

# Prof. Han-Bo-Ram Lee

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## Research Interests

Prof. Lee's current research interests and topics are focused on **understanding surface chemical reactions and controlling properties**, and applying this knowledge to various applications of which properties could be improved by functionalization of surface from nanoscopic to macroscopic ranges. Atomic-level theoretical calculations using density functional theory and physical modeling are employed, and experimental controls and functionalization of surface properties are realized by dry and wet methods, including **atomic layer deposition (ALD)** and solution-based chemical reactions. Research applications are categorized four parts; 1) **electronic textile**, 2) **hydrophobic surface**, 3) **2D materials**, and 4) **semiconductor device fabrications**. ([More Information](#))

## Highlights

**Ph.D at POSTECH ('09), Postdoc at Stanford ('10-'13), Asst. Prof. ('13-'17) & Assoc. Prof. ('17-present) at INU**  
**77 published papers, 1405 citations, 21 h-index, 24 granted patents, 17 pending patents**  
[Google Scholar](#) [Mendeley](#) [Researcher ID](#) [ORCID](#) [Research Gate](#)

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## Education

- Ph.D. in Materials Science and Engineering, POSTECH, Korea
  - Period: 3/2005 - 8/2009
  - Advisor: Professor Hyungjun Kim
  - GPA: 3.7/4.3
  - Thesis: Atomic layer deposition of cobalt
- B.S. in Materials Science and Engineering, Sungkyunkwan University, Korea
  - Period: 3/1998 - 2/2005 (3/1999 - 5/2002: Military service at the Korean Army)
  - Advisor: Professor Jae Chan Lee
  - GPA: 4.24/4.5, Magna cum laude
  - Thesis: Atomic layer deposition and applications to area-selective growth

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## Academic Appointment

- Associate Professor, Department of Materials Science & Engineering, Incheon National University
  - Period: 3/2017 - present
- Assistant Professor, Department of Materials Science & Engineering, Incheon National University
  - Period: 2/2013 - 2/2017

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# Research Experiences

- Postdoctoral Scholar, Department of Chemical Engineering, Stanford University
  - Period: 3/2010 - 1/2013
  - Fund: Department of Energy
  - PI: Professor Stacey F. Bent
  - Research area: Ultra thin atomic layer deposition Pt film for fuel cell (w/ National Renewable Energy Laboratory)
- Postdoctoral Scholar, School of Electrical and Electronic Engineering, Yonsei University
  - Period: 9/2009 - 2/2010
  - Fund: BK21 program
  - PI: Professor Hyungjun Kim
  - Research area: Atomic layer deposition of Co and Ni for metal silicides
- Research Assistant, Dept. of MSE, POSTECH
  - Period: 3/2005 - 8/2009
  - Academic advisor: Professor Hyungjun Kim
  - Research area: Atomic layer deposition of Ru for gate electrode; Atomic layer deposition of Co and Ni for metal silicide contacts; Supercritical fluid deposition of Ru and SiO<sub>2</sub>
- Visiting Researcher, Department of Biomedical Engineering, UC Irvine.
  - Period: 2/2007 - 2/2007
  - PI: Professor Noo Li Jeon (Jeon's Microfluidic Lab.)
  - Research area: Bio applications of Cobalt nanostructures
- Visiting Researcher, SNTTEK Co. Ltd., Kyunggido, Korea.
  - Period: 1/2005 - 2/2005
  - PI: Kyung Joon Ahn, CEO
  - Research area: Development and fabrication of atomic layer deposition-magnetron sputtering cluster systems
- Undergraduate Researcher, Dept. of MSE, Sungkyunkwan University
  - Period: 9/2004 - 11/2004
  - PI: Professor Jae Chan Lee (Semiconductor Thin Film Devices Lab.)
  - Research area: Atomic layer deposition and application to area-selective growth.

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# Technical Skills

- Thin film deposition equipment
  - Extensive experience with the design, construction, and film growth in atomic layer deposition
  - Nanoscale film depositions by sputtering and evaporation
  - Surface treatment and modification by using plasma or coating monolayer
  - Handling of toxic gases and safety system (design and construction of scrubber and gas lines)
- Thin film analysis
  - TEM sample preparation and imaging technique with energy dispersive spectroscopy and electron energy loss spectroscopy analyses
  - X-ray diffraction, synchrotron radiation XRD and XRR with simulation
  - Scanning electron microscopy with energy dispersive spectroscopy
  - Design and construction of in situ surface analysis equipments using quadrupole mass spectroscopy and synchrotron radiation X-ray reflectivity
  - Atomic force microscopy and roughness analyses
  - Secondary ion mass spectroscopy for depth profile analysis
  - Rutherford backscattering and simulation for depth profile analysis
  - X-ray photoelectron spectroscopy for chemical qualification and quantification analyses
  - Auger electron spectroscopy for depth profile and area mapping analyses
  - Glow discharge optical emission spectroscopy for depth profile analysis
  - Surface contact angle measurement for hydrophobicity analysis
  - Inductively-coupled plasma mass spectroscopy for metal quantification
- Device fabrication
  - Rapid thermal annealing (forming gas annealing, oxidation, reduction process)
  - Photolithography
  - Wet chemical etching and reactive ion etching
- Electrical property measurement:
  - Capacitance-voltage (CV) and current-voltage (IV) measurements for metal-oxide-semiconductor characterizations
  - 4-point probe measurement for thin film resistivity
- Software tools:
  - Mathematica for calculation and fitting data
  - Nanoparticle analysis using computational method (ImageJ, Gatan Microscope)
  - LabVIEW for control of equipment and data acquisition (Certificates of "LabVIEW Basics II Course" and "Signal Conditioning Course" from National Instrument)
  - SPEC and C-PLOT for control of X-ray goniometer and data acquisition of X-ray diffraction
  - Parratt32 for X-ray reflectivity simulation, RUMP for Rutherford backscattering simulation

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# Research Group

## - Current members -

- Dr. Rizwan Khan
  - Postdoctoral scholar
  - Department of Materials Science Engineering, INU, March 2017 ~
  - Electronic textiles
- Mr. Hyun Gu Kim
  - Ph.D. Course
  - Department of Materials Science Engineering, INU, March 2014 ~
  - Electronic textiles, ALD of Pt on reduced graphene oxide
- Mr. Jae Hong Yun
  - Ph.D. Course (Co-advising with Prof. Hyungjun Kim at Yonsei University)
  - School of Electrical and Electronic Engineering, YU, September 2013 ~
  - Superhydrophobic coating, ALD metals on nanoparticles
- Mr. Jong Seo Park
  - Ph.D. Course (Co-advising with Prof. Hyungjun Kim at Yonsei University)
  - School of Electrical and Electronic Engineering, YU, September 2015 ~
  - Electronic textiles, smart textile heater
- Mr. Tae Hee Han
  - Undergraduate internship
  - Department of Materials Science Engineering, INU, December 2016 ~
  - Electronic textiles, smart textile heater
- Mr. Woo Hyuk Kwon
  - Undergraduate internship
  - Department of Materials Science Engineering, INU, December 2016 ~
  - Electronic textiles, ALD of Pt on reduced graphene oxide
- Mr. Yung Hak Lee
  - Undergraduate internship
  - Department of Materials Science Engineering, INU, December 2016 ~
  - Superhydrophobic coating, ALD metals on nanoparticles
- Mr. Yong Woon Lee
  - Undergraduate internship
  - Department of Materials Science Engineering, INU, June 2017 ~
  - Electronic textiles, ferroelectric tunnel junction by ALD
- Mr. Jae Kwang
  - Undergraduate internship
  - Department of Materials Science Engineering, INU, June 2017 ~
  - Superhydrophobic coating, ALD metals on nanoparticles

## - Alumni -

- Ms. Sun Hwa Kim
  - Undergraduate student internship
  - Department of Materials Science Engineering, INU, September 2015 ~ 2016
  - Chemical bath deposition of rare earth oxides for hydrophobic coating
- Mr. Tae Hoon Park
  - Undergraduate student internship

- Department of Materials Science Engineering, INU, September 2014 ~ 2015
- ALD of Pt on carbon powder, ALD of Pt on reduced graphene oxide
- Ms. Min Ji Kim
  - Undergraduate student internship
  - Department of Materials Science Engineering, INU, September 2014 ~ 2015
  - ALD of TiO<sub>2</sub> for photocatalyst

# Research Project

## - Ongoing -

- Area-selective atomic layer deposition
  - Fund agency: Lam Research USA
  - Period: September 2017 - August 2018
  - Fund: KRW 25,000,000 (~USD 25,000)
- Ferroelectric tunnel junction for nonvolatile memory devices
  - Fund agency: Mistry of Trade, Industry & Energy
  - Period: September 2017 - December 2022
  - Fund: KRW 350,000,000 (~USD 350,000)
- Hydrophobic coating for ceramic coated pots
  - Fund agency: Mistry of Trade, Industry & Energy
  - Period: September 2017 - March 2018
  - Fund: KRW 26,000,000 (~USD 26,000)
- Development of atomic layer deposition system for defect healing of graphene
  - Fund agency: Mistry of Trade, Industry & Energy
  - Period: August 2017 - February 2018
  - Fund: KRW 26,000,000 (~USD 26,000)
- Fundamental study on oil/water separation and applications for waste water recycling
  - Fund agency: Mistry of Environment
  - Period: April 2017 - December 2017
  - Fund: KRW 50,000,000 (~USD 50,000)
- Fabrication of Ru/C composite gap filler using by atomic layer deposition and research on improvement of heat transfer efficiency in nuclear power plant
  - Fund agency: National Research Foundation of Korea
  - Period: November 2014 - October 2019
  - Fund: KRW 250,000,000 (~USD 250,000)
- Electronic textiles by atomic layer deposition method
  - Fund agency: National Research Foundation of Korea
  - Period: November 2016 - October 2019
  - Fund: KRW 150,000,000 (~USD 150,000)
- Development of plasma enhanced atomic layer deposition for SiN/SiO<sub>2</sub> of multi-patterning technology
  - Fund agency: Mistry of Trade, Industry & Energy
  - Period: August 2015 - July 2020
  - Fund: KRW 240,000,000 (~USD 240,000)

## - Completed -

- Defect healing of 2D materials by using atomic layer deposition
  - Fund agency: National Research Foundation of Korea
  - Period: November 2014 - April 2017
  - Fund: KRW 125,000,000 (~USD 125,000)
- Development of oil-water filtration system for recycling of industrial lubricant oil
  - Fund agency: Small and Medium Business Administration
  - Period: December 2014 - November 2015
  - Fund: KRW 59,471,000 (~USD 60,000)
- Development of hydrophobic ceramic powder by using nano powder coating technique

- Fund agency: Small and Medium Business Administration
- Period: December 2014 - November 2015
- Fund: KRW 99,480,000 (~USD 100,000)
- Research on Pt/C coreshell nano-catalyst using nanoscale analysis tools
  - Fund agency: Ministry of Science, ICT, and Future Planning
  - Period: September 2014 - March 2015
  - Fund: KRW 10,000,000 (~USD 10,000)
- Development of atomic layer deposition reactor and process for high quality Pt/C catalyst
  - Fund agency: Small and Medium Business Administration
  - Period: June 2014 - May 2015
  - Fund: KRW 106,667,000 (~USD 100,000)

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## Journal Articles

### - Selected Papers-

1. **Nature Communications** [IF: 11.329], "Selective Metal Deposition at Graphene Line Defects by Atomic Layer Deposition," <http://www.dx.doi.org/10.1038/ncomms5781>, [First author]
2. **Nature Publishing Group Asia Materials** [IF: 10.955] , "A Facile Method for Selective Healing of Graphene Defects Based on a Galvanic Displacement Reaction," <http://dx.doi.org/10.1038/am.2016.42>, [Corresponding author]
3. **Nature Publishing Group Asia Materials** [IF: 10.955], "Highly Conductive and Flexible Fiber for Textile Electronics Obtained by Extremely Low Temperature Atomic Layer Deposition of Pt," <http://dx.doi.org/10.1038/am.2016.182>, [Corresponding author]
4. **Nano Letters** [IF: 13.779], "Growth of Pt Nanowires by Atomic Layer Deposition on Highly Ordered Pyrolytic Graphite," <http://dx.doi.org/10.1021/nl303803p>, [First author]
5. **Chemistry of Materials** [IF: 9.407], "Atomic Layer Deposition on 2D Materials," <http://dx.doi.org/10.1021/acs.chemmater.6b05103>, [Corresponding author]
6. **Chemistry of Materials** [IF: 9.407], "Recent Advances in Atomic Layer Deposition," <http://dx.doi.org/10.1021/acs.chemmater.6b00673>, [Corresponding author]
7. **Chemistry of Materials** [IF: 9.407], "Nucleation and Growth of an HfO<sub>2</sub> Dielectric Layer for Graphene-Based Devices," <http://dx.doi.org/10.1021/acs.chemmater.5b01226>, [Corresponding author]
8. **Chemistry of Materials** [IF: 9.407], "Hydrophobicity of Rare Earth Oxides Grown by Atomic Layer Deposition," <http://www.dx.doi.org/10.1021/cm503659d>, [Corresponding author]
9. **ACS Nano** [IF: 13.334], "Internal and External Atomic Steps in Graphite Exhibit Dramatically Different Physical and Chemical Properties," <http://dx.doi.org/10.1021/nn506755p> [Co-author]
10. **Advanced Energy Materials** [IF: 15.23], "Atomic Layer Deposition of CdS Quantum Dots for Solid-State Quantum Dot Sensitized Solar Cells," <http://dx.doi.org/10.1002/aenm.201100363>, [Co-author]
11. **ACS Nano** [IF: 13.334], "Effects of Self-Assembled Monolayers on Solid- State CdS Quantum Dot Sensitized Solar Cells," <http://dx.doi.org/10.1021/nn103371v>, [Co-author]
12. **Nano Letters** [IF: 13.779], "Self-assembly Based Plasmonic Arrays Tuned by Atomic Layer Deposition for Extremely Concentrated Visible Light Absorption," <http://dx.doi.org/10.1021/nl401641v>, [Co-author]
13. **Advanced Materials** [IF: 18.96], "Flexible Wireless Temperature Sensors Based on Ni Microparticle-Filled Binary Polymer Composites," <http://dx.doi.org/10.1002/adma.201204082>, [Co-author]

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### - SCI & SCIE (77 published, 8 submitted, 1405 citations, 21 h-index) -

1. "Cobalt Titanium Nitride Amorphous Metal Alloys by Atomic Layer Deposition," Taewook Nam, Chang Wan Lee, Taehoon Cheon, Woo-Jae Lee, Soo-Hyun Kim, Se-Hun Kwon, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, submitted to **Journal of Alloys and Compound**, [Corresponding author]
2. "Water-Erasable Memory Device for Security Applications Prepared by the Atomic Layer Deposition of GeO<sub>2</sub>," Chang Mo Yoon, Il-Kwon Oh, Yoo-Jin Lee, Jeong-Gyu Song, Hyoung-Seok Moon, Bonggeun Shong, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, submitted to **Chemistry of Materials**, [Corresponding author]
3. "Reaction Mechanism of Area-Selective Atomic Layer Deposition for Al<sub>2</sub>O<sub>3</sub> Nanopatterns," Seunggi Seo<sup>†</sup> & Il-Kwon Oh<sup>†</sup>, Byung Chul Yeo, Sang Soo Han, Chang Mo Yoon, Joon Young Yang, Jonggeun Yoon, Choongkeun Yoo, Ho-jin Kim, Yong-baek Lee, Su Jeong Lee, Jae-Min Myoung, **Han-Bo-Ram Lee**, Woo-Hee Kim, and Hyungjun Kim\*, **ACS Applied Materials & Interfaces**, published online, 11/7/2017, <http://dx.doi.org/10.1021/acsami.7b13365>, <sup>†</sup>Equal contribution, [Co-author]

4. "Surface Wettability of Nitrogen-doped TiO<sub>2</sub> Films by Atomic Layer Deposition using NH<sub>4</sub>OH as a Doping Source," Rizwan Khan, Kyung Yong Ko, Jong Seo Park, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, submitted to **Ceramic International**, [Corresponding author]
5. "Conduction Mechanism Change with Transport Oxide Layer Thickness in Oxide Hetero-interface Diode," Bu-il Nam, Jong Seo Park, Keon-Hee Lim, Yong-keon Ahn, Jinwon Lee, Jun-woo Park, Nam-Kwang Cho, Donggun Lee, **Han-Bo-Ram Lee\***, and Youn Sang Kim\*, **Applied Physics Letters**, 111, 053506 (2017), 8/2/2017, <http://dx.doi.org/10.1063/1.4996862> [Corresponding author]
6. "Dual Role of Sb-incorporated Buffer Layers for High Efficiency Cuprous Oxide Photocathodic Performance: Remarkably Enhanced Crystallinity and Effective Hole Transport," Seung Ki Baek, Joo Sung Kim, Young Bin Kim, Jae Hong Yun, **Han-Bo-Ram Lee**, and Hyung Koun Cho\*, **ACS Sustainable Chemistry & Engineering**, 5(9), 8213-8221 (2017), 7/17/2017, <http://dx.doi.org/10.1021/acssuschemeng.7b01889>, [Co-author]
7. "Droplet Bursting Phenomenon on Superhydrophilic Structured Surface before Leidenfrost Temperature," Su Cheong Park, Dong Eok Kim, **Han-Bo-Ram Lee**, Moo Hwan Kim, and Ho Seon Ahn, submitted to **Nature Communications**, [Co-author]
8. "Interlayer-assisted Atomic Layer Deposition of MgO as a Magnetic Tunneling Junction Insulators," Seung Wook Ryu, Jeong-Gyu Song, Hyun Gu Kim, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, submitted to **Journal of Alloys and Compound**, [Corresponding author]
9. "Atomic layer deposition of Y-stabilized ZrO<sub>2</sub> for advanced DRAM capacitors," Bo-Eun Park, Il-Kwon Oh, Chandreswar Mahata, Chang Wan Lee, David Thompson, **Han-Bo-Ram Lee**, Wan Joo Maeng, and Hyungjun Kim\*, **Journal of Alloys and Compound**, 722, 307-322 (2017), 10/25/2017, <https://doi.org/10.1016/j.jallcom.2017.06.036>, [Co-author]
10. "Atomic Layer Deposition on 2D Materials," Hyun Gu Kim and **Han-Bo-Ram Lee\***, **Chemistry of Materials**, 29(9), 3809-3826 (2017), 4/25/2017, <http://dx.doi.org/10.1021/acs.chemmater.6b05103>, [Corresponding author]
11. "Artificially Designed Phase-blended Structure Based Copper Indium Selenide Photoabsorbers with High Photoelectrochemical Performances," Joo Sung Kim, Seung Ki Baek, Young Been Kim, Hyun Woo Do, Yong Hyun Kwon, Sung Woon Cho, Young Dae Yun, Jae Hong Yoon, **Han-Bo-Ram Lee**, and Hyung Koun Cho\*, submitted to **Energy and Environmental Science**, [Co-author]
12. "Nanoconfined Atomic Layer Deposition of TiO<sub>2</sub>/Pt Nanocavities: Towards Ultra-Small Highly Efficient Catalytic Nanorockets," Jinxing Li, Wenjuan Liu, Jiyuan Wang, Isaac Rozen, Sha He, Chuanrui Chen, Hyun Gu Kim, Ha-Jin Lee, **Han-Bo-Ram Lee**, Se-Hun Kwon, Tianlong Li, Longqiu Li\*, Yongfeng Mei\*, and Joseph Wang\*, **Advanced Functional Materials**, 27, 1700598 (2017), 4/24/2017, <http://dx.doi.org/10.1002/adfm.201700598>, [Co-author]
13. "Circular Double-Patterning Lithography using a Block Copolymer Template and Atomic Layer Deposition," Zhixin Wan, Ha Jin Lee, Hyun Gu Kim, Gyeong Cheon Jo, Woon Ik Park, Seung Wook Ryu, **Han-Bo-Ram Lee\***, and Se-Hun Kwon\*, submitted to **Nanoscale**, [Corresponding author]
14. "Vapor Phase Synthesis of TaS<sub>2</sub> Nanocrystals with Iodine as Transport Agent," Gangtae Jin, Chaeun Kim, Hyunjin Jo, Se-Hun Kwon, Seong-Jun Jeong, **Han-Bo-Ram Lee\***, and Ji-Hoon Ahn\*, **Japanese Journal of Applied Physics**, 56, 045501 (2017), 3/3/2017, <https://doi.org/10.7567/JJAP.56.045501>, [Corresponding author]
15. "Distribution of Oxygen Functional Groups of Graphene Oxide obtained from Low-temperature Atomic Layer Deposition of Titanium Oxide," Dong Seok Shin<sup>†</sup>, Hyun Gu Kim<sup>†</sup>, Ho Seon Ahn<sup>†</sup>, Hu Young Jeong, Yeon Jung Kim, Dorj Odkhoo, **Han-Bo-Ram Lee\*** and Byung Hoon Kim\*, **RSC Advances**, 7, 13979-13984 (2017), 3/2/2017, <http://dx.doi.org/10.1039/C7RA00114B>, [Corresponding author]
16. "A Composite Layer of Atomic-Layer-Deposited Al<sub>2</sub>O<sub>3</sub> and Graphene for Flexible Moisture Barrier," Taewook Nam, Youngju Park, Seung-Woo Seo, Il-Kwon Oh, Jong-Hyun Ahn, Sung Min Cho, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, **Carbon**, 116, 553-561 (2017), 2/17/2017, <http://dx.doi.org/10.1016/j.carbon.2017.02.023>, [Corresponding author]
17. "Atomic Layer Deposition of 1D and 2D Nickel Nanostructures on Graphite," Seung Wook Ryu<sup>†</sup> & Jaehong Yoon<sup>†</sup> & Hyung-Seok Moon<sup>†</sup>, Bonggeun Shong, Hyungjun Kim, and **Han-Bo-Ram Lee\***, **Nanotechnology**, 28(11),

- 115301 (2017), 2/13/2017, <https://doi.org/10.1088/1361-6528/aa5aec>, †Equal contribution, [Corresponding author]
18. "Growth Mechanism of Co Thin Films Formed by Plasma-enhanced Atomic Layer Deposition using NH<sub>3</sub> as Plasma Reactant," Il-Kwon Oh, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, *Current Applied Physics*, 17(3), 333-338 (2016), 12/24/2016, <http://dx.doi.org/10.1016/j.cap.2016.12.021>, [Corresponding author]
  19. "Highly Conductive and Flexible Fiber for Textile Electronics Obtained by Extremely Low Temperature Atomic Layer Deposition of Pt," Jaehong Lee<sup>†</sup> & Jaehong Yoon<sup>†</sup>, Hyun Gu Kim, Subin Kang, Woo-Suk Oh, Hassan Algadi, Saleh Al-Sayari, Bonggeun Shong, Soo-Hyun Kim, Hyungjun Kim, Taeyoon Lee\*, and **Han-Bo-Ram Lee\***, *NPG Asia Materials*, 8, e331 (2016), 11/25/2016, <http://dx.doi.org/10.1038/am.2016.182>, †Equal contribution, [Corresponding author]
  20. "Atomic Layer Deposition of TiN Thin Films for Improving a Corrosion Resistance of Metallic Bipolar Plates," Eun-Young Yun, **Han-Bo-Ram Lee**, Suck Won Hong, and Se-Hun Kwon\*, submitted to *ACS Applied Materials & Interfaces*, [Co-author]
  21. "Uniform Color Coating of Multilayered TiO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub> Films by Atomic Layer Deposition," Woo-Hee Kim, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, *Journal of Coatings Technology and Research*, 14(1), 177-183 (2017), 8/29/2016, <http://dx.doi.org/10.1007/s11998-016-9840-2>, [Corresponding author]
  22. "Fabrication of 50-nm Scale Nanostructures by Block Copolymer and Its Characteristics of Surface-enhanced Raman Scattering," Jae Hee Shin, Hyun Gu Kim, Gwang Min Baek, Reehyang Kim, Suwan Jeon, Jeong Ho Mun, **Han-Bo-Ram Lee**, Yeon Sik Jeong, Sang Ouk Kim, Kyoung Nam Kim, and Geun Young Yeom\*, *RSC Advance*, 6(75), 70756-70762 (2016), 7/26/2016, <http://dx.doi.org/10.1039/C6RA08608J>, [Co-author]
  23. "Very High Frequency Plasma Reactant for Atomic Layer Deposition," Il-Kwon Oh, Gilsang Yoo, Chang Mo Yoon, Tae Hyung Kim, Geun Young Yeom, Kangsik Kim, Zonghoon Lee, Hanearl Jung, Changwan Lee, Hyungjun Kim\* and **Han-Bo-Ram Lee\***, *Applied Surface Science*, 387, 109-117 (2016), 6/14/2016, <http://dx.doi.org/10.1016/j.apsusc.2016.06.048>, [Corresponding author]
  24. "High Efficiency n-Si/p-Cu<sub>2</sub>O Core-shell Nanowires Photodiode Prepared by Atomic Layer Deposition of Cu<sub>2</sub>O on Well-ordered Si Nanowires Array," Hangil Kim, Soo-Hyun Kim\*, Kyung Yong Ko, Hyungjun Kim, Jaehoon Kim, Jihun Oh, and **Han-Bo-Ram Lee**, *Electronic Materials Letters*, 12(3), 404-410 (2016), 5/10/2016, <http://dx.doi.org/10.1007/s13391-016-5356-2>, [Co-author]
  25. "A Facile Method for Selective Healing of Graphene Defects Based on a Galvanic Displacement Reaction," Juree Hong, Jae-Bok Lee, Sanggeun Lee, Jungmok Seo, Hyunsoo Lee, Jeong Young Park, Tae-il Seo, Jong-Hyun Ahn, Taeyoon Lee\*, and **Han-Bo-Ram Lee\***, *NPG Asia Materials*, 8, e262 (2016), 4/15/2016, <http://dx.doi.org/10.1038/am.2016.42>, [Corresponding author]
  26. "Recent Advances in Atomic Layer Deposition," Neil P. Dasgupta, Stacey Bent, Paul S. Weiss, and **Han-Bo-Ram Lee\***, *Chemistry of Materials*, 28(7), 1943-1947 (2016), 4/12/2016, <http://dx.doi.org/10.1021/acs.chemmater.6b00673>, [Corresponding author]
  27. "Formation of Ni Silicide from Atomic Layer Deposited Ni," Jaehong Yoon, Soo Hyeon Kim, Hangil Kim, Soohyun Kim, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, *Current Applied Physics*, 16(7), 720-725 (2016), 4/6/2016, <http://dx.doi.org/10.1016/j.cap.2016.04.005>, [Corresponding author]
  28. "Effects of Diffusion Barrier on Cu-gate ZnO:N Thin Film Transistors," Whang Je Woo, Taewook Nam, Hanearl Jung, Il-Kwon Oh, **Han-Bo-Ram Lee**, Wanjo Maeng, and Hyungjun Kim\*, *IEEE Electron Device Letters*, 37(5), 599-602 (2016), 3/31/2016, <http://dx.doi.org/10.1109/LED.2016.2549035>, [Co-author]
  29. "Comparison of Hydrogen Sulfide Gas and Sulfur Powder for Synthesis of Molybdenum Disulfide Nanosheets," Jusang Park, Jeonggyu Song, Taejin Choi, Sangwan Sim, Hyunyong Choi, Sang Wook Han, **Han-Bo-Ram Lee**, Soo-Hyun Kim, and Hyungjun Kim\*, *Current Applied Physics*, <http://dx.doi.org/10.1016/j.cap.2016.03.022>, 16(7), 691-695 (2016), 4/1/2016, [Co-author]
  30. "Growth Characteristics and Electrical Properties of SiO<sub>2</sub> Thin Films Prepared using Plasma-Enhanced Atomic Layer Deposition and Chemical Vapor Deposition with an Aminosilane Precursor," Hanearl Jung, Woo-Hee Kim,

- Il-Kwon Oh, Chang-Wan Lee, Clement Lansalot-Matras, Su Jeong Lee, Jae-Min Myoung, **Han-Bo-Ram Lee**, and Hyungjun Kim\*, **Journal of Materials Science**, 51(11), 5082-5091 (2016), 2/22/2016, <http://dx.doi.org/10.1007/s10853-016-9811-0>, [Co-author]
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# Patents

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7. **Han-Bo-Ram Lee** and Hyungjun Kim, "Area Selective Atomic Layer Deposition of Cobalt Thin Films," ECS Transactions, **16**, 219(2008), <http://dx.doi.org/10.1149/1.2979997>, [First author]

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# Conference Presentations

## - Invited talks-

1. **Han-Bo-Ram Lee**, "Defect Healing of Graphene for Conductive Flexible Electrodes by Wet & Dry Methods," International Conference on Electronic Materials and Nanotechnology for Green Environment (ENGE) 2016, Jeju, Korea, November 6 - 9, 2016
2. **Han-Bo-Ram Lee**, "Atomic Layer Deposition of Metals on Textiles for Wearable Electronics," China ALD 2016, Suzhou, China, October 16 - 19, 2016
3. **Han-Bo-Ram Lee**, "Electronic Textiles Fabricated using Atomic Layer Deposition," CIMTEC 2016, Perugia, Italy, June 5 - 10, 2016
4. **Han-Bo-Ram Lee**, "Textile-Based Pressure Sensor Prepared by Atomic Layer Deposition," Korean Society of Optoelectronics Meeting 2016, Gwangju, Korea, January 26 - 27, 2016
5. **Han-Bo-Ram Lee**, "Atomic Layer Deposition of Rare Earth Oxide for Hydrophobic Coating," Korean Institute of Surface Engineering Fall Meeting 2015, Yongin, Korea, November 26 - 27, 2015
6. **Han-Bo-Ram Lee**, "Opportunities of Atomic Layer Deposition for Electronic Textile Applications," The Korean Fiber Society Fall Meeting 2015, Busan, Korea, November 5 - 6, 2015
7. **Han-Bo-Ram Lee**, "Opportunities in Atomic Layer Deposition for Electronic Textile and Hydrophobic Coating Applications," 228<sup>th</sup> Electrochemical Society Meeting, Phoenix, AZ, USA, October 11 - 15, 2015
8. **Han-Bo-Ram Lee**, "ALD of Noble Metals for Energy Application," 14<sup>th</sup> International Conference on Atomic Layer Deposition, Kyoto, Japan, June 15 - 18, 2014
9. **Han-Bo-Ram Lee**, "Pt Nanoparticle on Site-Constrained Surface by Atomic Layer Deposition," The 6<sup>th</sup> Asian Conference on Crystal Growth and Crystal Technology, Jeju, Korea, June 11 - 14, 2014
10. **Han-Bo-Ram Lee**, "Pt Nanoparticle Fabrication by Atomic Layer Deposition with Self-Assembled Monolayers," The Korean Ceramic Society Fall Meeting 2013, Jeju, Korea, October 16 - 18, 2013
11. **Han-Bo-Ram Lee**, "Nucleation Control in Atomic Layer Deposition by using Self-Assembled Monolayer," Korean Materials Research Society Spring Meeting 2013, Yeosu, Korea, May 23-24, 2013
12. **Han-Bo-Ram Lee**, "Nucleation & Growth of ALD Metal on Carbon Surfaces," Korean Atomic Layer Deposition Workshop 2013, Seoul, Korea, April 26, 2013
13. **Han-Bo-Ram Lee**, "Nucleation of 1D Pt Nanowires by Atomic Layer Deposition on Highly Ordered Pyrolytic Graphite," 2013 Spring Conference of the Korean Institute of Metals & Materials, Jeju, Korea, April 25 - 26, 2013
14. **Han-Bo-Ram Lee**, "Atomic Layer Deposition of Metals on 2D Materials," China Semiconductor Technology International Conference 2013, Shanghai, China, March 16 - 18, 2013
15. Hyungjun Kim, **Han-Bo-Ram Lee**, Woo-Hee Kim, Jaehong Yun, Doyoung Kim, "Atomic Layer Deposition for Nanoscale Contact Applications," International Conference on Electronic Materials and Nanotechnology for Green Environment, Jeju, Korea, November 21 - 24, 2010
16. **Han-Bo-Ram Lee** and Hyungjun Kim, "The Applications of Atomic Layer Deposition of Cobalt for Nanoscale Devices," International Conference on Nano Science and Nano Technology 2009, Mokpo, Korea, November 5 - 6, 2009
17. **Han-Bo-Ram Lee** and Hyungjun Kim, "Atomic Layer Deposition for Nanoscale Contact Applications," 25<sup>th</sup> International VLSI/ULSI Multilevel Interconnection Conference, Fremont, CA, USA, October 28 - 30, 2008
18. Hyungjun Kim, **Han-Bo-Ram Lee**, Yong Jun Park, Dong Ryeol Lee, Moon-Kyun Song, Woo-Hee Kim, Shi-Woo Rhee, and Sunggi Baik, "Synchrotron X-ray Scattering Study on the Initial Growth of Atomic Layer Deposition Thin Films for the Next Generation MOSFET," Electroceramics XI, Manchester, UK, August 31 - September 3, 2008

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## - Contributed talks at international conferences-

1. Il-Kwon Oh, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, "Surface-Energy-Controlled Nanoscale Coating of ALD REO for R2R Printed Electronics System," Materials Research Society 2016 Fall Meeting, Boston, USA, November 27 - December 2, 2016
2. Chang Mo Yoon, Il-Kwon Oh, Clement Lansalot-Matras, Wontae Noh, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, "High Quality GeO<sub>2</sub> by Atomic Layer Deposition," International Workshop Atomic Layer Deposition Russia 2015, Moscow, Russia, September 21 - 23, 2015
3. Il-Kwon Oh, Chang Mo Yoon, Kangsik Kim, Zonghoon Lee, Clement Lansalot-Matras, Wontae Noh, **Han-Bo-Ram Lee\***, and Hyungjun Kim\*, "Fundamental Study of Atomic Layer Deposited Rare Earth Oxides for Hydrophobic Coating," International Workshop Atomic Layer Deposition Russia 2015, Moscow, Russia, September 21 - 23, 2015
4. Il-Kwon Oh, Chang Mo Yoon, Tae Hyung Kim, Geun Young Yeom, Kangsik Kim, Zonghoon Lee, Hanearl Jung, Changwan Lee, **Han-Bo-Ram Lee\***, and Hyungjun Kim\*, "Lowering Plasma Damage in PE-ALD by using VHF Plasma Source," 2015 Advanced Metallization Conference (ADMETA Plus) 25<sup>th</sup> Asian Session, Seoul, Korea, September 16 - 18, 2015
5. Taewook Nam, Soohyeon Kim, Chang Wan Lee, Daewon Hong, Oh Joong Kwon, **Han-Bo-Ram Lee\*** and Hyungjun Kim\*, "Atomic Layer Deposition of Cobalt-based Bifunctional Layer for Cu Interconnect," 2015 Advanced Metallization Conference (ADMETA Plus) 25<sup>th</sup> Asian Session, Seoul, Korea, September 16 - 18, 2015
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7. Bo-Eun Park, Il-Kwon Oh, Clement Lansalot-Matras, David Thompson, **Han-Bo-Ram Lee**, and Hyungjun Kim\*, "Significant Enhancement of the Electrical Properties through the Control of Oxygen Vacancy by Doping of Y into ZrO<sub>2</sub>," 15<sup>th</sup> International Conference on Atomic Layer Deposition, Portland, USA, June 28 - July 1, 2015
8. Jaehong Yoon, Soo-Hyun Kim, Hyungjun Kim, and **Han-Bo-Ram Lee\***, "Low Temperature Atomic Layer Deposition Pt for Electronic Textile Applications," European Material Research Society 2015 Spring Meeting, Lille, France, May 11 - 15, 2015
9. Il-Kwon Oh, Kang-Sik Kim, Zonghoon Lee, Kyung-Yong Ko, Su Jeong Lee, Jae-Min Myung, Clement Lansalot-Matras, Wontae Noh, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, "Nanoscale Hydrophobic Coating by Atomic Layer Deposition Rare Earth Oxides," Material Research Society 2015 Spring Meeting, San Francisco, CA, April 6 - 10, 2015
10. Gilsang Yoo, Il-Kwon Oh, Changwan Lee, Tae Hyung Kim, Geun Young Yeom, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, "Effects of Very High Frequency O<sub>2</sub> Plasma Reactant on High-k Film Properties Deposited by Atomic Layer Deposition," PacSurf 2014 (Pacific Rim Symposium on Surfaces, Coating & Interfaces), Honolulu, HI, December 7 - 11, 2014
11. Jaehong Yoon, Soohyeon Kim, Hyungjun Kim, and **Han-Bo-Ram Lee\***, "Low Temperature and High Growth Rate Atomic Layer Deposition of Pt using a New Pt Precursor and O<sub>2</sub> Reactant," 2<sup>nd</sup> China Atomic Layer Deposition Conference, Shanghai, China, October 16 - 17, 2014
12. Jaehong Yoon, Soohyeon Kim, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, "Atomic Layer Deposition of Ni using NH<sub>3</sub> on Carbon Surfaces," The 14<sup>th</sup> International Meeting on Information Display, Daegu, Korea, August 26 - 29, 2014
13. Bo-Eun Park, Il-Kwon Oh, Changwan Lee, Gyeongho Lee, Clement Lansalot-Matras, Wontae Noh, Hyungjun Kim\*, and **Han-Bo-Ram Lee\***, "The Effects of Precursor Ligands on Growth Characteristics and Dielectric Properties of Atomic Layer Deposition HfO<sub>2</sub>," International Conference on Microelectronics and Plasma Technology 2014, Gunsan, Korean, July 8 - 11, 2014

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23. Bruce M. Clemens, Chia-Jung Chung, Stacey F. Bent, **Han-Bo-Ram Lee**, and Marja N. Mullings, "Nucleation Control in Atomic Layer Deposition and Hydrogen Storage Reactions," The 23rd Conference on Crystal Growth and Epitaxy - West, Fallen Leaf Lake, CA, June 3 - 6, 2012
24. **Han-Bo-Ram Lee** and Stacey F. Bent, "Nucleation and formation of 1-D Pt nanowires by atomic layer deposition on highly oriented pyrolytic graphite," Material Research Society 2012 Spring Meeting, San Francisco, CA, April 9 - 13, 2012
25. Jonathan Servaites, Jonathan R. Bakke, **Han-Bo-Ram Lee**, and Stacey F. Bent, "Reducing Interfacial Recombination in CIGS Buffer Layers via Nanoscale Compositional Grading," Material Research Society 2012 Spring Meeting, San Francisco, CA, 2012.4
26. **Han-Bo-Ram Lee** and Stacey F. Bent, "The Effects of TiO<sub>2</sub> Crystallinity on Nucleation in Atomic Layer Deposition of Platinum," 11<sup>th</sup> International Conference on Atomic Layer Deposition, Cambridge, MA, June 26 - 29, 2011
27. **Han-Bo-Ram Lee**, Sung Hwan Bang, Gil Ho Gu, Young Kuk Lee, Taek-Mo Chung, Chang Gyoung Kim, C. G. Park, and Hyungjun Kim, "Plasma-Enhanced Atomic Layer Deposition of Ni," Advanced Metallization Conference 2009, Tokyo, Japan, October 19 - 21, 2009
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37. G. H. Gu, **Han-Bo-Ram Lee**, Hyungjun Kim, and C. G. Park, "Atomic Structure and Composition at the Interface of Epitaxial CoSi<sub>2</sub> on Si (001)," The 9<sup>th</sup> Asia-Pacific Microscopy Conference, Jeju, Korea, 2008.11
38. **Han-Bo-Ram Lee**, Woo-Hee Kim, J. W. Lee, K. Heo, I. C. Whang, Sang-Joon Park, S. Hong, and Hyungjun Kim, "Area Selective Atomic Layer Deposition Co," PRiME 2008 Electrochemical Society 214<sup>th</sup> Meeting, Honolulu, HI, 2008.10
39. Woo-Hee Kim, Sang-Joon Park, **Han-Bo-Ram Lee**, and Hyungjun Kim, "Atomic Layer Deposition of Ruthenium and Ruthenium Oxide Thin Films on Ta<sub>2</sub>O<sub>5</sub> Substrate," Advanced Metallization Conference 2008, Tokyo, Japan, 2008.10
40. G. H. Gu, **Han-Bo-Ram Lee**, Hyungjun Kim, and C. G. Park, "Quantitative Atomic-Scale Analysis of Interface Structure of CoSi<sub>2</sub> on polycrystalline and single crystalline silicon using by STEM-HAADF and 3D-AP," The International Union of Crystallography, Nagoya, Japan, 2008.9
41. Woo-Hee Kim, Sang-Joon Park, **Han-Bo-Ram Lee**, W. J. Maeng, and Hyungjun Kim, "Atomic Layer Deposition of Ruthenium and Ruthenium Oxide Thin Films on Ta<sub>2</sub>O<sub>5</sub> Substrate," The 14<sup>th</sup> International Symposium on the Physics of Semiconductors and Applications, Jeju, Korea; 2008. 8
42. **Han-Bo-Ram Lee** and Hyungjun Kim, "Cobalt Atomic Layer Deposition for Nanoscale Contact Applications," 1<sup>st</sup> International Conference on Microelectronics and Plasma Technology, Jeju, Korea, 2008.8
43. **Han-Bo-Ram Lee**, Gil Ho Gu, J.Y. Son, C.G. Park, and Hyungjun Kim, "Spontaneous Formation of Metal Nanorods by PE-ALD," 8<sup>th</sup> International Conference on Atomic Layer Deposition, Bruges, Belgium, 2008.7
44. Sung-Hwan Bang, **Han-Bo-Ram Lee**, and Hyungjun Kim, "Cobalt and Nickel Thin Films by Plasma-Enhanced Atomic Layer Deposition," 8<sup>th</sup> International Conference on Atomic Layer Deposition, Bruges, Belgium, 2008.7
45. Sung- Hwan Bang, **Han-Bo-Ram Lee**, Young Kuk Lee, Taek-Mo Chung, Chang Gyoung Kim, and Hyungjun Kim, "Nickel and Cobalt Thin Films by Plasma-Enhanced Atomic Layer Deposition," Material Research Society 2008 Spring Meeting, San Francisco, CA, 2008.3

46. **Han-Bo-Ram Lee**, Gil Ho Gu, J.Y. Son, C.G. Park, and Hyungjun Kim, "High Quality Epitaxial CoSi<sub>2</sub> using Plasma Nitridation-mediated Epitaxy; The Effects of Capping Layer," Material Research Society 2008 Spring Meeting, San Francisco, CA, 2008.3
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51. **Han-Bo-Ram Lee**, and Hyungjun Kim, "Epitaxial CoSi<sub>2</sub> Growth from PE-ALD Co Films through Nitride-Mediated Epitaxy," Material Research Society 2007 Spring Meeting, San Francisco, CA, 2007.4
52. S. J. Kim, W. J. Maeng, **Han-Bo-Ram Lee**, D. H. Park, Byeong-Hyeok Sohn, and Hyungjun Kim, "High Density Magnetic Co Nanodot Array Fabrication using Self-Assembled Diblock Copolymer," Material Research Society 2006 Fall Meeting, Boston, MA, 2006.11
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54. **Han-Bo-Ram Lee** and Hyungjun Kim, "Co and CoSi<sub>2</sub> Films Prepared by Plasma-Enhanced Atomic Layer Deposition for Contact Applications," American Vacuum Society 53<sup>rd</sup> International Conference, San Francisco, CA, 2006.11
55. Sang-Joon Park, **Han-Bo-Ram Lee**, W. J. Maeng, and Hyungjun Kim, "Ru ALD: Comparative Studies between RuCp<sub>2</sub> and Ru(EtCp)<sub>2</sub>," 6<sup>th</sup> International Conference on Atomic Layer Deposition 2006, Seoul, Korea, 2006.7
56. **Han-Bo-Ram Lee** and Hyungjun Kim, "Low Resistivity Cobalt Thin Films Prepared by Plasma-Enhanced Atomic Layer Deposition," 6<sup>th</sup> International Conference on Atomic Layer Deposition 2006, Seoul, Korea, 2006.7
57. **Han-Bo-Ram Lee**, Sang-Joon Park, W.J. Maeng, Y.S. Yang, C.G. Park and Hyungjun Kim, "Ru ALD and Applications for Advanced Devices," American Vacuum Society 52<sup>nd</sup> International Conference, Boston, MA, 2005.11
58. W.J. Maeng, S.J. Lim, **Han-Bo-Ram Lee**, J.S. Park, and Hyungjun Kim, "The ALD of Various Oxides from Alkylamide Precursors: the Growth and Film Properties," 5<sup>th</sup> International Conference on Atomic Layer Deposition, San Jose, CA, 2005.8

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**- Contributed talks at Korean conferences -**

1. Bo-Eun Park, Il-Kwon Oh, David Thompson, **Han-Bo-Ram Lee**, and Hyungjun Kim\*, "Control of Oxygen Vacancy and Enhancement of the Electrical Properties by Doping of Y into ZrO<sub>2</sub>," 2014 Korean Materials Research Society Spring Meeting, Gumi, Korea, May 14 - 15, 2015
2. Soohyeon Kim, Jaehong Yoon, Hyungjun Kim, and **Han-Bo-Ram Lee**, "Cobalt-based Bi-functional Layer for Cu Interconnect by Atomic Layer Deposition," The 22<sup>nd</sup> Korean Conference on Semiconductors, Incheon, Korea, February 10 - 12, 2015
3. Il-Kwon Oh, Han-earl Jung, Seung-Ki Lee, Jong-Hyun Ahn, Changwan Lee, Kangsik Kim, Mi Jin Lee, Zonghoon Lee, Clement Lansalot-Matras, Jukka Tanskanen, Hyungjun Kim, and **Han-Bo-Ram Lee**, "Nucleation and growth of Atomic Layer Deposition HfO<sub>2</sub> on Graphene," 2014 Korean Materials Research Society Fall Meeting, Daejeon, Korea, November 27 - 28, 2014



4. Jaehong Yoon, Soohyeon Kim, **Han-Bo-Ram Lee**, Byeongchul Cho, and Hyungjun Kim, "Area-Selective Chemical Vapor Deposition of Co for Reduction of Cu Electromigration," The 21<sup>st</sup> Korean Conference on Semiconductors, Seoul, Korea, February 24 - 26, 2014
5. Soohyeon Kim, Jaehong Yoon, **Han-Bo-Ram Lee**, and Hyungjun Kim, "Silicidation of Ni prepared by Atomic Layer Deposition with NH<sub>3</sub> Gas Reactant," The 21<sup>st</sup> Korean Conference on Semiconductors, Seoul, Korea, February 24 - 26, 2014
6. **Han-Bo-Ram Lee**, Gil Ho Gu, C.G. Park, and Hyungjun Kim, "Ru/Co/Si Nanowire Core-Shell Structure by Atomic Layer Deposition for Si Nanowire Contact," The 17<sup>th</sup> Korean Conference on Semiconductors, Daegu, Korea, 2010.2
7. Jae-Min Kim, **Han-Bo-Ram Lee**, Clement Lansalot, Christian Dussarrat, Julien Gatineau, and Hyungjun Kim, "Atomic Layer Deposition of Cobalt using a Novel Precursor," The Materials Research Society of Korea 2009 Fall Meeting, Pohang, Korea, 2009.11
8. Inchan Hwang, Sung-Hwan Bang, **Han-Bo-Ram Lee**, and Hyungjun Kim, "Surface Modification for Block Copolymer Nanolithography on Gold Surface," Korean Ceramic Society Fall Meeting 2009, Pohang, Korea, 2009.4
9. **Han-Bo-Ram Lee**, Woo-Hee Kim, Jeong Won Lee, Kwang Heo, In Chan Hwang, Sang-Joon Park, Seunghun Hong, and Hyungjun Kim, "Area Selective Atomic Layer Deposition of Cobalt," The 16<sup>th</sup> Korean Conference on Semiconductors, Daejun, Korea, 2009.2
10. **Han-Bo-Ram Lee**, Woo-Hee Kim, Moon-Kyun Song, Yong Jun Park, Shi-Woo Rhee, Dong Ryeol Lee, Sunggi Baik, and Hyungjun Kim, "Synchrotron X-ray Reflectivity Study on the Initial Growth of Atomic Layer Deposition Thin Films," 20<sup>th</sup> Korean Synchrotron Radiation User's Association, Pohang, Korea, 2008.11
11. Hyungjun Kim, Woo-Hee Kim, **Han-Bo-Ram Lee**, Sung-Hwan Bang, J.Y. Son, Gil Ho Gu, and C.G. Park, "Nanomaterials fabrication using atomic layer deposition," The Korean Institute of Metals and Materials, Daejun, Korea, 2008.4
12. **Han-Bo-Ram Lee**, Gil Ho Gu, Jong Yeog Son, Chan Gyung Park, and Hyungjun Kim, "High Quality Epitaxial CoSi<sub>2</sub> Using Plasma Nitridation-Mediated Epitaxy," The 15<sup>th</sup> Korean Conference on Semiconductors, Pyengchang, Korea, 2008.2
13. S.H. Bang, **Han-Bo-Ram Lee**, and Hyungjun Kim, "Plasma Enhanced Atomic Layer Deposition of Ni," The Materials Research Society of Korea 2007 Fall Meeting, Suwon, Korea, 2007.11
14. **Han-Bo-Ram Lee** and Hyungjun Kim, "Co and CoSi<sub>2</sub> by PE-ALD for Contact Applications," The 14<sup>th</sup> Korean Conference on Semiconductor, Jeju, Korea, 2007.2
15. **Han-Bo-Ram Lee**, Sang-Joon Park, W. J. Maeng, Y. S. Yang, C. G. Park, and Hyungjun Kim, "Ru ALD on ALD Ta<sub>2</sub>O<sub>5</sub> Substrates for Device Fabrication," The 13<sup>th</sup> Korean Conference on Semiconductors, Jeju, Korea, 2006.2

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## Invited Lectures

1. "How Nanotechnologies Can Make Our Life Better?," Myungduk Highschool, Seoul, Korea, April 21, 2017
2. "Electronic Textiles fabricated by Atomic Layer Deposition for Wearable Electronics," Korea Institute of Industrial Technology (KITECH), Ansan, Korea, February 28, 2017
3. "Surface Functionalization of Graphene by Atomic Layer Deposition," Electronic Convergence Material and Device Research Center, Korea Electronics Technology Institute (KETI), Sungnam, Korea, December 5, 2016
4. "Atomic Layer Deposition Beyond High Technology; Electronic Textiles, Hydrophobic Filter, and Transparent 2D Heater," Electronic Convergence Material and Device Research Center, Korea Electronics Technology Institute (KETI), Sungnam, Korea, November 11, 2016
5. "Atomic Layer Deposition Beyond High Technology; Electronic Textiles, Hydrophobic Filter, and Transparent 2D Heater," School of Energy and Chemical Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan, November 9, 2016
6. "Atomic Layer Deposition; from Fundamentals to Applications," Semiconductor Equipment Technology Center, Chunan, Korea, October 11, 2016
7. "Atomic Layer Deposition; An Essential Tool for Nanofabrication," Department of Chemistry, Thammasat University, Bangkok, Thailand, October 6, 2016
8. "Atomic Layer Deposition; An Essential Tool for Nanofabrication," Department of Materials Science and Engineering, Kasetsart University, Bangkok, Thailand, October 5, 2016
9. "Surface Functionalization for Property Tuning," Division of Materials Science and Engineering, Hanyang University, Seoul, Korea, September 27, 2016
10. "Conductive Textile for Sensors and Heaters," School of Materials Science and Engineering, Yonnam University, Gyeongsan, Korea, September 21, 2016
11. "Atomic Layer Deposition; An Essential Tool for Nanofabrication," Tera Semicon, Anseong, Gyeonggi, Korea, September 9, 2016
12. "Atomic Layer Deposition; An Essential Tool for Nanotechnology," Department of Materials Science and Engineering, Sejong University, Seoul, Korea, June 16, 2016
13. "Atomic Layer Deposition; from Fundamentals to Applications," Semiconductor Equipment Technology Center, Chunan, Korea, May 20, 2016
14. "Surface Functionalization for Property Tuning," School of Advanced Materials Engineering, Sungkyunkwan University, Suwon, Korea, May 12, 2016
15. "Surface Functionalization for Property Tuning," Department of Mechanical Engineering, Kyunghee University, Suwon, Korea, May 9, 2016
16. "Defect Healing of Graphene," School of Materials Science and Engineering, Yonnam University, Gyeongsan, Korea, April 1, 2016
17. "Platinum Atomic Layer Deposition," Department of Mechanical Engineering, Pusan National University, Yongin, Korea, December 29, 2015
18. "Atomic Layer Deposition for Nanofabrication," Myungji University, Yongin, Korea, November 6, 2015
19. "Atomic Layer Deposition; from Fundamentals to Applications," Semiconductor Equipment Technology Center, Chunan, Korea, October 5, 2015
20. "Atomic Layer Deposition; An Essential Tool for Nanotechnology," Department of Energy Science, Sungkyunkwan University, Suwon, Korea, September 30, 2015
21. "Tutorial: Atomic Layer Deposition," Advanced Metallization Conference 2015, Seoul, Korea, September 16, 2015
22. "Atomic Layer Deposition; from Fundamentals to Applications," Semiconductor Equipment Technology Center, Chunan, Korea, May 8, 2015
23. "Applications of Atomic Layer Deposition Pt," Tanaka Research Center, Tsukuba, Japan, April 2, 2015
24. "Series Class of Atomic Layer Deposition," Samsung Electronics, Hwasung, Korea, March 5-6, 2015

25. "Research Topics of the Lee's Group," Wonik IPS, Pyeongtaek, Korea, March 2, 2015
26. "Material Synthesis and Applications by Atomic Layer Deposition," Graduate School of Convergence Science and Technology, Seoul National University, Seoul, Korea, January 19, 2015
27. "Low Temperature Atomic Layer Deposition of Pt for Electronic Textile Applications," State Key Laboratory, Nanjing Tech University, Nanjing, China, January 16, 2015
28. "Surface Functionalization by Atomic Layer Deposition," Samsung Medical Center, Seoul, Korea, November 26, 2014
29. "Atomic Layer Deposition," e-Nanoschool 2014 by Korea Nano Technology Research Society, 6 on-line classes from November 18 to December 4, 2014
30. "Atomic Layer Deposition on 2D Materials," School of Energy and Chemical Engineering, Ulsan National Institute of Science and Technology (UNIST), Ulsan, November 5, 2014
31. "Atomic Layer Deposition; from Fundamentals to Applications," Semiconductor Equipment Technology Center, Chunan, Korea, October 8, 2014
32. "Atomic Layer Deposition of Pt and Applications," Shonan Site, Tanaka Kikinzoku Kogyo K.K., Hiratsuka, Japan, September 19, 2014
33. "Atomic Layer Deposition of Pt/TiO<sub>2</sub> for VOC Removal," Head Office, Tanaka Kikinzoku Kogyo K.K., Tokyo, Japan, September 18, 2014
34. "Atomic Layer Deposition of Metals on 2D Materials and Applications," Department of Materials Science and Engineering, Hanyang University, Seoul, Korea, July 30, 2014
35. "Pt/Carbon by Atomic Layer Deposition for Catalyst, Electrode, and Sensor Applications," Electronic Materials Research Center, Korea Institute of Science and Technology (KIST), Seoul, Korea, July 28, 2014
36. "Atomic Layer Deposition; from Fundamentals to Applications," Semiconductor Equipment Technology Center, Chunan, Korea, May 15, 2014
37. "Atomic Layer Deposition for Emerging Applications," Department of Polymer Science and Engineering, Korean National University of Transportation, Chungju, Korea, December 23, 2013
38. "Atomic Layer Deposition for Interconnect Technology," Inter-University Semiconductor Research Center, Seoul National University, Seoul, Korea, November 29, 2013
39. "What is a Scientific Paper?," School of Materials Science and Engineering, Pusan National University, Pusan, Korea, November 7, 2013
40. "Atomic Layer Deposition of Pt on Carbon Surfaces; Graphite and Graphene," Korea Institute of Machinery and Materials, Daejun, Korea, September 26, 2013
41. "Atomic Layer Deposition of Pt on Carbon Surfaces; Graphite and Graphene," Korea Research Institute of Standards and Science, Daejun, Korea, September 26, 2013
42. "Atomic Layer Deposition of Pt on Carbon Surfaces," Department of Mechanical Engineering, Korea University, Seoul, Korea, August 20, 2013
43. "Atomic Layer Deposition of Pt on Carbon Surfaces" Department of Materials Science and Engineering, Yeongnam University, Daegu, Korea, June 26, 2013
44. "Atomic Layer Deposition of Pt on Carbon Surfaces," Graduate School of Energy, Environment, Water, and Sustainability, Korea Advanced Institute of Science and Technology, Daejeon, Korea, May 8, 2013
45. "Atomic Layer Deposition for Nanotechnologies," Department of Chemical Engineering, Inha University, Incheon, Korean, May 3, 2013
46. "Nucleation & Growth of ALD Metal on Carbon Surfaces," Korean ALD Workshop 2013, Seoul, Korean, April 26, 2013
47. "How Nanotechnologies Can Make Our Life Better?," Myungduk Highschool, Seoul, Korea, April 23, 2013

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# Fellowship and Honor

- Young Scientist Award, The Korean Institute of Metals and Materials 2015
  - Date: 4/23/2015
- Best Paper Award, Material Research Society of Korea 2009
  - Title: High quality nickel atomic layer deposition for nanoscale contact applications
  - Date: 5/21/2009
- Graduate Student Award (Outstanding Paper), Dept. of MSE, POSTECH
  - Title: Spontaneous formation of vertical magnetic metal nanorod arrays during plasma enhanced atomic layer deposition
  - Date: 12/15/2008
- Samsung Award (Best Paper Award), The 15<sup>th</sup> Korean Conference on Semiconductor
  - Title: High quality epitaxial CoSi<sub>2</sub> using plasma nitridation-mediated epitaxy
  - Date: 2/22/2008
- Graduate Student Award (Outstanding Conf. Presentation), Dept. of MSE, POSTECH
  - Title: High quality epitaxial CoSi<sub>2</sub> using plasma nitridation-mediated epitaxy
  - Date: 12/15/2007
- Best Poster Award, Material Research Society 2007 Fall Meeting
  - Title: Analytical study on initial growth stage of metal atomic layer deposition by synchrotron radiation X-ray reflectivity analysis
  - Date: 11/28/2007
- University fellowship, Sungkyunkwan University
  - Period: 2002 - 2004

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# Press

1. "Electronic Textiles fabricated by Low Temperature Atomic Layer Deposition," in [The Kukmin Daily](#), [Yonhap News](#), [Kyeonggi Daily](#), [Herald Economy](#), [NSP News Agency](#), [Maeil Daily](#), [Daehak News](#), [Bridge News](#), 12/5/2016.
2. "Defect Healing of Graphene by Galvanic Displacement Reaction for Transparent Electrode," in [YP News](#), [The Electronic Times](#), [Veritas Alpha](#), [Energy & Economy Times](#), 4/20/2016.
3. "Guest Editor for ACS Virtual Issue (Recent Advances in Atomic Layer Deposition)," in [Aju Business Daily](#), [Gukje News](#), [Sport Kyunghyang](#), [Bridge News](#), [Asia Today](#), [Kyeonggi Daily](#), [Kyeongin Daily](#), 4/14/2016.

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## Teaching Activities

- Computer for Engineers
  - For freshmen, fall
- Energy Materials
  - For junior, spring
- MSE Laboratory 1
  - For sophomore, spring
- Modern Physics
  - For sophomore, fall
- Nanofabrications
  - For junior, fall
- Nanomaterial Analysis
  - For senior, fall
- Special Lecture on Nanomaterial
  - For graduate, Spring
- Special Lecture on Nanofabrication
  - For graduate, Spring
- Special Lecture on Energy Materials
  - For graduate, Spring

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## University and Departmental Committees

- Advisory Committee, INU Center for Research Facilities, 2014 ~
- Committee, Task Force Team of College of Engineering, INU, 2015 ~

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# Professional Activities

- Guest Editor for ACS Virtual Issue, "Recent Advances in Atomic Layer Deposition," 2016 (<http://pubs.acs.org/page/vi/advances-ald.html>)
- Organizing committee, Advanced Metallization Conference 2015 (ADMETA 2015), 2015, Korea
- General Secretary, Division of Materials Science Convergence in The Korean Institute of Metals and Materials, 2015, Korea
- Organizer, 2nd Korean Meeting on Atomic Layer Deposition for Emerging Technologies, supported by The Korean Information Display Society, 2014, Korea
- Advisory Committee, Division of Nanoprocessing & Nanoanalysis Tools, Selection of Nano R&BD Topics, 2014, Korea
- Symposium Organizer, Division of Equipments and Tools for Display Technology, The 14th International Meeting on Information Display, 2014, Korea
- Symposium Organizer and Chair, "Atomic Layer Deposition for Energy Applications," Korean Ceramic Society Fall Meeting 2013, 2013, Korea
- Organizer, 1st Korean Meeting on Atomic Layer Deposition for Emerging Technologies, supported by The Korean Information Display Society, 2013, Korea
- Advisory Committee, Division of Nanoprocessing & Nanoanalysis Tools, Nano Roadmap 2nd Edition, 2013, Korea
- Editorial Board Member, 2015 - , Electronic Materials Letters (<http://link.springer.com/journal/13391>)
- External Journal Reviewer for
  - ACS Applied Materials & Interfaces
  - **ACS Nano**
  - **Advanced Functional Materials**
  - Advanced Materials Interfaces
  - Ceramic International
  - Chemical Vapor Deposition
  - **Chemistry of Materials**
  - Current Applied Physics
  - Journal of Alloys and Compounds
  - Journal of Applied Physics
  - Journal of Catalysis
  - Journal of Semiconductor Technology and Science
  - Journal of Vacuum Science and Technology A
  - Langmuir
  - Materials Science in Semiconductor Processing
  - MRS Bulletin
  - **Nature Communications**
  - RSC Advances
  - Sensors
  - Thin Solid Films
- External Research Proposal Reviewer for
  - Academy of Finland, Finland
  - National Research Foundation of Korea, Korea
  - Ulsan Technopark, Korea
  - Technology Foundation STW in the Netherlands

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