

# Hongki Kang, Ph.D.

Postdoctoral Scholar  
in Department of Bio and Brain Engineering  
& Information & Electronics Research Institute at KAIST

Last update: March 9<sup>th</sup>, 2018

## CONTACT INFORMATION

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KAIST  
291 Daehak-ro, Yuseong-gu  
Daejeon, South Korea, 34141  
Website <https://sites.google.com/view/hkang/>  
<https://goo.gl/BZqwuc> (Google scholar)

## EMPLOYMENT HISTORY

2015 – Now **Postdoctoral researcher, Dept. of Bio and Brain Engineering**  
**KAIST**, Daejeon, South Korea  
PI: Dr. Yoonkey Nam  
Alternative military service as technical research personnel (term: 3 years)

2014 – 2015 **Postdoctoral Research Scientist, Dept. of Electrical Engineering**  
**Columbia University**, New York, NY United States  
PI: Dr. Kenneth L. Shepard

2012 **Technical Co-op,**  
**IBM Semiconductor Research and Development Center**, East Fishkill, NY United States  
Manager: Dr. Dan M. Mocuta, Dr. Dae-Gyu Park, and Dr. Chris M. Schnabel

## EDUCATION

2008 – 2013 **Ph.D., Electrical Engineering and Computer Sciences,**  
**University of California, Berkeley**, Berkeley, CA, United States  
Research advisor: Prof. Vivek Subramanian  
Dissertation: Gravure-printed Highly-scaled Organic Thin-film Transistors for Low-cost and Large-area Electronics  
Outside minor: Fluid mechanics

2008 – 2010 **M.S., Electrical Engineering and Computer Sciences,**  
**University of California, Berkeley**, Berkeley, CA, United States  
Research advisor: Prof. Vivek Subramanian  
Thesis: Hydrostatic optimization of inkjet-printed films

2004 – 2008 **B.S., Electrical Engineering,**  
**KAIST**, Daejeon, South Korea  
Summa Cum Laude  
Research advisor: Prof. Yang-Kyu Choi  
Thesis: Analytical Threshold Voltage Model for Double-Gate MOSFETs with Localized Charges

## RESEARCH INTERESTS

- Inkjet-printed functional nanoparticle precision patterning for biomedical applications
- Thermo-plasmonic device fabrication and its application in bioengineering
- Bioelectronics, and neural engineering/interface for large-scale neural stimulation and recording
- Semiconductor devices and physics
- Solution processed low-cost and large area flexible electronics
- Roll-to-roll/inkjet printing technologies for printed electronics and bioelectronics
- Low frequency noise behavior of novel semiconductor devices for sensor/RF applications
- Impact of hydrostatic/dynamics and wetting phenomena on nanoparticles and printed devices

## RESEARCH EXPERIENCES

Jul. 2015 – **Neural Engineering Laboratory, KAIST, Daejeon, South Korea**

Now **PI: Prof. Yoonkey, Nam**

BK21 Postdoctoral researcher (July 2015 – June 2017)

- Inkjet-printed thermo-plasmonic heaters using gold nanorods for selective neuromodulation
- Novel materials and transistors for neural recording
- ASIC chip based 256-channel microelectrode neural recording system development
- High-speed optical neural recording

Mar. 2014 – **Bioelectronic Systems Lab, Columbia University, New York, NY United States**

Jun. 2015 **PI: Prof. Kenneth L. Shepard**

Postdoctoral research scientist

- Novel IC design/fabrication for flexible neural/biomedical/implantable electronics applications
- Flexible CMOS probes for chronic, large-scale neural stimulation and record
- Micron-scale ultrasonic sensing tags
- Vertical GaN power transistors and boost converters, ARPA-E SWITCHES program, “Vertical GaN Power Transistors Using Controlled Spalling for Substrate Heterogeneity”

Oct. 2008 – **Printed Electronics group, UC Berkeley, Berkeley, CA United States**

Dec. 2013 **PI: Prof. Vivek Subramanian**

Graduate student researcher

- Gravure-printed highly-scaled features and thin-film transistors
- Understanding of low frequency noise (1/f noise) in organic TFTs
- Fundamental understanding of the pattern generation of printed films
- Electrowetting devices

Jun. 2012 – **IBM Semiconductor Research and Development Center, East Fishkill, NY United States**

Aug. 2012 Summer Co-Op in 14nm CMOS Device Design area

(supervised by Dr. Dan M. Mocuta, Dr. Dae-Gyu Park, and Dr. Chris M. Schnabel)

Sep. 2007 – **Integrated Organic Electronics Lab, KAIST, Daejeon, South Korea**

May 2008 **PI: Prof. Seunghyup Yoo**

Undergraduate researcher

- Fabrication of organic conductors by using Micro Contact Printing ( $\mu$ CP)

Mar. 2007 – **Nano Bio Electronics Laboratory, KAIST, Daejeon, South Korea**

Dec. 2007 **PI: Prof. Yang-Kyu Choi**

Undergraduate researcher

- Hot-Carrier-Effects in Double Gate MOSFET

## PUBLICATIONS

### Bioelectronics/Neural Engineering/Thermo-plasmonic Neural Interface

- 2018 1. [Hongki Kang](#), Gu-Haeng Lee, Hyunjun Jung, Jee Woong Lee and Yoonkey Nam, "Inkjet-Printed Bio-Functional Thermo-Plasmonic Interfaces for Patterned Neuromodulation," *ACS NANO*, 2018. ([Link](#))
2. [Hongki Kang](#), Jee Woong Lee, and Yoonkey Nam, "Inkjet-printed multi-wavelength thermo-plasmonic images for anti-counterfeiting applications," *ACS APPLIED MATERIALS & INTERFACES*, 2018. ([Link](#))
- 2017 3. [Hongki Kang](#), Gu-Haeng Lee and Yoonkey Nam, "Inkjet-Printed Gold Nanorods using Biocompatible Polyelectrolyte Layer-by-Layer Coating for Patterned Photothermal Applications," *39<sup>th</sup> Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2017 (EMBS '17)*, 3545–3548, 2017. ([Link](#))
4. Hyunjun Jung, [Hongki Kang](#), and Yoonkey Nam, "Digital Micromirror based Near-infrared Illumination System for Plasmonic Photothermal Neuromodulation," *BIOMEDICAL OPTICS EXPRESS*, 8, 2866, 2017. ([Link](#))
5. [Hongki Kang](#), Jee-Yeon Kim, Yang-Kyu Choi, and Yoonkey Nam, "Feasibility Study of Extended-gate Type Silicon Nanowire Field-Effect Transistor for Neural Recording," *SENSORS*, 17(4), 705, 2017. ([Link](#))

### Printed, Solution Processed, and Flexible Thin-film Transistors

- 2016 6. Gerd Grau, Jialiang Cen, [Hongki Kang](#), Rungrot Kitsomboonloha, William Scheideler, and Vivek Subramanian, "Gravure-printed electronics: Recent progress in tooling development, understanding of printing physics, and realization of printed devices," *FLEXIBLE and PRINTED ELECTRONICS*, 1, 023002, 2016. ([Link](#))
7. Jaewon Jang, Seungjun Chung, [Hongki Kang](#), and Vivek Subramanian, "P-type CuO and Cu<sub>2</sub>O transistor derived from a sol-gel copper (II) acetate monohydrate precursor," *THIN SOLID FILMS*, Vol. 600, pp. 157-161, February 2016. ([Link](#))
- 2015 8. Rungrot Kitsomboonloha, [Hongki Kang](#), Gerd Grau, William Scheideler, and Vivek Subramanian, "MHz-Range Fully Printed High-Performance Thin-Film Transistors by Using High-Resolution Gravure-Printed Lines," *ADVANCED ELECTRONIC MATERIALS*, vol. 1, no. 12, Dec. 2015. ([Link](#))
9. Jaewon Jang, [Hongki Kang](#), Himamshu C. Nallan Chakravarthula, and Vivek Subramanian, "Fully inkjet-printed transparent oxide thin film transistors using a fugitive wettability switch," *ADVANCED ELECTRONIC MATERIALS*, vol. 1, no. 7, July 2015. ([Link](#))
10. Vivek Subramanian, Jialiang Cen, Alejandro de la Fuente Vornbrock, Gerd Grau, [Hongki Kang](#), Rungrot Kitsomboonloha, Daniel Soltman, and Huai-Yuan Tseng, "High-speed printing of transistors: From Inks to Devices," *PROCEEDINGS of the IEEE*, vol. 103, no. 4, 2015. ([Link](#))
11. Gerd Grau, Rungrot Kitsomboonloha, [Hongki Kang](#), and Vivek Subramanian, "High performance printed organic transistors using a novel scanned thermal annealing technology," *ORGANIC ELECTRONICS*, vol. 20, pp. 150–157, May 2015. ([Link](#))
- 2014 12. [Hongki Kang](#), Rungrot Kitsomboonloha, Kurt Ulmer, Lisa Stecker, Gerd Grau, Jaewon Jang and Vivek Subramanian, "Megahertz-class printed high mobility organic thin-film transistors and inverters on plastic using attoliter-scale high-speed gravure-printed sub-5  $\mu\text{m}$  gate electrodes," *ORGANIC ELECTRONICS*, vol. 15, no. 12, pp. 3639–3647, Dec. 2014. ([Link](#))
13. Hyuk-Jun Kwon, Jaewon Jang, [Hongki Kang](#), Sunkook Kim, Vivek Subramanian and Costas P. Grigoropoulos, "Electrical Characteristics of Multilayer MoS<sub>2</sub> Transistors at Real Operating Temperatures and Different Ambient Conditions," *ECS Trans. 2014*, vol. 64, 8, pp. 127-133, 2014. ([Link](#))
14. Gerd Grau, Rungrot Kitsomboonloha, Sarah L Swisher, [Hongki Kang](#), Vivek Subramanian, "Printed Transistors on Paper: Towards Smart Consumer Product Packaging," *ADVANCED FUNCTIONAL MATERIALS*, vol. 24, no. 32, pp. 5067–5074, 2014. ([Link](#))

- 2012 15. Hongki Kang, Rungrot Kitsomboonloha, Jaewon Jang, and Vivek Subramanian, "High-performance printed transistors realized using femtoliter gravure-printed Sub-10 $\mu$ m metallic nanoparticle patterns and highly uniform polymer dielectric and semiconductor layers," *ADVANCED MATERIALS*, vol. 24, no. 22, pp. 3065–3069, 2012. (Link)
16. Jaewon Jang, Rungrot Kitsomboonloha, Sarah L. Swisher, Eung Seok Park, Hongki Kang, and Vivek Subramanian, "Transparent High-Performance Thin Film Transistors from Solution-Processed SnO<sub>2</sub>/ZrO<sub>2</sub> Gel-like Precursors," *ADVANCED MATERIALS*, vol. 25, no. 7, pp. 1042–1047, 2012. (Link)
- 2010 17. Alejandro de la Fuente Vornbrock, Donovan Sung, Hongki Kang, Rungrot Kitsomboonloha, and Vivek Subramanian, "Fully gravure and ink-jet printed high speed pBTTT organic thin film transistors," *ORGANIC ELECTRONICS*, vol. 11, no. 12, pp. 2037-2044, DEC 2010. (Link)

#### 1/f Noise Study

- 2014 18. Hyuk-Jun Kwon<sup>‡</sup>, Hongki Kang<sup>‡</sup>, Jaewon Jang, Sunkook Kim, and Costas P. Grigoropoulos, "Flicker noise analysis of 2D multi-layer MoS<sub>2</sub> transistors," *APPLIED PHYSICS LETTERS*, 104, 083110, 2014. (Link) – <sup>‡</sup>Equal contribution with H.-J. Kwon
19. Hongki Kang, and Vivek Subramanian, "Measurement and analysis of 1/f noise under switched bias in organic thin film transistors," *APPLIED PHYSICS LETTERS*, 104, 023301, 2014. (Link)
- 2011 20. Hongki Kang, Lakshmi Jagannathan, and Vivek Subramanian, "Measurement, analysis, and modeling of 1/f noise in pentacene TFTs," *APPLIED PHYSICS LETTERS*, 99, 062106, 2011. (Link)

#### Physicochemical Hydrodynamics in Printing

- 2010 21. Dan Soltman, Ben Smith, Hongki Kang, S.J.S. Morris, and Vivek Subramanian, "Methodology for inkjet printing partially wetting films," *LANGMUIR*, 2010, 26 (19), pp 15686-15693. (Link)
22. Hongki Kang, Dan Soltman, and Vivek Subramanian, "Hydrostatic Optimization of Inkjet-Printed Films," *LANGMUIR*, 2010, 26(13), 11568-11573. (Link)

#### Multi-gate MOSFETs

- 2008 23. Hongki Kang, Jin-Woo Han, and Yang-Kyu Choi, "Analytical Threshold Voltage Model for Double-Gate MOSFETs with Localized Charges," *IEEE ELECTRON DEVICE LETTERS*, VOL. 29, NO. 8, 927-930, AUGUST 2008. (Link)

#### BOOKS

1. Hongki Kang and Yoonkey Nam, "In Vitro Neural Recording by Microelectrode Arrays," in *Stretchable Bioelectronics for Medical Devices and Systems*, J. A. Rogers, R. Ghaffari and D.-H. Kim, Eds. *Springer US*, 2016, pp. 275-291. (ISBN: 978-3-319-28692-1, Link)

## CONFERENCES

- 2018 1. Hongki Kang<sup>‡</sup>, Jee Woong Lee<sup>‡</sup>, and Yoonkey Nam, "Optimization of photothermal efficiency of thermal evaporated gold film for modulating neural activity in vitro," *Microtechnologies in Medicine and Biology*, Monterey, US, March 2018.
- 2017 2. Hongki Kang, Hyunjun Jung, Jee Woong Lee, and Yoonkey Nam, "Selective neuro-modulation using inkjet-printed thermo-plasmonic gold nanorods," *Materials Research Society*, Boston, US, Fall 2017. (Oral presentation)
3. Hongki Kang, Hyunjun Jung, Jee Woong Lee, and Yoonkey Nam, "Inkjet-printed micro thermo-plasmonic heater based patterned heat generation for neuro-modulation on microelectrode array chip," *2017 Annual Fall Meeting of the Korean BioChip Society (KBCS)*, Busan, South Korea, November 2017. (Oral presentation)
4. Daejeong Kim, Hongki Kang, and Yoonkey Nam, "Compact 256 channel multi-well PEDOT microelectrode array for neuron-based high-throughput drug screening," *2017 Annual Fall Meeting of the Korean BioChip Society (KBCS)*, Busan, South Korea, November 2017. (Best poster award)
5. Hongki Kang, Jee Woong Lee, Nari Hong, and Yoonkey Nam, "Selective and reversible functional connectivity modulation in neuronal network using patterned thermo-plasmonic effect," *The 20<sup>th</sup> Annual Meeting of the Korean Society for Brain and Neural Science (KSBNS 2017)*, Seoul, South Korea, August 2017.
6. Daejeong Kim, Hongki Kang, and Yoonkey Nam, "Customized Multi-Well Microelectrode Array System for Massive Electrical Recordings from Neuronal Cultures," *IEEE EMBC 2017*, Jeju, South Korea, July 2017.
7. Hongki Kang, Gu-Haeng Lee, and Yoonkey Nam, "Inkjet-Printed Gold Nanorods using Biocompatible Polyelectrolyte Layer-by-Layer Coating for Patterned Photothermal Applications," *IEEE EMBC 2017*, Jeju, South Korea, July 2017. (Oral presentation)
8. Jeewong Lee, Hongki Kang, and Yoonkey Nam, "Near-infrared light-based photothermal stimulation of cultured neurons using gold nanofilm chip," *SPIE NBSIS 2017*, Jeju, South Korea, Feb 2017.
- 2016 9. Hongki Kang, Jee-Yeon Kim, Yang-Kyu Choi, and Yoonkey Nam, "A Feasibility Study of Tri-Gate Silicon Nanowire Field-Effect Transistor for Neural Signal," *IEEE EMBC 2016*, Orlando, US, August 2016.
10. Hongki Kang, Jee-Yeon Kim, Yang-Kyu Choi, and Yoonkey Nam, "In-depth characterization of silicon nanowire field-effect transistor (SiNW-FET) for neural recording and direct performance comparison with passive MEA," *MEA Meeting 2016*, Reutlingen, Germany, June 2016.
- 2015 11. Hongki Kang, Kevin Tien, Kenneth L. Shepard, Devendra Sadana, Stephen W. Bedell, Yuhao Zhang, Min Sun, Tomás Palacios, Ajit Paranjpe, "Vertical GaN Power Transistors Using Controlled Spalling for Substrate Heterogeneity," *ARPA-E Energy Innovation Summit 2015*, Washington D.C., US, Feb 2015.
- 2013 12. Rungrot Kitsomboonloha, Hongki Kang, and Vivek Subramanian, "High Performance Organic TFTs Using High-Resolution Gravure Printed Electrodes," *Materials Research Society*, Boston, US, Fall 2013.
13. Gerd Grau, Rungrot Kitsomboonloha, Sarah Swisher, Hongki Kang, and Vivek Subramanian, "Printed Transistors on Paper: Towards Smart Consumer Product Packaging," *LOPE-C*, Germany, June 2013.
- 2012 14. (Invited) Vivek Subramanian, Stephen J. S. Morris, Hongki Kang, and Rungrot Kitsomboonloha, "Modeling, Scaling, and Integration of Gravure Printing for Fast Switching Organic FETs," *Materials Research Society*, Boston, US, Fall 2012.
15. Jaewon Jang, Eung Seok Park, Hongki Kang, and Vivek Subramanian, "Inkjetted Inorganic Transistors Using a Sol-gel Processed SnO<sub>2</sub> Semiconductor and Sb-doped SnO<sub>2</sub> Electrodes," *Materials Research Society*, Boston, US, Fall 2012.

- 2012 16. Hongki Kang, Alejandro de la Fuente Vornbrock, Rungrot Kitsomboonloha, Jaewon Jang, and Vivek Subramanian, "Highly-Scaled Gravure Printed organic TFTs with 10  $\mu\text{m}$  channel length on Plastic with 300 kHz operation," *Materials Research Society Spring 2012*. (Oral presentation)
17. (Invited) Hongki Kang, Huai-Yuan Tseng, Rungrot Kitsomboonloha, and Vivek Subramanian, "High-performance printed organic transistors: Advances in printing techniques and processes," *2012 Flexible Electronics & Displays Conference & Exhibition*, Phoenix, AZ, Feb 6-9, 2012.
- 2011 18. Hongki Kang, Lakshmi Jagannathan, and Vivek Subramanian, "Measurement, analysis, and modeling of 1/f noise in pentacene TFTs," *LOPE-C, Messe Frankfurt, Germany*, June 2011. (Oral presentation)
- 2010 19. Jaewon Jang, Rungrot Kitsomboonloha, Lakshmi Jagannathan, Hongki Kang and Vivek Subramanian, "Electrical Characterization of close-packed ZnSe Nanoparticle Films," *Materials Research Society*, Boston, US, Fall 2010.
20. Dan Soltman, Ben Smith, Hongki Kang, Stephen Morris, and Vivek Subramanian, "Methodology for Inkjet Printing Partially Wetting Films," *IS&T Digital Fabrication conference*, Austin, TX, Sept. 19-23, 2010.
21. Dan Soltman, Ben Smith, Hongki Kang, Stephen Morris, and Vivek Subramanian, "Methodology for two dimensional pattern generation in inkjet printing," *LOPE-C, Messe Frankfurt, Germany*, May 2010.
22. Hongki Kang, Dan Soltman, and Vivek Subramanian, "Hydrostatic concerns in inkjet-printed films," *Materials Research Society*, San Francisco, US, Spring 2010.
23. Dan Soltman, Hongki Kang, and Vivek Subramanian, "Considerations for pattern generation in inkjet-printed electronics," *SPIE Advanced Lithography*, San Jose, US, Feb 2010. (Oral presentation)

## PATENTS

- 남윤기, 이지웅, 강홍기, "광열 신경자극이 가능한 미세전극칩 및 이를 이용한 신경세포 제어 방법, Microelectrode array chip capable of photothermal stimulation and control method of nerve cell using the same" 출원 번호 10-2017-0081120, 2017.
- 남윤기, 강홍기, 이구행, "나노 입자를 포함하는 잉크를 인쇄하는 프린팅 장치 및 나노 입자를 포함하는 잉크의 인쇄 방법, 이를 이용한 신경세포칩 및 제조 방법, Printing device for printing ink containing nanoparticles and printing method of ink containing nanoparticles, neural interface chip and manufacturing method using same thereof" 출원 번호 10-2017-0065181, 2017.
- Kenneth Shepard, Hongki Kang, Jordan Thimot, and Chen Shi, "Micron-scale ultrasonic tags," in United States Provisional Application No. 62/214,822, September 4, 2015.
- Kenneth Shepard, David Tsai, and Hongki Kang, "Flexible complementary metal-oxide-semiconductor probes for chronic, large-scale neural stimulation and recording," in United States Provisional Application No. 62/210,532, August 27, 2015.

## ENGINEERING SKILLS

- Neural recording and analysis: multichannel action potential recording, spike sorting, neuro explorer
- Neural signal recording system fabrication: microelectrode array fabrication, Intan ASIC chip based 256 channel system recording system fabrication from scratching
- Primary culture of neurons from the early postnatal mouse hippocampus and cortex
- Calcium imaging
- Printed Electronics fabrication; Inkjet printing, Gravure printing, Micro-contact printing.
- Micro/nanofabrication on both wafer level and for post-IC process
- Bias temperature instability test, and vertical gate resistance measurement, S-parameter measurement & analysis
- Noise signal measurement & characterization in electronic devices
- Device characterization, electrical and mechanical; Silicon based transistors, and printed TFTs.
- Dynamic contact angle characterization
- Ultrasound imaging and wireless power transfer, Piezoelectric transducer modeling
- Simulation and Design Tools: Sentaurus, Silvaco, Cadence, L-Edit, AutoCAD, PCB Layout design

## HONORS AND AWARDS

- 2004 – 2008 Scholarship of the 2nd Presidential Science Scholarship from Korea Science and Engineering Foundation, certified by South Korean President Roh, Moo-hyun
- 2003 Gold Prize at 15th National Math/Science Olympiad, Physics Part
- 2002 Scholarship of Samsung, JFL (Junior Frontier Leader)

## JOURNAL REVIEW ACTIVITIES

- IEEE Electron Device Letters
- Organic Electronics
- Langmuir
- ACS Applied Materials & Interfaces
- Journal of Electrical and Computer Engineering
- Robotics and Computer-Integrated Manufacturing

## PROFESSIONAL MEMBERSHIP

- IEEE
- Materials Research Society

## TEACHING EXPERIENCES

### Graduate Student Instructor, UC Berkeley, Berkeley, CA United States

- 2012 EE231, Solid State Devices (Spring 2012), Overall teaching effectiveness: N/A
- 2011 EE42/100, Introduction to Digital Electronics (Fall 2011), Overall teaching effectiveness: 5.0/5.0
- 2009 EE42/100, Introduction to Digital Electronics (Fall 2009), Overall teaching effectiveness: 4.3/5.0
- EE40, Introduction to Microelectronic Circuits (Summer 2009), Overall teaching effectiveness: N/A

## OTHER ACTIVITIES

- 2016 – Now IEEE Young Professionals
- 2014 Columbia University IDP (Individual Development Plan) completion
- 2011 – 2012 Director of Industrial Relationship at KGSA (Korean Graduate Student Association) at UC Berkeley
- 2006 – 2008 A chair of EENL (a newsletter of the Department of Electrical Engineering at KAIST)
- 2004 – 2008 Acoustic guitar club at KAIST, 'Sixline' (performed more than 15 big and small concerts)
- 2002 A certificate achievement of 12th International Physics Olympiad Summer School, Korea Division