CW, Ta CN, Tan DTH, Mehta JS, Preclinical testing of two PEG/PAA interpenetrating polymer networks as corneal inlays following deep stromal pocket implantation. *J Mater Sci: Mater Med* (2013) 24:967–977
b. **Myung D**, Farooqui N, Koh W, Carrasco M, Noolandi J, Cochran JR, Frank CW, and Ta CN. Bioactive interpenetrating polymer networks that support corneal epithelial wound healing. *Journal of Biomedical Materials Research, Part A,* 90A, 2009: pp. 70–81.
c. **Myung D**, Farooqui N, Koh W, Waters D, Schaber S, Carrasco M, Noolandi J, Frank CW, and Ta CN. Glucose-permeable interpenetrating polymer network hydrogels for corneal implant applications: a pilot study. *Current Eye Research*, 33, 2007: pp. 29-43.

3. Biomechanical Enhancement of Hydrogel Alloys. In the course of my thesis work, we came to understand the fundamental principles that dictate the mechanical properties of the IPN. An additional property that I discovered about this class of polymers (without biological surface modification) was its lubriciousness and potential to mimic hyaline cartilage. Re-engineering the material to more closely match the stiffness of cartilage (10-12 MPa) led to a collaboration with orthopaedic surgeons and biomechanical engineers focused on creating orthopaedic bearing based on this technology, which has been licensed out of the university. Mechanical, biocompatibility, and friction testing, as well as wear-resistance evaluation demonstrated its great promise as a cartilage substitute. Preliminary *in vitro* work was also conducted on the response of bone cells (osteoblasts) to particles of the material, showing minimal inflammatory response. Robust chemical adhesion of candidate polymers to metal has also been achieved.

a. Muir, B **Myung D**, Knoll W, and Frank CW. Grafting of crosslinked hydrogel networks to titanium surfaces. *ACS Journal of Applied Materials and Interfaces,* 6(2), 2014: pp. 958-966
b. **Myung, D**. Structure, Properties, and Medical Device Applications of Biomimetic Hydrogel Alloys. *Ph.D. Dissertation,* Stanford University, Copyright 2008.
c. Hydrogel arthroplasty device, United States Patent 8679190 B2, 2014.
d. **Myung D**, Koh WG, Ko J, Hu Y, Carrasco M, Noolandi J, Ta CN, and Frank CW. Biomimetic strain hardening in interpenetrating polymer network hydrogels. *Polymer,* 48, 2007: pp. 5376-5387.
e. Yim ES, Zhao BY, **Myung D**, Kourtis L, Frank CW, Carter D, Smith RL, and Goodman SB. Response of Raw264.7 macrophage and MG63 osteoblast cell lines to poly(ethylene glycol)/poly(acrylic acid) interpenetrating polymer network hydrogel particles *in vitro*. *Journal of Biomedical Materials Research, Part A,* 91A(3), 2009: pp. 894 – 902.

4. Digital Health and Telemedicine. During residency I led the development of a smartphone-based ophthalmic imaging system for both the anterior and posterior segments of the eye. The system is a set of low-cost adapters designed to co-axially mount user-owned examination lenses in front of a smartphone camera while also providing proper illumination. The system is coupled to a smartphone app that not only controls the camera and provides secure upload of photos to a HIPAA-secure database, but also enables visual acuity and other measures of visual function. The device was registered with the FDA as a 510(k) Class II exempt ophthalmic camera in November 2015. It has been used and test in emergency room and inpatient settings, in a high-volume diabetic screening clinic, as well as on international missions to Nepal and Ethiopia, and has been shown to provide excellent sensitivity and specificity for capturing ophthalmic pathology compared to in-person clinical examination.

a. **Myung D**, Jais A, He L, Blumenkranz MS, Chang RT. 3D Printed Smartphone Lens Adaptor for Rapid, High Quality Retinal Imaging, *Journal of Mobile Technology in Medicine*, 2014, Vol. 3, Issue 1: 9-15.
b. **Myung D**, Jais A, He L, Blumenkranz MS, Chang RT. Simple, Low-Cost Smartphone Adapter for Rapid, High Quality Ocular Anterior Segment Imaging: A Photo Diary, *Journal of Mobile Technology in Medicine*, 2014, Vol. 3, Issue 1: pp. 2-8.
c. Toy B, **Myung D**, He L, Pan C, Chang R, Polkinhorne A, Merrell D, Foster D, Blumenkranz M. Smartphone Ophthalmoscopy Adapter as an Inexpensive Screening Tool to Detect Referral-Warranted Diabetic Retinopathy. *Retina,* 2016, Vol 36 Issue 5: 1000-1008.
d. Ludwig CA, Murthy SI, Pappuru RR, Jais A, **Myung D**, Chang RT. A novel smartphone ophthalmic imaging adapter: User feasibility studies in Hyderabad, India. *Indian Journal of Ophthalmology*, 2016, Vol 64, Issue 3: 191-200.

5. Corneal Augmentation and Regeneration. I am currently focused on clinical applications of chemical crosslinking. Toward the end of my PhD work, I had explored the effect of surface-tethering epidermal growth factor (EGF) to collagen-coated hydrogel substrates using azide-active-ester photochemistry. This work remained largely dormant for the better part of four years until I was established in my ophthalmology residency, when I was introduced to riboflavin-mediated corneal crosslinking. I learned more about this technology through my involvement in the FDA clinical trial evaluating UV/riboflavin crosslinking for keratoconus and post-LASIK ectasia. Before long, I realized the broad potential for using chemistry to treat other ocular conditions. During my residency, I developed a particular interest in ocular wound healing and an appreciation of the continued unmet clinical need for better treatments for challenging conditions of the ocular surface such as Stevens-Johnsons Syndrome and chemical injury. My interactions with patients suffering from these diseases are what inspired the idea to combine collagen crosslinking technologies with my prior work on biomolecular surface modification of materials as a potential way to enhance corneal wound healing using both light-based and light-free approaches. My research group and our collaborators recently presented at ARVO in 2017 and are set to do so again in 2018, and we have recently published our work on biomolecule anchoring in *ACS Applied Materials and Interfaces* and *Biomacromolecules*.

a. Fernandes-Cunha G, Lee HJ, Kumar A, Kreymerman A, and **Myung D**. Immobilization of Growth Factors to Collagen Surfaces Using Visible Light. Biomacromolecules, 2017. *18* (10), pp 3185–3196
b. Lee HJ, Fernandes-Cunha G, Putra I, Koh WG, **Myung D**. Tethering Growth Factors to Collagen Surfaces Using Copper-free Click Chemistry: Surface Characterization and In Vitro Biological Response. *ACS Applied Materials and Interfaces*, 2017. *9* (28), pp 23389–23399
c. **Myung D**, Manche EE, Tabibian D, Hafezi F. “The Future of Crosslinking,” Invited book chapter, in *Corneal Collagen Crosslinking*, Edited by A. Cummings. and M. Sinjab, Springer 2016, pp: 269-292, ISBN 978-3-319-39775-7
d. **Myung D**, Manche EE. Early clinical experience with corneal crosslinking at the Byers Eye Institute at Stanford. Abstract presented at the American Society of Cataract and Refractive Surgery Meeting, 2015.

Complete List of Published Work in MyBibliography:
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