

UNIVERSITY OF PENNSYLVANIA – SCHOOL OF DENTAL MEDICINE

Curriculum Vitae

Date: November 2019

**Geelsu Hwang, Ph.D.**

Office Address: 240 40<sup>th</sup> St. Levy 422  
School of Dental Medicine, University of Pennsylvania  
Philadelphia, PA 19104

Education: 2004-10 Ph.D. Yonsei University (Chemical and Biomolecular Engineering)  
1997-2004 B.S. Yonsei University (Chemical Engineering)

Postgraduate Training and Fellowship Appointments:

2013-15 Postdoc, Orthodontics, School of Dental Medicine, University of Pennsylvania, Philadelphia, PA  
2012-13 Postdoc, Center for Oral Biology, University of Rochester, Rochester, NY  
2010-12 Postdoc, Civil & Environmental Engineering, University of Alberta, Edmonton, Canada  
2010 Postdoc, Nano Medical National Core Research Center, Yonsei University, Seoul, South Korea

Faculty Appointments:

2019- Assistant Professor, University of Pennsylvania, School of Dental Medicine, Philadelphia, PA  
2017-19 Research Assistant Professor, University of Pennsylvania, School of Dental Medicine, Philadelphia, PA  
2015-17 Research Associate, University of Pennsylvania, School of Dental Medicine, Philadelphia, PA  
2010 Lecturer, Chemical Engineering, Seoul National University of Science and Technology, Seoul, South Korea

Awards and Fellowships:

Individual:

2018 The Joseph and Josephine Rabinowitz Award for Excellence in Research at The University of Pennsylvania School of Dental Medicine

- 2016 AADR Travel Award, Penn Dental Research Day, School of Dental Medicine, University of Pennsylvania, Philadelphia, PA
- 2014 AADR Travel Award, Penn Dental Research Retreat, School of Dental Medicine, University of Pennsylvania, Philadelphia, PA
- 2008-09 BK21 fellowship from NRF, Yonsei University, Seoul, South Korea
- 2004, 2006 Doctoral scholarship, Yonsei University, Seoul, South Korea
- 2002-03 Undergraduate scholarship, Yonsei University, Seoul, South Korea

By students/fellows (as mentor/supervisor):

- 2019 AADR Travel Award, Penn Dental Research Day, School of Dental Medicine, University of Pennsylvania, Philadelphia, PA (Hye-Eun Kim)
- 2018 AADR Travel Award, Penn Dental Research Day, School of Dental Medicine, University of Pennsylvania, Philadelphia, PA (Sherry X. Wan)

Memberships in Professional and Scientific Societies:

National Societies:

- Biomedical Engineering Society (2019-)
- American Chemical Society (2019-)
- American Society for Microbiology (2015-)
- American Association for Dental Research/International Association for Dental Research (2014-)

International Societies:

- Korean-American Scientists and Engineers Association (2018-)
- Canadian Society for Civil Engineering (2012)
- Korean Society of Environmental Engineer (2009)
- The Korean Society of Industrial and Engineering Chemistry (2008-09)
- The Korean Institute of Chemical Engineers (2006-09)
- The Korean Society for Biotechnology and Bioengineering (2005-09)

Scientific Committees:

- AADR Edward H. Hatton Awards Committee (2020-2022)

Proposal Coordinator for Clinical and Translational Science Network for the 2020 IADR/AADR/CADR General Session in Washington, D.C., USA (2020)

Abstract reviewer for Cariology Research Group; Poster session chair for the 2019 IADR/AADR/CADR General Session in Vancouver, BC, Canada (2019)

Ad hoc reviewer for NIH/NIDCR study section (2018)

#### Journal Reviews:

ACS Applied Materials & Interfaces (2019-)

mBio (2019-)

ACS Infectious Diseases (2019-)

Frontiers in Microbiology (2019-)

Frontiers in Chemistry (2019-)

Future Microbiology (2019-)

Photochemistry and Photobiology (2019-)

Biomedicine & Pharmacotherapy (2019-)

Chemical Biology & Drug Design (2019-)

Thin Solid Films (2019-)

Chemical Science (2018-)

Environmental Microbiology (2018-)

Molecular Oral Microbiology (2018-)

Scientific Reports (2018-)

Journal of Membrane Science (2018-)

Materials Chemistry and Physics (2018-)

Materials Letters (2018-)

International Journal of Mining Science and Technology (2018-)

Biofouling (2017-)

Journal of Oral Microbiology (2017-)

Journal of Industrial and Engineering Chemistry (2017-)

Journal of Dental Research (2016-)

Archives of Oral Biology (2016-)

International Biodeterioration & Biodegradation (2016-)

Head & Face Medicine (2016-)

Microbiology (2013-)

#### Major Teaching and Training Responsibilities:

Lecturer:

Separation Process, Chemical Engineering, Seoul National University of Science and Technology, Seoul, South Korea (2010)

Training Activities:

Post-Doctoral Trainees and Fellows:

Atul Dhall, Ph.D. Post-Doctoral Fellow (2019-)

Hye-Eun Kim, Ph.D. Post-Doctoral Fellow (2018-)

Graduate Students:

Serry X. Wan, dual-degree D.M.D./M.S. candidate in Bioengineering, Penn Dental Medicine and Penn Engineering (Co-mentor; 2017-18)

Jia Tian, dual-degree D.M.D./M.S. in Bioengineering, Penn Dental Medicine and Penn Engineering (Co-mentor; 2014-17)

Lectures by Invitation:

- 2019 Forsyth Institute, Cambridge, MA.
- 2019 Levy Research Seminar Series, School of Dental Medicine, University of Pennsylvania, Philadelphia, PA.
- 2018 PKSA symposium, Philadelphia, PA
- 2018 Department of Biological Sciences, University of Delaware, Newark, DE
- 2018 Speaker at the IADR/PER Symposium, 2018 IADR/PER General Session & Exhibition, London, England.
- 2017 Speaker at the Penn Dental Research Day, School of Dental Medicine, University of Pennsylvania, Philadelphia, PA.
- 2016 Levy Research Seminar Series, School of Dental Medicine, University of Pennsylvania, Philadelphia, PA.
- 2016 Biofilm Forum, Dentsply Sirona Global Headquarters, York, PA.
- 2014 Seoul National University of Science and Technology, Seoul, South Korea.

Bibliography:

Research Publications, peer reviewed:

**Hwang G**, Paula AJ, Hunter EE, Yuan Liu, Stebe K, Kumar V, Steager E, Koo H. Catalytic antimicrobial robots for biofilm eradication. **Sci. Robot.** 2019; 4(29): eaaw2388.

Naha PC, Liu Y, **Hwang G**, Huang Y, Gubara S, Jonnakuti V, Simon-Soro A, Kim D, Gao L, Koo H, Cormode DP. Dextran-coated iron oxide nanoparticles as biomimetic catalysts for

localized and pH-activated biofilm disruption. **ACS Nano** 2019; 13: 4960-71.

Ren Z, Kim D, Paula AJ, **Hwang G**, Liu Y, Li J, Daniell H, Koo H. A dual-targeting antibiofilm approach degrades exopolysaccharides matrix and potentiates bacterial killing. **J. Dent Res.** 2019; 98(3):322-30.

Sims KR Jr., Liu Y, **Hwang G**, Jung HI, Koo H, Benoit DSW. Enhanced Design and Formulation of Nanoparticles for Anti-Biofilm Drug Delivery. **Nanoscale** 2019; 11(1):219-36.

Palmer SR, Ren Z, **Hwang G**, Liu Y, Combs A, Söderström B, Vasquez PL, Khosravi Y, Brady LJ, Koo H, Stoodley P. Streptococcus mutans yidC1 and yidC2 impact cell-envelope biogenesis, biofilm matrix and biophysical properties. **J. Bact.** 2018; 12(6):1427-1442.

Liu Y, Naha PC, **Hwang G**, Kim D, Huang Y, Simon-Soro A, Jung HI, Ren Z, Li Y, Gubara S, Alawi F, Zero D, Hara AT, Cormode DP, Koo H. Topical ferumoxytol nanoparticles disrupt biofilms and prevent tooth decay in vivo via intrinsic catalytic activity. **Nat. Commun.** 2018; 9(1):2920.

Kim D, Liu Y, Benhamou RI, Sanchez H, Simón-Soro Á, Li Y, **Hwang G**, Fridman M, Andes DR, Koo H. Bacterial-derived exopolysaccharides enhance antifungal drug tolerance in a cross-kingdom oral biofilm, **ISME J.** 2018; 12(6): 1427-42.

**Hwang G**, Koltisko B, Jin X, Koo H. Non-leachable imidazolium-incorporated composite for disruption of bacterial clustering, exopolysaccharide matrix assembly and enhanced biofilm removal, **ACS Appl. Mater. Interfaces** 2017; 9(44): 38270-80.

**Hwang G**, Liu Y, Kim D, Li Y, Krysan DJ, Koo H. *Candida albicans* mannans mediate *Streptococcus mutans* exoenzyme GtfB binding to modulate cross-kingdom biofilm development *in vivo*, **PLoS Pathog.** 2017; 13(6): e1006407.

Xiao J, Hara AT, Koo H, Zero DT, **Hwang G**. Biofilm 3D architecture influences *in situ* pH distribution pattern on the enamel surface, **Int. J. Oral Sci.** 2017; 9(2): 74-9.

**Hwang G**, Liu Y, Kim D, Sun V, Aviles-Reyes A, Kajfasz JK, Lemos JA, Koo H. Simultaneous spatiotemporal mapping of *in situ*

pH and bacterial activity within an intact 3D microcolony structure, **Sci. Rep.** 2016; 6: 32841.

He J, **Hwang G**, Liu Y, Gao L, Kilpatrick-Liverman LT, Santarpia P, Zhou X, Koo H. L-arginine modifies the exopolysaccharides matrix and thwarts *Streptococcus mutans* outgrowth within mixed-species oral biofilms. **J. Bact.** 2016; JB-00021.

Gao L, Liu Y, Kim D, Li Y, **Hwang G**, Naha PC, Cormode D, Koo H. Nanocatalysts simultaneously disrupt biofilm matrix and kill bacteria to suppress biofilm-associated oral disease in vivo. **Biomaterials** 2016; 101:272-84.

Zhou J, Horev B, **Hwang G**, Klein MI, Koo H, Benoit DSW. Characterization and optimization of pH-responsive polymer nanoparticles for drug delivery to oral biofilms. **J. Mater. Chem. B** 2016; 4:3075-85.

Kim D, **Hwang G**, Liu Y, Wang Y, Singh AP, Vorsa N, Koo H. Cranberry Flavonoids Modulate Cariogenic Properties of Mixed-Species Biofilm through Exopolysaccharides-Matrix Disruption. **PLoS One** 2015; 1-133.

**Hwang G**, Marsh G, Gao L, Waugh R, Koo H. Binding Force Dynamics of *Streptococcus mutans*–glucosyltransferase B to *Candida albicans*. **J. Dent. Res.** 2015; 94(9):1310-7.

Reginah N, Yoo M, Kwon HS, Kim YJ, **Hwang G**, Lee CH, Ahn IS. Application of the extended DLVO approach to mechanistically study the algal flocculation. **J. Ind. Eng. Chem.** 2015; 30: 289-94.

Horev B, Klein MI, **Hwang G**, Li Y, Kim D, Koo H, and Benoit DSW. pH-activated nanoparticles for controlled topical delivery of farnesol to disrupt oral biofilm virulence. **ACS Nano.** 2015; 9(3):2390-404. \**Highlighted in Science*; 'doi:10.1126/science.aab2471'.

Klein MI, **Hwang G**, Santos P, Campanella O, Koo H. *Streptococcus mutans*-derived extracellular matrix in cariogenic oral biofilms. **Front. Cell. Infect. Microbiol.** 2015; 5:10.

**Hwang G**, Klein MI, Koo H. Analysis of the mechanical stability and surface detachment of mature *Streptococcus mutans* biofilms by applying a range of external shear forces. **Biofouling**. 2014; 30(9):1079-91.

Nguyen PT, Falsetta ML, **Hwang G**, Gonzalez-Begne M, Koo H.  $\alpha$ -Mangostin disrupts the development of *Streptococcus mutans* biofilms and facilitates its mechanical removal. **PLoS One**. 2014; 9(10):e111312.

Choi J, **Hwang G**, Gamal El-Din M, Liu Y. Effect of reactor configuration and microbial characteristics on biofilm reactors for oil sands process-affected water treatment. **Int. Biodeterior. Biodegrad.** 2014; 89:74-81.

Alpatova A, Kim ES, Sun X, **Hwang G**, Liu Y, El-Din MG. Fabrication of porous polymer nanocomposite membranes with enhanced anti-fouling properties: Effect of casting composition. **J. Membr. Sci.** 2013; 444: 449-60.

**Hwang G**, Liang J, Kang S, Liu Y. The role of conditioning film formation in *Pseudomonas aeruginosa* PAO1 adhesion to inert surfaces in aquatic environments. **Biochem. Eng. J.** 2013; 76:90-98.

**Hwang G**, Dong T, Islam MS, Sheng Z, Pérez-Estrada LA, et al. The impacts of ozonation on oil sands process-affected water biodegradability and biofilm formation characteristics in bioreactors. **Bioresour. Technol.** 2013; 130:269-77. PMID: 23313671.

**Hwang G**, Ahn IS, Mhin BJ, Kim JY. Adhesion of nano-sized particles to the surface of bacteria: mechanistic study with the extended DLVO theory. **Colloids Surf. B Biointerfaces.** 2012; 97:138-44.

**Hwang G**, Kang S, El-Din MG, Liu Y. Impact of an extracellular polymeric substance (EPS) precoating on the initial adhesion of *Burkholderia cepacia* and *Pseudomonas aeruginosa*. **Biofouling**. 2012; 28(6):525-38.

**Hwang G**, Kang S, El-Din MG, Liu Y. Impact of conditioning films on the initial adhesion of *Burkholderia cepacia*. **Colloids Surf. B Biointerfaces.** 2012; 91:181-8.

Kim ES, **Hwang G**, El-Din MG, Liu Y. Development of nanosilver and multiwalled carbon nanotube thin-film nanocomposite membrane for enhanced water treatment, **J. Membr. Sci.** 2012; 394-395:37-48.

**Hwang G**, Yang JH, Lee CH, Ahn IS, Mhin BJ. New selection criterion of a base polar liquid in LW-AB approach. **J. Phys. Chem. C.** 2011; 115(25):12458-12463.

**Hwang G**, Lee CH, Ahn IS, Mhin BJ. Determination of reliable Lewis acid-base surface tension components of a solid in LW-AB approach. **J. Ind. Eng. Chem.** 2011; 17(1):125-9.

**Hwang G**, Lee CH, Ahn IS, Mhin BJ. Analysis of the adhesion of *Pseudomonas putida* NCIB 9816-4 to a silica gel as a model soil using extended DLVO theory. **J. Hazard. Mater.** 2010; 179(1-3):983-8.

**Hwang G**, Park SR, Lee CH, Ahn IS, Yoon YJ, et al. Influence of naphthalene biodegradation on the adhesion of *Pseudomonas putida* NCIB 9816-4 to a naphthalene-contaminated soil. **J. Hazard. Mater.** 2009; 172(1):491-3.

Park B, **Hwang G**, Haam S, Lee C, Ahn IS, et al. Absorption of a volatile organic compound by a jet loop reactor with circulation of a surfactant solution: performance evaluation. **J. Hazard. Mater.** 2008; 153(1-2):735-41.

**Hwang G**, Ban YM, Lee CH, Chung CH, Ahn IS. Adhesion of *Pseudomonas putida* NCIB 9816-4 to a naphthalene-contaminated soil. **Colloids Surf. B Biointerfaces.** 2008; 62(1):91-6.

Reviews, peer reviewed:

Liu Y, Ren Z, **Hwang G**, Koo H. Therapeutic strategies targeting cariogenic biofilm microenvironment, **Adv. Dent. Res.** 2018; 29(1):86-92.

Islam MS, **Hwang G**, Yang Liu. Biological Fixed Film, **Water Environ. Res.** 2012; 84(10):1081-113.



Chelme-Ayala P, Afzal A, Ding N, Moustafa A, Pourrezaei P, Alpatova A, Drzewicz P, **Hwang G**, Kim ES, Liu Y, El-Din MG. Physico-Chemical Processes, **Water Environ. Res.** 2012; 84(10):971-1028.

Afzal A, Pourrezaei P, Ding N, Moustafa A, **Hwang G**, Drzewicz P, Kim ES, Perez-Estrada LA, Chelme-Ayala P, Liu Y, El-Din MG. Physico-Chemical Processes, **Water Environ. Res.** 2011; 83(10): 994-1091.

Books:

Petry R, Oliveira NC, Alves AC, Filho AGS, Martinez DST, **Hwang G**, Sousa FA, Paula AJ. Nanomaterials properties of environmental interest and how to assess them. Nanomaterials Applications for Environmental Matrices: Water, Soil and Air, Ed. Nascimento R; Ferreira OP; Paula AJ; Oliveira V; Neto S. 2019, 45-105.

Grant Support:

Current:

Name of Grant: NIDCR (R01)  
Funding Source: NIH/NIDCR  
**PI: Hwang G**  
Period of Award: 07/01/18-06/30/23

Completed:

Name of Grant: NIDCR Small Grant Program for New Investigators (R03)  
Funding Source: NIH/NIDCR  
**PI: Hwang G**  
Period of Award: 01/01/16-12/31/17

Name of Grant: Industry Sponsored Research  
Funding Source: Dentsply  
PI: Koo H  
Role in Grant: Co-Investigator  
Period of Award: 07/01/15-06/30/16