

Young Duck Kim

Post-Doctoral Research Scientist,
 Department of Mechanical Engineering,
 Columbia University,
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Education

Ph. D. in Physics, Aug. 2012

Seoul National University,

Department of Physics and Astronomy, Seoul, Republic of Korea

- Advisor: Yun Daniel Park
- Dissertation title: Nanoelectromechanical system for characterization of low dimensional materials

B. S. in Physics, Feb. 2006

Yonsei University,

Department of Physics, Seoul, Republic of Korea

Research Career

Post-Doctoral Research Scientist (Dec. 2013-)

Department of Mechanical Engineering, Columbia University, New York, U.S.A

- Advisor: James Hone
- van der Waals heterostructure electrical transport and optoelectronics

Post-Doctoral Research Associate (Sept. 2013- Nov. 2013)

Division of Physical Metrology,

Korea Research Institute of Standards and Science, Daejeon, Republic of Korea

- Advisor: Jae-Hyuk Choi
- SQUID-micro torsional resonator hybrid system

Post-Doctoral Research Associate (Sept. 2012- Aug. 2013)

BK 21 Frontier Physics Research Division,

Department of Physics and Astronomy, Seoul National University, Seoul, Republic of Korea

- Advisor: Yun Daniel Park
- Optical, thermal, electrical and mechanical properties of suspended graphene and nanowire
- Mesoscopic system with mechanical degree of freedom

Special Adviser of Valuations of Patented Technologies (Feb. 2013- Feb. 2016)

Korea Invention Promotion Association

Research Assistant (Feb. 2011- Aug. 2013)

Korea Research Institute of Standards and Science, Daejeon, Republic of Korea

- Magnetic flux quantization in superconductor nano-ring
- Aharonov-Bohm effect in novel metal nano-ring

Head Manager of Cleanroom (Feb. 2009-Mar. 2010)

Department of Physics and Astronomy, Seoul National University, Seoul, Republic of Korea

Teaching and Research Assistant (Mar. 2006-Feb. 2009)

Department of Physics and Astronomy, Seoul National University, Seoul, Republic of Korea

Research Interest

van der Waals materials (Graphene, MoS₂, WSe₂, CNT, Nanowire)

- Quantum transport in van der Waals heterostructure
- van der Waals heterostructure based optoelectronics
- 2D material based flexible and transparent optoelectronics for display module
- Ultrafast light emitter and photodetector for on-chip optical interconnects

Nanoelectromechanical System (NEMS) in the quantum regime

- Ultra high frequency and high Q-factor nanomechanical resonators
- Low dimensional material nanoelectromechanical systems
- Opto-electro-mechanical systems
- On-chip mechanical motion detection systems

Mesoscopic system with mechanical degree of freedom

- Aharonov-Bohm effect in novel metal nano-rings with mechanical degree of freedom
- Magnetic flux quantization and persistent current in superconductor/normal-metal rings
- Quantum momentum squeezing effects in nanomechanical systems
- Graphene and 2D superconductor Josephson junctions

**Area of
Specialization****1. Nanofabrication of low dimensional material**

- Sub 20nm **e-beam lithography** patterning using Tescan VEGA TS 5130MM and Nano Patterning Generate System (NPGS)
- Sub 50nm **align** and transfer with **graphene, carbon nanotube and nanowires**
- Sub micron **photo lithography** patterning using Karl Suss MJB3
- Dry etching using home built **Reactive Ion Etching (RIE)**—O₂, Ar, CF₄, SF₆
- Sub 50nm ion milling and Pt deposition **using Dual beam FIB** (FEI 3D Quanta)
- Metallization using **e-gun evaporator, thermal evaporator and sputter system**
- Suspended low dimensional materials (graphene, carbon nanotube and nanowire) structures** using wet/dry etching and transfer method

2. Ultrafast opto-electrical characterization of low dimensional materials

- Photo/thermoelectric** transport of low dimensional materials
- Blackbody radiation** spectrum measurement
- Micro Raman-PL spectroscopy** of graphene and nanowire
- Photonic crystal and plasmonic structure**
- Ultrafast on-chip optical communications**

3. Ultra small mechanical motion detection

- Sub-picometer displacement detection** technique using **optical interferometer** and **magnetomotive techniques**
- Developing of **mesoscopic system** for angular displacement detection
- Anelastic effect** measurement by dynamic long loading cycle technique
- Quasi-flexure measurement** for investigation mechanical properties of low dimensional material using AFM

4. Low temperature and high magnetic field measurement

- Quantum transport of low dimensional material at low temperature (300 mK)**
- High magnetic field transport of low dimensional material (32 and 45 Tesla – National High Magnetic Field Laboratory in U.S.A)**

**Scholarship
& Award****Guinness World Records – Thinnest Light Source (2016)**

“The thinnest light source is 0.335 nm thick”

Graduation with honors and The Graduate Student Research Award (2012)

Department of Physics and Astronomy, Seoul National University, 29 August, 2012

Best Presentation Award (2011)

The Korean Physical Society Fall Meeting, Busan, Republic of Korea, 19-21 October, 2011

4th BK 21 Young Physicists Poster Award (2011)

Pohang University of Science and Technology, Pohang, Republic of Korea, 20-21 January, 2011

Presentation Award (2010)

Seoul National University BK Workshop, Seoul, Republic of Korea, 23 December, 2010

Best Presentation Award (2010)

The Korean Physical Society Fall Meeting, Pyoungchang, Republic of Korea, 20-22 October, 2010

Best Poster Award (2010)

The Korean Physical Society Fall Meeting, Pyoungchang, Republic of Korea, 20-22 October, 2010

BK 21 excellent TA Award (2010)

Department of Physics and Astronomy, Seoul National University, Seoul, Republic of Korea, 2010

2nd BK 21 Young Physicists Award (2009)

Korea Advanced Institute of Science and Technology, Daejeon, Republic of Korea, 17-18 January, 2009

BK 21 Fellowship (2008)

Department of Physics and Astronomy, Seoul National University, Seoul, Republic of Korea, 2008

Best Poster Award (2008)

The Korean Physical Society Fall Meeting, Gwangju, Republic of Korea, 23-24 October, 2008

Seoul Science Fellowship (2008)

Department of Physics and Astronomy, Seoul National University, Seoul, Republic of Korea, 2008

Publications

1. J.H. Bak*, **Y.D. Kim***, S.S. Hong, B.Y. Lee, S.R. Lee, K.H. Jang, M. Kim, K. Char, S. Hong and Y.D. Park, "High-frequency micromechanical resonators from aluminum-carbon nanotube nanolaminates", *Nature Materials* **7**, 459 (2008). (* **Equally contributed**)
- This paper introduced as **Highlights of NPG Asia Materials**, 9 July (2008).
2. Y.J. Yi, **Y.D. Kim**, J.H. Bak, S.R. Lee, K. Heo, S. Hong, K. Char, and Y.D. Park, "Effects of tensile stress on the resonant response of Al thin-film and Al-CNT nanolaminate nanomechanical beam resonators", *Current Applied Physics* **11**, 746 (2011).
3. **Y.D. Kim**, K. Heo, M.R. Cho, S. Cho, D. Yoon, H. Cheong, J. Jian, S. Hong and Y.D. Park, "Determination of Mechanical Properties of Single-Crystal CdS Nanowires from Dynamic Flexural Measurements of Nanowire Mechanical Resonators", *Applied Physics Express* **4**, 065004 (2011).
4. Y.S. Kim, J.H. Lee, **Y.D. Kim**, S.-K. Jern, K. Joo, E. Kim, J. Jung, E. Yoon, Y.D. Park, S. Seo and S.-H. Chun, "Methane as an effective hydrogen source for single-layer graphene synthesis on Cu foil by plasma enhanced chemical vapor deposition", *Nanoscale* **5**, 1221 (2013).
5. B. Kumar, K. Min, M. Bashirzadeh, A. Barati Farimani, M.-H. Bae, D. Estrada, **Y.D. Kim**, P. Yasaei, Y. D. Park, E. Pop, N. Aluru and A. Salehi-Khojin, "The Role of External Defects in Chemical Sensing of Graphene Field-Effect Transistors", *Nano Letters* **13**, 1962 (2013).
6. **Y.D. Kim**, M.-H. Bae, J.-T. Seo, Y.S. Kim, H. Kim, J.H. Lee, J.R. Ahn, S. W. Lee, S.-H. Chun and Y.D. Park, "Focused-Laser-Enabled *p-n* Junctions in Graphene Field-Effect Transistors", *ACS Nano* **7**, 5850 (2013).
7. Y. Li, J. Ludwig, T. Low, A. Chemikov, X. Cui, G. Arefe, **Y. D. Kim**, A. M. van der Zande, A. Rigosi, H. Hill, S. H. Kim, J. Hone, Z. Li, D. Smimov and T. F. Heinz, "Valley Splitting and Polarization by the Zeeman Effect in Monolayer MoSe₂", *Physical Review Letters* **113**, 266804 (2014).
8. X. Cui*, G.-H. Lee*, **Y.D. Kim***, G. Arefe, P. Y. Huang, C.-H. Lee, D. A. Chenet, X. Zhang, L. Wang, F. Ye, F. Pizzocchero, B. S. Jessen, K. Watanabe, T. Taniguchi, D. A. Muller, T. Low, P. Kim and J. Hone, "Multi-terminal transport measurements of MoS₂ using a van der Waals heterostructure device platform", *Nature Nanotechnology* **10**, 534 (2015). (* **Equally contributed**)

9. **Y.D. Kim**^{†*}, H. Kim*, Y.J Cho*, J. H. Ryoo*, C.-H Park, P. Kim, Y. S. Kim, S. Lee, Y. Li, S.-N. Park, Y. S. Yoo, D. Yoon, V. E. Dorgan, E. Pop, T. F. Heinz, J. Hone, S.-H. Chun, H. Cheong, S. W. Lee, M.-H. Bae[†] and Y.D. Park[†], “Bright visible light emission from graphene”, *Nature Nanotechnology* **10**, 676 (2015). ([†] **Corresponding author**, * **Equally contributed**)
- This paper introduced on the above 100 press including **Nature, The Wall Street Journal, National Geography, Popular Science, The Independent, The Daily Mail, Foxnews, Wired, Science Daily, NYC Today, NY City News, Physics World, MBC TV, YTN TV, Jongang, Donga Science, etc.**
10. G.-H. Lee, X. Cui , **Y.D. Kim**, G. Arefe, X. Zhang, C.-H. Lee, F. Ye, K. Watanabe, T. Taniguchi, P. Kim and J. Hone, “Highly Stable, Dual-Gated MoS₂ Transistors Encapsulated by Hexagonal Boron Nitride with Gage-Controllable Contact, Resistance, and Threshold Voltage”, *ACS Nano* **9**, 7019 (2015).
11. A. W. Tsen, R. Hovden, D. Z. Wang, **Y.D. Kim**, J. Okamoto, K. A. Spoth, Y. Liu, W. J. Lu, Y. P. Sun, J. Hone, L. F. Kourkoutis, P. Kim, and A. N. Pasupathy, “Structure and control of charge density waves in two-dimensional 1T-TaS₂”, *Proceedings of the National Academy of Sciences* **112**, 15054 (2015).
12. A. W. Tsen, B. Hunt, **Y.D. Kim**, Z. J. Yuan, S. Jia, R. J. Cava, J. Hone, P. Kim, C. R. Dean and A. N. Pasupathy, “Nature of the Quantum Metal in a Two-Dimensional Crystalline Superconductor”, *Nature Physics*, doi:10.1038/nphys3579 (2015).
13. J. Gao, **Y.D. Kim**, L. Liang, J. C. Idrobo, P. Chow, B. Li, J. Tan, L. Li, B. G. Sumpter, T.-M. Lu, V. Meunier, J. Hone and N. Koratkar, “Transition metal doping in synthetic atomically-thin semiconductors”, *under Review* (2016).
14. I. Lee, S. Rath, D. Lim, L. Li, J. Park, Y. Lee, K. S. Yi, K. P. Dhakal, J. Kim, C. Lee, G.-H. Lee, **Y.D. Kim**, J. Hone and G.-H. Kim, “Ambipolar field-effect transistor with atomically thin dual-channel of WSe₂/MoS₂ heterostructure” *under Review* (2016)
15. **Y.D. Kim**, X. Cui, G. Arefe, D. Seo, J. Yin, G.-H. Lee, D. A. Chenet, K. Watanabe, T. Taniguchi, T. Low, C. R. Dean, P. Kim and J. Hone, “Quantum Oscillation and Spin-Valley Zeeman effect in the Monolayer MoS₂”, *in Preparation* (2016).
16. **Y.D. Kim**, Y. Gao, R.-J. Shiue, C. Tan, S. Lee, K. Watanabe, T. Taniguchi, D. Englund and J. Hone, “Ultrafast Graphene Light Emitter”, *in preparation* (2016).
17. **Y.D. Kim**, Y. Gao, H.-S. Kim, L. Wang, O. B. Aslan, G. Arefe, S. Lee, D. Seo, K. Watanabe, T. Taniguchi, G.-H. Lee, T. F. Heinz and J. Hone, “Flexible and Transparent Graphene Visible Light Emitter”, *in preparation* (2015).
18. **Y.D. Kim***, D. Seo, G. Arefe, S. Lee, G.-H. Lee, K. Watanabe, T. Taniguchi, and J. Hone, “Water-Vapor Assistant Ultraclean Direct Pick-up Technique for CVD Transition Metal Dichalcogenides”, *in preparation* (2016).
19. R.-J. Shiue, Y. Gao, C. Peng, D. K. Efetov, **Y.D. Kim**, J. Hone and D. Englund, “Cavity-enhanced Narrowband Radiation of an Electrically Driven Graphene Light Emitter”, *in preparation* (2016).

International Conference Presentation

1. “Bright Visible Light Emission from Graphene”
International Winterschool on Electronic Properties of Novel Materials 2016, Kirchberg, Tirol, Austria, 13-20 February, 2016. (**Invited**)
2. “h-BN Encapsulated MoS₂ for Intrinsic Transport”
Material Research Society 2014 Fall Meeting, Boston, Massachusetts, USA, 1-5 December, 2014.
3. “van der Waals Heterostructure for Approaching Intrinsic Transport”
The 2014 X-ray Scattering Principal Investigators’ Meeting, Gaithersburg, Maryland, USA, 4-6 November, 2014.

4. “*Focused Laser Induced Spatially Controllable P-N Junctions in Graphene Field-Effect Transistor*”, **The American Physical Society 2013 March Meeting**, Baltimore, Maryland, USA, 18-22 March, 2013.
5. “*Ultra small angular displacement measurement from superconductor/AB nano-ring coupled to a micro-torsional resonator*”, **Gordon Research Conference-Mechanical Systems in the Quantum Regime**, Hotel Galvez, Galveston, Texas, USA, 4-9 March, 2012.
6. “*Mechanical and Optical Properties of Single CdS Nanowire of Nanomechanical Resonators*”, **Workshop on Nano-Opto-Electro-Mechanical Systems Approaching the Quantum Regime, The Abdus Salam International Centre for Theoretical Physics**, Miramare, Trieste, Italy, 6-10 September, 2010.
7. “*Enhanced Stabilities in Resonant Response of Carbon Nanotube Network Reinforced Al Thin-Film Nanomechanical Resonators*”, **AVS 56th International Symposium & Exhibition**, San Jose, California, USA, 8-13 November, 2009.
8. “*Suppression of Anelastic Effect in Micromechanical Resonators from suspended Al-CNT Nanolaminate Thin-Films*”, **AVS 55th International Symposium & Exhibition**, Boston, Massachusetts, USA, 19-24 October, 2008.
9. “*Metal-carbon nanotube composite nanoelectromechanical torsional resonators*”, **The American Physical Society 2007 March Meeting**, Denver, Colorado, USA, 5-9 March, 2007.

Domestic Conference Presentation

1. “*Focused-Laser-Enabled P-N Junctions in Graphene Field-Effect Transistors*”, **The Korean Physical Society 2013 Spring Meeting**, Daejeon Rep. Korea, 24-26 April, 2013.
2. “*Local Laser Heating to Graphene Nanomechanical Resonator for probing Negative Thermal Expansion of Graphene*”, **The Korean Physical Society 2011 Fall Meeting**, Busan, Rep. Korea, 19-21 October, 2011.
3. “*Nanomechanical System for Accurate Characterization of Low Dimensional Material*”, **4th BK21 Young Physicists Workshop**, Pohang, Rep. Korea, 20-21 January, 2011.
4. “*Nanomechanical System for Characterization of Low Dimensional Material*”, **Seoul National University BK21 Workshop**, Seoul, Rep. Korea, 23 December, 2010.
5. “*High Frequency CdS Nanowire Opto-Mechanical Resonators*”, **The Korean Physical Society 2010 Fall Meeting**, Pyeongchang, Rep. Korea, 20-22 October, 2010.
6. “*Characterization of Anelastic effects in Metallic and Metallic-CNT Micromechanical Resonators*”, **The Korean Physical Society 2009 Fall Meeting**, Changwon, Rep. Korea, 21-23 October, 2009.
7. “*Suppression of Anelastic Effect in Micromechanical Resonators from suspended Al-CNT Nanolaminate Thin-Films*”, **2nd BK21 Young Physicists Workshop**, Daejeon, Rep. Korea, 17-18 January, 2009.
8. “*Enhanced Elastic Modulus and Thermo Mechanical Behavior of Micromechanical Resonators from Metal-carbon Nanotube Nanolaminates*”, **The Korean Physical Society 2008 Fall Meeting**, Gwangju, Rep. Korea, 23-24 October, 2008.
9. “*Control of Nonlinear Effect in Carbon Nanotube Network Encapsulated in a Metallic Nanoelectromechanical system (NEMS) Resonator*”, **The Korean Physical Society 2007 Fall Meeting**, Jeju, Rep. Korea, 18-19 October, 2007.

10. “*Nanoelectromechanical systems (NEMS) torsional resonators of carbon nanotube network and metal-carbon nanotube composites*”, **The Korean Physical Society 2007 Spring Meeting**, Pyeongchang, Rep. Korea, 19-20 April, 2007.

Patents

1. “*An integrated direct-band semiconductor nanowire on mechanical structures to facilitate measurement of structures displacement*”, **Republic of Korea**, 10-1223233 (2013).
2. “*Graphene device and manufacturing method of thereof*”, **Republic of Korea**, 10-2013-0020594 (2013).
3. “*Bright visible light emission from electrically biased graphene*”, **U.S.A.**, Patent pending (2016).
4. “*Interlayer-mediated control of crack propagation*”, **U.S.A.**, Patent pending (2016).