

KYOO-CHUL KENNETH PARK

Assistant Professor of Mechanical Engineering, Northwestern University

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EDUCATION

Ph.D. Mechanical Engineering, Massachusetts Institute of Technology (MIT) 2013

Dissertation: “Physico-Chemical Hydrodynamics of Droplets on Textured Surfaces
with Engineered Micro/Nanostructures”

Advisor: Dr. Gareth H. McKinley

M.S. Mechanical Engineering, Massachusetts Institute of Technology 2010

B.S. Mechanical and Aerospace Engineering, Seoul National University (SNU) 2008

ACADEMIC & PROFESSIONAL APPOINTMENTS

NAISE Fellow Applied Materials Division, Argonne National Lab 2019-Present

Assistant Professor Mechanical Engineering, Northwestern University 2017-Present

Postdoctoral Fellow John A. Paulson School of Engineering and Applied Sciences,
Harvard University (Advisor: Dr. Joanna Aizenberg) 2013-2016

Graduate Research Assistant Mechanical Engineering, MIT 2008-2013

HONORS AND AWARDS

14. Searle Fellowship (Searle Center for Advanced Learning and Teaching) 2018-2019

13. **IChemE Global Award 2016** (Water Award, Highly Commended (2nd Prize)) 2016

12. **Harvard Postdoctoral Awards for Professional Development** 2016

11. **MIT Wunsch Foundation Silent Hoist and Crane Award** *for Outstanding Graduate Research* 2013

10. MIT de Florez Award (Engineering Design) *for Outstanding Ingenuity and Creative Judgment* 2012

9. **Samsung Scholarship** (\$50k/year) 2011 – 2013

8. **Xerox-MIT Fellowship** (~\$60k/9 months, ~5 MIT students/year only) 2010 – 2011

7. **Cambridge Scholarship** (~\$50k/year) 2008 – 2010

6. **Winner of Hyundai Motor Group Global Top Talent Forum** (1st place, \$10k) 2012

5. The Korean Honor Scholarship 2012

4. New England SNU Alumni Association Scholarship 2012

3. SNU Excellent Thesis Fellowship 2007

2. SNU Scholarship for Academic Excellence 2006 – 2008

1. The Army Commendation Medal (for KATUSA Soldiers, 8th US Army) 2005

RESEARCH INTERESTS

- Multiple length scale surface fabrication – nano-, micro-, and macro- scale surface texture fabrication methods
- Interfacial transport phenomena – fluid mechanics, phase change heat transfer, mass diffusion, and droplet/bubble/particle-surface interaction
- Bio-inspired surface engineering for a sustainable future – water harvesting, energy-saving, and environmental pollution reduction surface designs

PUBLICATION (Total Citation: 1,750 & h-index: 12 based on *Google Scholar*, *Corresponding Author)

19. Youhua Jiang, Allison E. O'Donnell, Christian Machado, Neelesh A. Patankar, and **Kyoo-Chul Park***, Oscillatory Coalescence-Induced Self-Acceleration of Droplets on a Superhydrophilic Wire. Submitted to *Physical Review Letters*.
18. Yuehan Yao, Tom Y. Zhao, Emma Feldman, Christian Machado, Neelesh A. Patankar, and **Kyoo-Chul Park***, Frost-Free Zone on Macro-Textured Surfaces. *PNAS (Impact Factor:9.58)*, 117, 6323-6329, 2020.
17. Alexander B. Tesler*, Zhizhi Sheng, Wei Lv, Yi Fan, David Fricke, **Kyoo-Chul Park**, Jack Alvarenga, Joanna Aizenberg and Xu Hou*, Metallic Liquid Gating Membranes, *ACS Nano (Impact Factor: 13.709)*, 14, 2465-2474, 2020.
16. Sun Mi Yoon, Young A Lee, **Kyoo-Chul Park**, Sahn Nahm, Myoung-Woon Moon*, Subwavelength Hollow-Nanopillared Glass with Gradient Refractive Index for Ultralow Diffuse Reflectance and Antifogging. *ACS Applied Materials & Interfaces (Impact Factor:8.097)*, 12, 6234-6242, 2020.
15. Youhua Jiang, Christian Machado, Shaan Savarirayan, Neelesh A. Patankar, and **Kyoo-Chul Park***, Onset Time of Fog Collection. *Soft Matter (Impact Factor: 3.889)*, 15, 6779-6783, 2019. **(Back Cover)**
14. Youhua Jiang, Shaan Savarirayan, Yuehan Yao, and **Kyoo-Chul Park***, Fog Collection on a Superhydrophilic Wire. *Applied Physics Letters (Impact Factor:3.495)* 114, 083701, 2019.
 - Highlighted in *Nature Materials* (<https://www.nature.com/articles/s41563-019-0331-6>)
13. Yuehan Yao, Joanna Aizenberg, and **Kyoo-Chul Park***, Dropwise Condensation on Hydrophobic Bumps and Dimples. *Applied Physics Letters (Impact Factor:3.495)*, 112, 151605, 2018.
12. Hyungryul J. Choi, **Kyoo-Chul Park**, Hyomin Lee, Thomas Crouzier, Michael F. Rubner, Robert E. Cohen, George Barbastathis, and Gareth H. McKinley, Superoleophilic Titania Nanoparticle Coatings with Fast Fingerprint Decomposition and High Transparency. *ACS Applied Materials & Interfaces (Impact Factor:8.097)*, 9, 8354-8360, 2017.
11. **Kyoo-Chul Park***, Philseok Kim, Alison Grinthal, Neil He, David Fox, James C. Weaver, and Joanna Aizenberg*, Condensation on Slippery Asymmetric Bumps. *Nature (Impact Factor:41.577)* 531, 78-82, 2016.
 - **First and co-corresponding author, total citation more than 270**
 - Harvard SEAS News and Events (https://www.seas.harvard.edu/news/2016/02/pulling-water-from-thin-air?utm_source=facebook&utm_medium=social&utm_campaign=hseas),

- The Atlantic, RSC Chemistry World, IEEE Spectrum, BBC News, Popular Mechanics, ...
- **Nature Physics** Research Highlights
(<http://www.nature.com/nphys/journal/v12/n3/full/nphys3690.html>)
 - **Nature Materials** News and Views
(<http://www.nature.com/nmat/journal/v15/n4/full/nmat4612.html>)
10. Sani LeClerc, Johnathon LeClerc, Abhijeet, **Kyoo-Chul Park**, and Wonjae Choi, Drop Impact on Inclined Superhydrophobic Surfaces. *J. Colloid Interface Sci. (Impact Factor: 5.091)*, 461, 114-121, 2016.
 9. **Kyoo-Chul Park**, Abhijeet, and Wonjae Choi, Energy-Efficient Applications Using Surfaces with Special Wettabilities. *J. Nanotech. Smart Mater. (Impact Factor: N/A)*, 1, 1-9, 2014.
 8. Jeong-Gil Kim, Hyungryul J. Choi, **Kyoo-Chul Park**, Robert E. Cohen, Gareth H. McKinley, and George Barbastathis, Multifunctional Inverted Nanocone Arrays for Non-Wetting, Self-Cleaning Transparent Surface with High Mechanical Robustness. *Small (Impact Factor: 9.598)*, 10, 2487-2494, 2014.
 7. Siddarth Srinivasan, Shreerang S. Chhatre, Jesus O. Guardado, **Kyoo-Chul Park**, Andrew R. Parker, Michael F. Rubner, Gareth H. McKinley and Robert E. Cohen, Quantification of Feather Structure, Wettability and Resistance to Liquid Penetration. *J. R. Soc. Interface (Impact Factor: 3.355)*, 6, 20140287, 2014.
 6. **Kyoo-Chul Park**, Shreerang S. Chhatre, Siddarth Srinivasan, Robert E. Cohen, and Gareth H. McKinley, Optimal Design of Permeable Fiber Network Structures for Fog Harvesting. *Langmuir (Impact Factor: 3.789)*, 29, 13269-13277, 2013.
 - Highlighted in *Nature* on Oct 16, 2013 (<https://www.nature.com/articles/502275f>).
 - MIT News (<http://news.mit.edu/2013/how-to-get-fresh-water-out-of-thin-air-0830>), Wired, Environmental News Network, ...
 - “The most read article from *Langmuir* in September and October, 2013”
 5. Siddarth Srinivasan, Wonjae Choi, **Kyoo-Chul Park**, Shreerang S. Chhatre, Robert E. Cohen, and Gareth H. McKinley, Friction Reduction for Fluid Flow on Spray-Coated Non-Wetting Surfaces. *Soft Matter (Impact Factor: 3.889)*, 9, 5691-5702, 2013.
 4. **Kyoo-Chul Park**, Hyungryul J. Choi, Chih-Hao Chang, Robert E. Cohen, Gareth H. McKinley, and George Barbastathis, Nanotextured Silica Surfaces with Robust Super-Hydrophobicity and Omnidirectional Broadband Super-Transmissivity. *ACS Nano (Impact Factor: 13.709)*, 6, 3789-3799, 2012.
 - Total citation more than 360.
 - MIT News (<http://news.mit.edu/2012/glare-dust-and-fog-free-glass-0426>), MIT Technology Review, Discovery News, Popular Science, phys.org, ...
 - “The most read article from *ACS Nano* between April and June in 2012”
 3. Hong Zhao, **Kyoo-Chul Park**, and Kock-Yee Law, Effect of Surface Texturing on Superoleophobicity, Contact Angle Hysteresis, and Robustness. *Langmuir (Impact Factor: 3.789)*, 28, 14925-14934, 2012.
 2. Chih-Jen Shih, Qing Hua Wang, Shangchao Lin, **Kyoo-Chul Park**, Zhong Jin, Michael S. Strano, and Daniel Blankschtein, Breakdown in the Wetting Transparency of Graphene. *Phys. Rev. Lett. (Impact Factor: 8.839)*, 109, 176101, 2012. (*Phys. Rev. Lett.* cover)

1. Shreerang S. Chhatre, Wonjae Choi, Anish Tuteja, **Kyoo-Chul Park**, Joseph M. Mabry, Gareth H. McKinley and Robert E. Cohen, Scale Dependence of Omniphobic Mesh Surfaces. *Langmuir* (Impact Factor: 3.789), 26, 4027-4035, 2010.

PATENTS (6 issued and 1 licensed out of 17 patent applications)

17. Youhua Jiang, Christian J. Machado, Allison E. O'Donnell, **Kyoo-Chul Park**, Collection/Filtration of Emulsion and Particles by a Cylinder. **US Patent App. 62/934,055**
16. Youhua Jiang, **Kyoo-Chul Park**, Smog Filtration Using Flexible Wires. **US Patent App. 62/833,885**
15. Youhua Jiang, Neelesh A. Patankar, **Kyoo-Chul Park**, Brine Management System for Achieving Zero Liquid Discharge. **US Patent App. 62/746,652**
14. Yuehan Yao, **Kyoo-Chul Park**, Serrated Surfaces for Anti-Icing Applications. **US Patent App. 62/716,014**
13. Youhua Jiang, Yuehan Yao, **Kyoo-Chul Park**, Liquid Collection on Wavy Surfaces. **US Patent App. 62/716,000**
12. Yuehan Yao, Nicolas M. Prieto, Jian Cao, **Kyoo-Chul Park**, Mechanically-Robust Multiphobic Surfaces with Multifunctionalities. **US Patent App. 62/675,925**
11. Katherine A. Cai, Neelesh A. Patankar, **Kyoo-Chul Park**, Enhanced Vaporization of Liquid on a Surface. **US Patent App. 62/626,855**
10. Natalia A. Alvarez, Neelesh A. Patankar, **Kyoo-Chul Park**, Superomniphilic Surfaces with High Surface Areas for Enhanced Condensation and Mist/Fog Elimination. **US Patent App. 62/621,849**
9. Yuehan Yao, George Wells, **Kyoo-Chul Park**, Bio-Inspired, Adhesion-Tunable, and Actuable Micro/Nanotextured Surfaces for Anti-Biofouling and Anti-Icing Applications. **US Patent App. 62/587,942**
8. Alex Gelber, Yuehan Yao, Morgan L. Petrovich, George Wells, **Kyoo-Chul Park**, Magnetically Controlled Particle Abrasion Method for Biofouling Removal. **US Patent App. 62/587,913**
7. **Kyoo-Chul Park**, Hyomin Lee, Hyungryul J. Choi, Michael F. Rubner, Robert E. Cohen, George Barbastathis, Gareth H. McKinley, Anti-Fingerprint Photocatalytic Nanostructure for Transparent Surfaces. **US Patent 10,478,802**
6. **Kyoo-Chul Park**, Philseok Kim, and Joanna Aizenberg, High Energy Efficiency Heat Transfer through Phase Change on Slippery Surfaces. **US Patent App. 62/069,591**
5. Hyungryul Choi, Jeong-Gil Kim, **Kyoo-Chul Park**, Robert E. Cohen, Gareth H. McKinley, and George Barbastathis, Inverted Nanocone Structures for Multifunctional Surface and Its Fabrication Process. **US Patent 9,469,083**
4. **Kyoo-Chul Park**, Shreerang S. Chhatre, Gareth H. McKinley, and Robert E. Cohen, Liquid-collecting Permeable Structures. **US Patent 9,352,258**
 - *Licensed to NBD Nanotechnologies, Inc.*

3. Yuanjia Zhang, **Kyoo-Chul Park**, Hong Zhao, and Kock-Yee Law, Method of Making Superoleophobic Re-entrant Resist Structures. **US Patent 8,870,345**
2. Hong Zhao, **Kyoo-Chul Park**, and Kock-Yee Law, 2012. Ink Jet Print Head Front Face Having a Textured Superoleophobic Surface. **US Patent 8,562,110**
1. Hyungrul Choi, Chih-Hao Chang, **Kyoo-Chul Park**, Gareth H. McKinley, George Barbastathis, and Jeong-Gil Kim, Process for Making Nancone Structures and Using the Structures to Manufacture Nanostructured Glass. **US Patent 9,120,669**

PRESENTATIONS

■ INVITED TALKS

22. (Planned) Fog Collection and beyond Mist Elimination, June 2020, 3M, St. Paul, MN.
21. Frost Pattern on Macrot textured Surfaces, January 2020, Michigan Technical University, Houghton, MI.
20. Fog Collection on Vertical Wires, September 2019, University of Illinois at Chicago, Chicago, IL.
19. Interfacial Solutions to Water-Energy Problems, July 2019, ASME MNHMT 2019, Dalian, China.
18. Interfacial Solutions to Water Problems, July 2019, Korea Institute of Science and Technology, Seoul, South Korea.
17. Water Collection on Functional Surfaces, April 2019, Korea University, Seoul, South Korea.
16. Growth and Transport of Water Droplets on Textured Surfaces, April 2019, Yonsei University, Seoul, South Korea.
15. Phase Change of Water on Convex and Concave Surface Textures, April 2019, Korea Advanced Institute of Science and Technology, Daejeon, South Korea.
14. Phase Change of Water on Slippery Asymmetric Bumps, April 2019, Korean Physical Society Spring Meeting, Daejeon, South Korea.
13. Bio-Inspired Surface Engineering, April 2019, Korea Institute of Machinery and Materials, Daejeon, South Korea.
12. Dew and Fog Harvesting, April 2019, Seoul National University, Seoul, South Korea.
11. Interfacial Solutions to Water Problems, November 2018, Argonne National Lab, Lemont, IL.
10. Bio-Inspired Atmospheric Water Generation – Enhanced Condensation by Focused Diffusion, Telluride Science Research Conference, July 2018, Telluride, CO.
9. Bio-Inspired Atmospheric Water Collection, December 2017, Stevens Institute of Technology,

Hoboken, NJ.

8. Bio-Inspired Atmospheric Water Collection, November 2017, Syracuse University, Syracuse, NY.
7. Bio-Inspired Atmospheric Water Generation, ACS National Meeting, August 2017, Washington, DC.
6. Bio-Inspired Atmospheric Water Generation, Ben-Gurion University, March 2017, Beer-Sheva, Israel.
5. Bio-Inspired Atmospheric Water Generation, Wyss Retreat, November 2016, Boston, MA.
4. Atmospheric Water Generation, Workshop for Water Research, September 2016, Evanston, IL.
3. Condensation on Slippery Asymmetric Bumps, Harvard Squishy Physics Seminar, February 2016, Cambridge, MA.
2. Physico-Chemical Hydrodynamics of Droplets on Textured Surfaces with Engineered Micro/Nanostructures, Beth Israel Deaconess Medical Center, September 2013, Boston, MA.
1. Multifunctional Nano-Surfaces, Hyundai Motor Group, August 2013, Los Angeles, CA.

TEACHING EXPERIENCE

Northwestern University, Department of Mechanical Engineering

Instructor

2019 – Present

- “Experimental Interfacial Phenomena” (Newly-Developed, Undergraduate/Graduate Level)
- Prepared five lab sessions from multiscale functional surfaces preparation to 100 times cheaper contact angle measurement system development, high-speed and long working distance custom-made visualization system development, the Peltier effect-based condensation, and 3D printed wind tunnel for fog harvesting experiments.
- Designed and evaluated two class competitions – (1) the Olympic games of droplets and (2) 3D structures for atmospheric water generation.
- **The highest CTEC (Course and Teacher Evaluation Council) score: 6.00/6.00** for “overall rating of instruction”

Instructor

2018 – Present

- “Bio-Inspired Surface Engineering” (Newly-Developed, Undergraduate/Graduate Level)
- Lectured on the interdisciplinary principles ranging from fluid mechanics to thermodynamics, heat and mass transfer, optics, and solid mechanics at multiple length scales (from nanometer to millimeter) associated with biological examples.
- Designed and mentored on a class project composed of two presentations on (1) how to define research problems related to surface engineering and (2) how to propose logical approaches to solve the defined problems based on biologically-inspired engineering.
- The highest CTEC score: 5.33/6.00 for “overall rating of instruction”

Instructor

2017 – Present

- “Engineering Analysis 3 – System Dynamics” (All Engineering Major **Freshman, 100+ Students/year**)
- Lectured on how to mathematically model dynamic mechanical and electrical systems, how to solve differential equations, how to interpret the physical meaning of the solutions, and how to modify and improve the dynamic systems.
- **The highest CTEC score: 5.05/6.00** for “overall rating of instruction”, *the highest among ~10 instructors of this spring quarter course for the past 7 years*

Research Mentor

2017 – Present

- Have mentored 1 postdoc, 2 PhD students, 2 MS students, and 5 undergraduate students on their research projects.
- Youhu Jiang/Mechanical Engineering (Postdoc)
- Yuehan Yao/Materials Science and Engineering (PhD)
- Christian Machado/Mechanical Engineering (PhD)
- Natalia Alvarez/Mechanical Engineering (MS, graduated in 2018)
- Katherine Cai/Mechanical Engineering (MS, graduated in 2018)
- Alex Gelber/Mechanical Engineering (undergraduate)
- Shaan Savarirayan/Mechanical Engineering (undergraduate)
- Emma Feldman/Chemical and Biological Engineering (undergraduate)
- Benjamin Salazar/Mechanical Engineering (undergraduate)
- Yerim Lee/Mechanical Engineering (undergraduate)

Harvard University, School of Engineering and Applied Sciences (SEAS)*Guest Lecturer*

Fall 2015

- “Nano Micro Macro: Adaptive Material Laboratory”
(Graduate Level, Prof. Martin Bechthold and Dr. James C. Weaver)
- Lectured on slippery liquid-infused porous surfaces (SLIPS) and condensation on slippery asymmetric bumps.
- Mentored 1/3 of registered graduate students on their team projects.
- Evaluated class projects associated with novel surface design and fabrication.

Research Mentor

2014 – 2016

- Have mentored 5 undergraduate students on the phase change heat transfer project.
- Catherine Roy/University of Waterloo/Chemical Engineering(c6roy@uwaterloo.ca)
- Brendan McManus/Northeastern University/Mechanical Engineering(mcmanus.br@husky.neu.edu)
- Michelle Hoang/University of Waterloo/Chemical Engineering(m3hoang@uwaterloo.ca)
- David Fox/Northeastern University/Mechanical Engineering(fox.d@husky.neu.edu)
- Neil He/Case Western Reserve University/Materials Science and Engineering(nqh@case.edu)

MIT, Department of Mechanical Engineering*Teaching Assistant*

Fall 2012

- “Advanced Fluid Mechanics” (Graduate Level, Prof. Gareth H. McKinley)
- Led recitation and office hour sessions.
- Prepared exam and homework solutions and graded results.

PROFESSIONAL ACTIVITIES**Conference Technical Committee Chair**

2019 American Institute of Sciences – Nature Inspired Surface Engineering

Conference Session Organizer/Chair

2019 APS Division of Fluid Dynamics – Drops: Coalescence II

2019 APS March Meeting Focus Session – Physics of Bio-Inspired Materials

2018 APS March Meeting Invited Session – Lessons from Biological Soft Materials and Their Applications (Session Chair)

2018 APS March Meeting Focus Session – Physics of Bio-Inspired Materials

2017 APS March Meeting Focus Session – Physics of Bio-Inspired Materials

2016 APS March Meeting Focus Session – Physics of Bio-Inspired Materials

Professional Society Vice President

Korean-American Scientists and Engineers Association (KSEA)-Chicagoland (CHI)

- Prepared the 2019 KSEA UKC
- Prepared and led the 7th Youth Science Camp
- Participated in the KSEA-CHI STEM Career Night as a panelist
- Reviewed the KSEA-CHI scholarship applications
- Assisted the KSEA National Math and Science Competition

Article Reviewer

Nature, Science, PNAS, Nature Materials, Nature Sustainability, Nature Communications, Science Advances, ACS Nano, Advanced Materials, Advanced Functional Materials, ACS Applied Materials and Interfaces, Soft Matter, Langmuir, Biofouling, AIChE Journal, Colloids and Surfaces A: Physicochemical and Engineering Aspects, Journal of Colloid and Interface Science

Editorial Board

Journal of Mechanical Science and Technology Advances

Professional Membership

American Physical Society, Materials Research Society, American Chemical Society, Korean-American Scientists and Engineers Association, International Society of Bionic Engineering, American Vacuum Society.