# Pilgyu Kang, Ph.D.

Postdoctoral Research Associate
Department of Mechanical Science and Engineering
University of Illinois at Urbana-Champaign

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## EDUCATION

**Cornell University**, Ithaca, NY, USA 2009-2014
**Ph.D. in Mechanical Engineering, Minor: Applied and Engineering Physics** (Advisor: Prof. David Erickson)
Dissertation title: "Nanophotonic technologies for manipulating biomolecules and investigating molecular interactions"

**Carnegie Mellon University**, Pittsburgh, PA, USA 2007-2009
**M.S. in Mechanical Engineering** (Advisor: Prof. Shelley Anna)
Research field: Microfluidics and Interfacial Science

**Seoul National University**, Seoul, South Korea 2000-2007
**B.S. in Mechanical Engineering** (Advisor: Prof. Lee, Joonsik), **Minor**: **Electrical Engineering**

## RESEARCH & PROFESSIONAL EXPERIENCE

**Assistant Professor** 2017- Present
Department of Mechanical Engineering
Volgenau School of Engineering, George Mason University

**Postdoctoral Research Associate** 2014-2017
Department of Mechanical Science and Engineering, **University of Illinois at Urbana-Champaign (UIUC)**
Research Advisor: Professor SungWoo Nam (http://nam.mechse.illinois.edu/)
- Graphene-integrated flexible microelectrode array for neural/muscular interfacing
- Graphene-based Bio-field effect transistors (Bio-FETs) for the electrochemical sensing of cortisol and glucose
- Graphene optoelectronics and plasmonics / $MoS_2$ based optoelectronics
- Flexible/stretchable photodetectors based on crumpled graphene and Au-graphene hybrid plasmonic nanostructures
- Mechanically reconfigurable crumpled graphene plasmonics
- Graphene-photonic crystal hybrid sensor for structural health monitoring
- Graphene-based strain sensors for monitoring human bodily motion
- Graphene-integrated biomedical implant devices

**Graduate Research Assistant** 2010-2014
Sibley School of Mechanical and Aerospace Engineering, **Cornell University**
Research Advisor: Professor David Erickson (http://www.ericksonlab.org/)
- Optofluidic-integrated NanoTweezer for label-/immobilization-free detection of molecular interaction
- Nanophotonic force microscopy for label-free analysis of particle-surface interactions
- Microfluidic-integrated photonic-crystal based optical resonator for manipulating biological/non-biological materials
- Self-assembled colloidal photonic crystals for creating erasable, high-resolution, color images with transparent inks

**Graduate Research Assistant** 2007-2009
Department of Mechanical Engineering, **Carnegie Mellon University**
Research Advisor: Professor Shelley Anna (https://annalab.org/)
- Dynamic behavior of non-Newtonian droplets spreading on a flat surface
- Driven spreading and coalescence of sessile droplets
- Droplet-based Lab-on-a-chip system for manipulating droplets in microfluidic channels by channel geometries

**Undergraduate Researcher** 2004-2006
Department of Mechanical and Aerospace Engineering, **Seoul National University**
- Optimal dynamic motions of a robotic arm manipulator and contact forces for control of a robotic manipulation (Undergraduate thesis, Research Mentor: Professor Frank C. Park)
- Fabrication of Ionic Polymer Metal Composites (IPMC) actuators for prosthetic fingers (Research Mentor: Yong-hyup Kim)

**Intern**, Samsung Techwin, Semi-conductor Business, Seoul, South Korea July 2004

- CAD design of semiconductor equipment developed for packaging semiconductor memory devices

## JOURNAL PUBLICATIONS

### UIUC (2014-Present)

1. Kim, M.*, **Kang, P.***, Leem, J.*, and Nam, S., "Stretchable Crumpled Graphene Photodetector with Plasmonically-Enhanced Photoresponsivity" ***Nanoscale*** (IF = 7.760), 9, 4058–4065 (2017)
   *Authors with equal contributions

   **Featured as the *Front Cover* in *Nanoscale*, 9, 4037-4037 (2017)**

   **Selected as the Hot Article 2017 web collection for *Nanoscale***
2. Wang, M. C., Leem, J., **Kang, P.**, Choi, J., Knapp, P., Yong, K., Nam, S., "Mechanical Instability Driven Self-assembly and Architecturing of Two-dimensional Materials" ***2D Materials*** (Impact Factor (IF) = 9.611), 4, 022002 (2017)
3. **Kang, P.**, Wang, M. C., Knapp, P. M., Nam, S., "Crumpled Graphene Photodetector with Enhanced, Strain-tunable and Wavelength-selective Photoresponsivity" ***Advanced Materials*** (IF = 18.960) 28, 4639–4645 (2016)

   **Featured as the *Front Cover* in *Advanced Materials*, 28, 4565-4565 (2016)**
4. **Kang, P.**†, Wang, M. C., Nam, S.†, "Bioelectronics with Two-dimensional Materials" ***Microelectronic Engineering*** (IF = 1.277), 161, 18-35 (2016)
   † **Corresponding author**
5. Yong, K., Ashraf, A., **Kang, P.**, and Nam, S., "Rapid Stencil Mask Fabrication Enabled One-Step Polymer-Free Graphene Patterning and Direct Transfer for Flexible Graphene Devices" ***Scientific Reports*** (Nature Publishing Journal, IF = 5.228) 6, 24890 (2016).
6. Leem, J., Wang, M. C., **Kang, P.**, Nam, S., "Mechanically Self-assembled, Three-dimensional Graphene-Gold Hybrid Nanostructures for Advanced Nanoplasmonic Sensors" ***Nano Letters*** (IF = 13.779) 15 (11), 7684–7690 (2015)
   **Highlighted in Nature Nanotechnology (Vol. 10, Published Dec 3, 2015, DOI:10.1038/nnano.2015.298)**
7. Wang, M. C., S. Chun, R. S. Han, Ashraf, A., **Kang, P.**, and Nam, S., "Heterogeneous, Three-dimensional Texturing of Graphene" ***Nano Letters*** (IF = 13.779) 15 (3), 1829–1835 (2015)
   **Highlighted in the Front Cover (Vol. 15, Issue 3)**

### CORNELL (2009-2014)

8. **Kang, P.**, Schein, P., Serey, X., O'Dell, D., and Erickson, D., "Nanophotonic Detection of Freely Interacting Molecules on a Single Influenza Virus" ***Scientific Reports*** (Nature Publishing Journal, IF = 5.228) 5, 12087 (2015)
9. Schein, P., **Kang, P.**, O'Dell, D., and Erickson, D., "Nanophotonic Force Microscopy: Characterizing Particle-Surface Interactions using Near-field Photonics" ***Nano Letters*** (IF = 13.779) 15 (2), 1414-1420 (2015)
10. O'Dell, D., Serey, X., **Kang, P.**, and Erickson, D., "Localized Opto-mechanical Control of Protein Adsorption onto Carbon Nanotubes" ***Scientific Reports*** (Nature Publishing Journal, IF = 5.228) 4, 6707 (2014)
11. **Kang, P.**, Serey, X., Chen, Y. F., and Erickson, D., "Angular Orientation of Nanorods using Nanophotonic Tweezers" ***Nano Letters*** (IF = 13.779) 12, 6400-6407 (2012)
12. **Kang, P.**, Ogunbo, S., Erickson, D., "High Resolution Reversible Color Images on Photonic Crystal Substrates" ***Langmuir*** (IF = 3.993) 27, 9676-9680 (2011)

## MANUSCRIPTS UNDER REVIEW & IN PREPARATION

1. **Kang, P.***, Kim*, K., Park, H., and Nam, S., "Mechanically reconfigurable architectured graphene for tunable plasmonic resonances" (Submitted)
   *Authors with equal contributions.
2. Knapp, P. M., **Kang, P.**, Leem, J., and Nam, S., "Photonic crystal-integrated stretchable crumpled graphene photodetector for structural health monitoring" (in preparation)

## PATENTS/INVENTIONS

1. **Kang, P.**, Wang, M. C., Knapp, P. M., and Nam, S., "Stretchable and Plasmonic-Reconfigurable Photodetectors based on Reversible Crumpling of Graphene" Invention Disclosure Filed, August 2016
2. Yong, K., Ashraf, A., **Kang, P.**, and Nam, S., "Rapid Two-dimensional (2D) Material Patterning by Stencil Lithography" Invention Disclosure Filed, May 2016
3. Erickson, D. and **Kang, P.**, "Methods and Apparatus for Monitoring Interactions Between Particles and Molecules Using Nanophotonic Trapping" Published: US20160047944 A1, February 18, 2016
4. Erickson, D., Schein, P., and **Kang, P.**, "Nanophotonic Force Microscope for Measuring Particle-surface Interactions" Invention Disclosure Filed, April 2014

## AWARDS / HONORS / FELLOWSHIPS

1. Best Paper Award, The Micro & Nanotechnology Forum, ASME International Mechanical Engineering Congress and Exposition (IMECE) 2016, Phoenix, Arizona.
2. Postdoctoral Presentation Award, 5th Annual MRL Biological Conference, Frederick Seitz Materials Research Laboratory, University of Illinois at Urbana-Champaign, November 3, 2016
3. Chemistry and Micro-Nano Systems (CHEMINAS) Young Researcher Poster Award, Micro-Total Analysis Systems (MicroTAS): the 17th International Conference on Miniaturized Systems for Chemistry and Life Sciences, Freiburg, Germany, 2013
4. Chemical and Biological Microsystems Society (CBMS) Student/Young Researcher Grant, MicroTAS, Freiburg, Germany, 2013
5. Conference Grants, Cornell University, 2011- 2013
6. Graduate Fellowship, Sibley School of Mechanical and Aerospace Engineering, Cornell University, 2009
7. Graduate Small project Help (GuSH) Research Funding, Carnegie Mellon University, 2008
8. Academic Honor Scholarships (Merit-based), Seoul National University, 2003 – 2006
9. Sinyang Fellowship, Sinyang Cultural Foundation, 2005

## CONFERENCE PRESENTATIONS

1. **Kang, P.**, Wang, M. C., Knapp, P. M., Leem, J., Nam, S., "Controlled Crumpling of Two-dimensional Materials for Enhanced and Tunable Optical Absorption and Mechanical Stretchability" International Mechanical Engineering Congress and Exposition, The American Society of Mechanical Engineers, November 16, 2016, Phoenix, Arizona, USA
2. **Kang, P.**, Wang, M. C., Knapp, P. M., Nam, S., "Flexible and Wearable Optoelectronic Sensors for Biomedical Technologies: Crumpled Graphene Stretchable Photodetector" The 5th Annual MRL Biological Conference, Frederick Seitz Materials Research Laboratory, University of Illinois at Urbana-Champaign, November 2, 2016, Urbana, IL, USA
3. Leem, J., Wang, M. C., **Kang, P.**, Nam, S., "Mechanically Self-Assembled, Three-Dimensional Graphene-Gold Hybrid Nanostructures for Advanced Nanoplasmonic Sensors" Materials Research Society (MRS) Spring Meeting, March 30, 2016, Phoenix, Arizona, USA
4. **Kang, P.**, "Stretchable and Conformal Photodetector with Enhanced Photoresponsivity by Textured Graphene" The 1st Midwest Mechanics of Materials and Structures Workshop, August 26, 2015, Urbana, IL, USA
5. **Kang, P.**, Schein, P., Serey, X., D. O′Dell, D. Erickson, "Nanophotonic Stoichiometry of Antibodies to Influenza Virus at the Single Particle Level" the 41st Annual Northeast Bioengineering Conference (NEBEC), April 18, 2015, Troy, NY, USA
6. **Kang, P.**, Wang, M. C., Knapp, P. M., Nam, S., "Multi-modal Sensing with Mechanical Modulation of the Hybrid System of Crumple Graphene and Colloidal Photonic Crystals" Materials Research Society (MRS) Spring Meeting, April 10, 2015, San Francisco, CA, USA
7. Schein, P., **Kang, P.**, Erickson, D., "Nanophotonic Force Microscopy: Measuring Particle-surface Interactions using Near-field Photonics" Photonics West, The International Society for Optics and Photonics, SPIE, February 8, 2015, San Francisco, CA, USA
8. O′Dell, D., Schein, P., **Kang, P.**, Erickson, D., "Characterizing Protein Aggregation by Observing Confined Brownian Fluctuations in a Near-field Optical Trap" Photonics West, The International Society for Optics and Photonics, SPIE, February 8, 2015, San Francisco, CA, USA
9. **Kang, P.**, Chen, Y. F., Erickson, D., "Label-free Optofluidic Biomolecular Sensing using a Photonic Crystal Nanotweezer: The Wiggle Assay" Micro-Total Analysis Systems (MicroTAS): The 17th International Conference on Miniaturized Systems for Chemistry and Life Sciences, October 30, 2013, Freiburg, Germany

10. **Kang, P.**, Erickson, D., "Optofluidic Nanomanipulation with Photonic Crystal Nanotweezers: A Simplified Design for Variation" US-KOREA Conference, August 10, 2013, East Rutherford, NJ, USA
11. **Kang, P.**, Serey, X., Chen, Y. F., O′Dell, D., Erickson, D., "Near-Field Angular Orientation Of Biological Materials", Biophysical Society 57th Annual Meeting, February 6, 2013, Philadelphia, PA, USA
12. Serey, X., **Kang, P.**, O′Dell, D., Erickson, D., "Near-Field Optical Immobilization of Antibodies for Novel Fluorescent Bioassays", Biophysical Society 57th Annual Meeting, February 5, 2013, Philadelphia, PA, USA
13. Serey, X., Chen, Y. F., R. Fain, **Kang, P.**, and Erickson, D., "Overcoming the temperature increase hurdle in photonic crystal molecular tweezers" Conference on Lasers and Electro-Optics (CLEO), May 2012, San Jose, CA, USA
14. **Kang, P.**, Ogunbo, S., Erickson, D., "High Resolution Reversible Color Images on Photonic Crystal Substrates" Micro-Total Analysis Systems (MicroTAS):The International Conference on Miniaturized Systems for Chemistry and Life Sciences, October 2-6, 2011, Seattle, Washington, USA
15. Anna, S. L. , **Kang, P.**, Shojaei-Zadeh, S., C. Appleby, "Forced Spreading and Coalescence of Viscous Drops" 62nd Annual Meeting of the APS Division of Fluid Dynamics, November 22-24, Minneapolis, MN, USA
16. **Kang, P.**, Shojaei-Zadeh, S., C. Appleby, Anna, S. L. , "Scaling Law for Driven Spreading and Coalescence of Sessile Droplets" APS March Meeting, March 16-20, 2009, Pittsburgh, PA, USA
17. Y. Wei, L. Walker, Anna, S. L. , **Kang, P.**, S. Garoff, "Dynamic Wetting by Non-Newtonian Fluids" 2008 AIChE Annual Meeting, November 16-21, 2008, Philadelphia, PA, USA

## INVITED TALKS

1. "Mechanics and Optics at Nanoscale" Department of Mechanical Engineering, George Mason University, Fairfax, VA, May 5, 2017
2. "Mechanics and Optics at Nanoscale" Department of Mechanical and Nuclear Engineering, The Pennsylvania State University, University Park, PA, December 1, 2016
3. "Bio-Nanophotonic Technologies via Nanophotonic Systems and the Hybrid Systems Integrated with Two-dimensional Materials" The School of Biomedical Engineering, Korea University, Seoul, Republic of Korea, May 28, 2015
4. "Bio-Nanophotonic Technologies via Nanophotonic Systems and the Hybrid Systems Integrated with Two-dimensional Materials" Department of Biological Engineering, Inha University, Incheon, Republic of Korea, May 28, 2015
5. "Bio-Nanophotonic Technologies via Nanophotonic Systems and the Hybrid Systems Integrated with Two-dimensional Materials" The Korea Research Institute of Standards and Science (KRISS), Daejeon, Republic of Korea, May 27, 2015
6. "Bio-Nanophotonic Technologies via Nanophotonic Systems and the Hybrid Systems Integrated with Two-dimensional Materials" Department of Mechanical and Aerospace Engineering, Seoul National University, Seoul, Republic of Korea, May 26, 2015
7. "Bio-Nanophotonic Technologies via Nanophotonic Systems and the Hybrid Systems Integrated with Two-dimensional Materials" the Korea Aerospace Research Institute (KARI), Daejeon, Republic of Korea, May 20, 2015
8. "Bio-Nanophotonic Technologies via Nanophotonic Systems and the Hybrid Systems Integrated with Two-dimensional Materials" Department of Mechanical Engineering, The Korea Advanced Institute of Science and Technology (KAIST), Daejeon, Republic of Korea, May 19, 2015
9. "Nanophotonic Technologies for Manipulating Biomolecules and Investigating Molecular Interactions" Department of Mechanical and Aerospace Engineering, University of Missouri-Columbia, MO, August 13, 2014
10. "Nanophotonic Technologies for Manipulating Biomolecules and Investigating Molecular Interactions" Department of Mechanical Science and Engineering, UIUC, Urbana, IL, July 16, 2014
11. "Nanophotonic Technologies for Manipulating Biomolecules and Investigating Molecular Interactions" MIT Media Lab, Massachusetts Institute of Technology, Cambridge, MA, July 8, 2014

## MENTORING EXPERIENCE

Managed and mentored 3 UIUC graduate/undergraduate students who served as research assistants and 2 Research Experiences for Undergraduates (REU) students.

1. Minsu Kim, M.S. student — Mar 2016-Present
   Department of Materials Science and Engineering, UIUC
   Project: Crumpled graphene-Au hybrid photodetector for plasmonic-enhanced, strain-tunable photoresponsibility
2. Da Woon Kim, Undergraduate student — May 2016-Present
   Department of Mechanical Science and Engineering, UIUC
   Project: Graphene-integrated biomedical implant devices
3. Ernesto Garcia, Summer REU program, undergraduate student — May-Dec 2015
   Department of Mechanical Science and Engineering, UIUC
   Project: Crumpled graphene strain sensor for monitoring human bodily motions

4. Peter Knapp, M.S./Ph.D. student Sep 2014-Present
   Department of Mechanical Science and Engineering, UIUC
   Project: Photonic crystal-integrated crumpled graphene hybrid strain sensor for structural health monitoring
5. Samuel Ogunbo, Cornell University-Louis Stokes Alliance for Minority Participation Research June-Aug 2010
   Department of Mechanical Engineering, University of Maryland-Baltimore County
   Project: Reconfigurable photonics using colloidal photonic crystals

**OTHER PRESENTATIONS (Seminar, Workshop and Symposium)**

1. Nam, S., Kim, D., **Kang, P.**, Kim, M., "Graphene-integrated Biomedical Implant Devices" 3rd Health Care Engineering Systems Symposium, Peoria, IL, Sep 9, 2016
2. **Kang, P.**, "Bio-Nanophotonic Technologies and the Hybrid Systems integrated with Two-dimensional Materials" Bio-Interest Group Seminar, Department of Mechanical Science and Engineering, UIUC, Urbana, IL, Nov 2, 2015
3. **Kang, P.**, Chen, Y.-F., Erickson, D., "Optofluidic Biomolecular Sensing using a Nanotweezer: The Wiggle Assay" Biological and Biomedical Sciences Symposium, Cornell University, August 21, 2013, Ithaca, NY, USA
4. **Kang, P.**, "Label-free Optofluidic Biomolecular Sensing using a Nanotweezer (LOBSTER): The Wiggle Assay" STEM Graduate Student Summer Colloquium, Department of Physics, Cornell University, July 1, 2013
5. **Kang, P.**, "Photonic Crystal-enabled Technologies: Optofluidic Nanomanipulation and Reconfigurability" Electron Devices Society, Cornell University, April 12, 2013, Ithaca, NY, USA
6. **Kang, P.** and Erickson, D., "High Resolution Reversible Color Images on Photonic Crystal Substrates" Cornell Center for Technology Enterprise and Commercialization (CCTEC) Seminar, April 17, 2012, Ithaca, NY, USA
7. **Kang, P.**, Ogunbo, S., and Erickson, D., "High Resolution Reversible Color Images on Photonic Crystal Substrates" Cornell Nanoscale Facility Annual Meeting, September 15, 2011, Ithaca, NY, USA
8. **Kang, P.** and Erickson, D., "The Color Display of Bioinspired Photonic Crystals" Cornell Nanoscale Facility Annual Meeting, September 16, 2010, Ithaca, NY, USA

**RESEARCH GRANT PROPOSALS**

1. Zhejiang University – University of Illinois at Urbana-Champaign Institute Research Program, "Advanced Wearable Biosensors based on Crumpled Atomically-thin Semiconductors" March 2017 (written with PI)
2. Air Force Office of Scientific Research, the Defense University Research Instrumentation Program (DURIP), "Reconfigurable Crumpled Graphene Plasmonics" July 2016 (written with PI)
3. The Ministry of Science, ICT and Future Planning, the Republic of Korea, "Direct Low-temperature Synthesis of Two-dimensional Materials and Heterostructures on Flexible Substrate for Next-generation High-mobility Electronic Devices" Program: Development of material and device technology, March 2016 (written with PI, **Awarded**)
4. The Korea Institute for Advancement of Technology (KIAT), "Development of Low-temperature, Fast-synthesis Equipment for Large-scale Two-dimensional Semiconductor Thin Films and Fabrication Technologies of Flexible Substrates for High-performance, Highly Stretchable, Flexible Devices" Mar 2016 (written with PI)
5. The Army Construction Engineering Research Laboratory (CERL) – University of Illinois Collaborative Program Development funding, "High-sensitivity Tunable Bio/Environmental Sensing with Graphene" Nov 2015 (written with PI)
6. National Science Foundations - Electronics, Photonics, and Magnetic Device (NSF-EPMD) program, "Strain-engineered Two-dimensional Atomic Crystals Photodetector" Nov 2015 (written with PI)
7. The Campus Research Board of University of Illinois at Urbana-Champaign, "Textured Graphene Photovoltaics" Aug 2015 (written with PI)
8. Korea Institute of Energy Research (KIER) – The International Collaboration Project, "Textured Graphene Plasmonic Solar Cells" Mar 2015 (written with PI)
9. Samsung Electronics, "High Performance and Transparent Graphene-Nanowire Hybrid Electrodes" Dec 2014 (written with PI)
10. National Science Foundations - Electronics, Photonics, and Magnetic Device (NSF-EPMD) program, "Textured Graphene Optoelectronics" Nov 2014 (written with PI)
11. NineSigma, "Crystal Draw – A Low-Cost Color Drawing Display using Self-Assembled Photonic Crystals (2010)" 2010 (written with PI)
12. Carnegie Mellon University Graduate Support Programs - GuSH Research Grants, "Dynamics of Sessile Droplet Coalescence" 2008
13. Erickson, D. and **Kang, P.**, "High Resolution Reversible Color Images on Photonic Crystal Substrates" Provisional Patent Filed, November 2011

## TEACHING EXPERIENCE

**Teaching ME 313 Materials Science** Fall 2017
**ME 221 Thermodynamics** (Two-week Guest Lecture)

**Teaching Assistant**, Sibley School of Mechanical and Aerospace Engineering, **Cornell University** Aug-Dec 2012
Course: Introductory Fluid Mechanics (MAE 3230)
- Substitute lecturer, recitation teaching, and holding office hours

**Teaching Assistant**, Sibley School of Mechanical and Aerospace Engineering, **Cornell University** Aug-Dec 2011
Course: Thermodynamics (MAE 2210)
- Substitute lecturer, recitation teaching, and holding office hours

The International Teaching Assistant Program (ITAP) Summer Institute June-July 2013
Center for Teaching Excellence, Cornell University
- Completion of the intensive program to prepare for a career in academia and expand teaching skills as a TA through researching, discussing, and presenting a workshop related to current topics in teaching in higher education
- Public presentation on teaching strategies at the ITAP Summer Institute Symposium: **Kang, P.**, Nayak, M. A., Wu C., "Strategies for Gauging Student Learning in STEM (Science, Technology, Engineering, and Math) Classrooms"

**Trainee**, International Teaching Assistant Program Spring 2010
Center for Teaching Excellence, Cornell University
- Development of oral communication with cross-cultural classroom teaching skills
- Completion of International Teaching Assistant Program Language Assessment (ITAP-ILA)

**Mathematics Teacher**, BlueSky Math Academy, Seoul, South Korea Jan-July 2007

**Private Tutor**, Seoul, South Korea 2003-2007