

Curriculum Vitae

Han-Bo-Ram Lee

Office Address

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Education

Ph.D. degree: Ph.D. in Materials Science and Engineering, POSTECH in Korea, May 2009.

B.S. degree: B.S. in Materials Science and Engineering, Sungkyunkwan University in Korea.
Graduated with Magna Cum Laude, February 2005.

Professional Experience

9/09-present: Post Doctoral Course by BK21 program, Electrical and Electronic Engineering, Yonsei University with Professor Hyungjun Kim

Developed atomic layer deposition of Co and Ni thin films for metal silicide contacts gate electrode

Developed supercritical fluid deposition of Ru and SiO₂

Research Projects: *The silicidation in nanoscale systems*
The supercritical fluid deposition of SiO₂

3/05-8/09: Research Assistant, Materials Science and Engineering, POSTECH.

Academic advisor: Professor Hyungjun Kim

Developed atomic layer deposition of Ru thin films for gate electrode

Developed atomic layer deposition of Co and Ni thin films for metal silicide contacts gate electrode

Developed supercritical fluid deposition of Ru and SiO₂

Research Projects: *The atomic layer deposition of transition metals for nanoscale device contacts*

2/05 - 12/08: Teaching Assistant, Materials Science and Engineering, POSTECH.

Class: “*Semiconductor Processing (03/05 – 06/05)*” Professor Hyungjun Kim

“*Materials Laboratory (03/05 – 06/05)*” Professor Hyungjun Kim

“*Chief TA of Semiconductor Processing Laboratory (03/06 – 06/06)*” Professor Hyungjun Kim and Moon Ho Jo

“*Nanoscale Semiconductor Devices (09/06 – 12/06)*” Professor Hyungjun Kim

“*Chief TA of Semiconductor Processing Laboratory (03/08 – 06/08)*” Professor Hyungjun Kim and Moon Ho Jo

“Special Topics in Electronic Materials with Hynix Semiconductor (09/08 – 12/08)” Researchers of Hynix and Professor Hyungjun Kim

2/07 - 2/07: **Visiting Researcher.** Jeon’s Microfluidic Lab., Department of Biomedical Engineering, University of California, Irvine. With Professor Noo Li Jeon.
Research Project: *“Bio applications of Cobalt nanostructures”*

1/05 - 2/05: **Visiting Researcher.** SNTEK Co. Ltd., Kyunggi, Korea
Research Project: *“Development and Fabrication of Atomic Layer Deposition-Magnetron Sputtering Cluster Systems”*

9/04 - 11/04: **Undergraduate Researcher.** Semiconductor Thin Film Devices Lab. Professor Jaichan Lee
Thesis Projects: *“Atomic Layer Deposition and Application to Area-Selective Growth.”*

Technical Skills

Thin Film Deposition equipment:

1. Extensive experience with the design, construction, and film growth in atomic layer deposition
2. Nanoscale Film depositions by sputtering and evaporation
3. Surface treatment and modification by using plasma or coating monolayer
4. Handling of toxic gases and safety system (design and construction of scrubber and gas lines)

Post deposition process and patterning tools:

1. Rapid thermal annealing
2. Photolithography and reactive ion etching of materials

In-situ surface analytical tools:

1. Design and construction of *in-situ* surface analysis equipments (quadrupole mass spectroscopy, synchrotron radiation X-ray reflectivity)

Ex-situ film analytical equipment:

1. TEM sample preparation and imaging technique with energy dispersive spectroscopy and electron energy loss spectroscopy analyses
2. X-ray diffraction, synchrotron radiation XRD and XRR with simulation
3. Scanning electron microscopy with energy dispersive spectroscopy, atomic force microscopy and roughness analyses
4. Secondary ion mass spectroscopy, Rutherford backscattering spectroscopy, X-ray photoelectron spectroscopy, Auger electron spectroscopy, glow discharge optical emission spectroscopy, surface contact angle measurement
5. Focused ion beam, 3-D atomic probe

Electrical property measurement:

1. Capacitance-Voltage and Current-Voltage measurements for device structure

2. 4-point probe measurement for thin film resistivity

Software tools:

1. LabVIEW for control of equipment and data acquisition (*Certificates of “LabVIEW Basics II Course” and “Signal Conditioning Course” from National Instrument*)
2. SPEC and C-PLOT for control of X-ray goniometer and data acquisition of X-ray diffraction
3. Parratt32 for X-ray reflectivity simulation, RUMP for Rutherford backscattering simulation

Fellowship and Honors

2008 Graduate Student Award (*Outstanding Paper*), Department of Materials Science and Engineering, POSTECH

2008 Samsung Award (*Best Paper Award*), The 15th Korean Conference on Semiconductor, “High Quality Epitaxial CoSi₂ using Plasma Nitridation-Mediated Epitaxy”

2007 Graduate Student Award (*Outstanding Conference Presentation*), Department of Materials Science and Engineering, POSTECH

2007 Best Poster Award, Material Research Society 2007 Fall Meeting, “Analytical Study on Initial Growth Stage of Metal Atomic Layer Deposition By Synchrotron Radiation X-Ray Reflectivity Analysis”

2002 - 2004 University fellowship: Fellowship from Sungkyunkwan University.

International Journal Publications

1. “Atomic Layer Deposition of Ni Thin Films and Application to Area Selective Deposition,” Woo-Hee Kim, **Han-Bo-Ram Lee**, Kwang Heo, Young Kuk Lee, Taek-Mo Chung, Chang Gyoung Kim, Seunghun Hong, and Jong Hyun Heo, Gunhee Han, and Hyungjun Kim, *submitted*
2. “Plasma-Enhanced Atomic Layer Deposition of Ni,” **Han-Bo-Ram Lee**, Sung-Hwan Bang, Woo-Hee Kim, Gil Ho Gu, Young Kuk Lee, Taek-Mo Chung, Chang Gyoung Kim, C. G. Park, Gunhee Han, and Hyungjun Kim, *submitted*
3. “Plasma-Enhanced Atomic Layer Deposition of Cobalt using CoCp(AMD) as a precursor,” Jae-Min Kim, **Han-Bo-Ram Lee**, Clement Lansalot, Christian Dussarrat, Julien Gatineau, Gunhee Han, and Hyungjun Kim, *submitted*
4. “Self-formation of Dielectric Layer Containing CoSi₂ Nanocrystals by Plasma-Enhanced Atomic Layer Deposition,” **Han-Bo-Ram Lee**, Gunhee Han, and Hyungjun Kim, *submitted*
5. “In-situ Synchrotron X-ray Scattering Study of Thin Film Growth by Atomic Layer Deposition,” Yong Jun Park, Dong Ryeol Lee, Hyun Hwi Lee, **Han-Bo-Ram Lee**, Hyungjun Kim, Gye-Choon Park, Shi-Woo Rhee, and Sunggi Baik, *submitted*
6. “The Supercritical Fluid Deposition of Conformal SrTiO₃ Films with Composition Uniformity in Nano-contact Holes,” J. H. Lee, J. Y. Son, **Han-Bo-Ram Lee**, Heung-

- Soon Lee, D.-J. Ma, C.-S. Lee, and Hyungjun Kim, *Electrochemical and Solid State Letters*, 12, D45-D47(2009)
7. "The Degradation of Deposition Blocking Layer during Area Selective Plasma Enhanced Atomic Layer Deposition of Cobalt," **Han-Bo-Ram Lee**, Woo-Hee Kim, Jeong Won Lee, Jaemin Kim, Inchan Hwang, and Hyungjun Kim, *Journal of Korean Physical Society*, *in press*.
 8. "High Quality Area-Selective Atomic Layer Deposition Co using Ammonia Gas as a Reactant," **Han-Bo-Ram Lee**, Woo-Hee Kim, Jeong Won Lee, Kwang Heo, In Chan Hwang, Yongjun Park, Seunghun Hong, and Hyungjun Kim, *Journal of Electrochemical Society*, 157, D10-D15(2010)
 9. **(Review Article)** "Applications of Atomic Layer Deposition to Nanofabrication and Emerging Nanodevices," Hyungjun Kim, **Han-Bo-Ram Lee**, and W.-J. Maeng, *Thin Solid Films*, 517, 2563-2580(2009)
 10. "Spontaneous Formation of Vertical Magnetic Metal Nanorod Arrays during Plasma Enhanced Atomic Layer Deposition," **Han-Bo-Ram Lee**, Gil Ho Gu, J. Y. Son, C.G. Park, and Hyungjun Kim, *Small*, 4, 2247-2254(2008)
 11. "Thermal and Plasma Enhanced Atomic Layer Deposition Ruthenium and Electrical Characterization as a Metal Electrode," Sang-Joon Park, Woo-Hee Kim, **Han-Bo-Ram Lee**, W. J. Maeng, and H. Kim, *Microelectronic Engineering*, 85, 39-44(2008)
 12. "High Quality Epitaxial CoSi₂ using Plasma Nitridation-Mediated Epitaxy; The Effects of Capping Layer," **Han-Bo-Ram Lee**, Gil Ho Gu, J.Y. Son, C.G. Park, and Hyungjun Kim, *Journal of Applied Physics*, 102, 094509(2007)
 13. "Stress dependence of growth mode change of epitaxial layered cobaltite γ -Na_{0.7}CoO₂," J. Y. Son, **Han-Bo-Ram Lee**, and J. H. Cho, *Applied Surface Science*, 254, 436-440(2007)
 14. "Surface Charge on Ferroelectric Thin Film by The High Electric Field Induced at Scanning Probe Microscope Tip," J. Y. Son, Young-Han Shin, **Han-Bo-Ram Lee**, Hyungjun Kim, J. H. Cho, and A. I. Ali, *Journal of Korean Physical Society*, 51, S125(2007)
 15. "Nitride Mediated Epitaxy of CoSi₂ Through Self-interlayer-formation of Plasma-Enhanced Atomic Layer Deposition Co," **Han-Bo-Ram Lee**, J. Y. Son and Hyungjun Kim, *Applied Physics Letters*, 90, 123509(2007)
 16. "High Quality Cobalt Thin Films by Plasma-Enhanced Atomic Layer Deposition," **Han-Bo-Ram Lee** and Hyungjun Kim, *Electrochemical and Solid State Letters*, 9, G323-G325(2006)

Proceeding Publications

1. "Nanomaterials Fabrication using Advanced Thin Film Deposition and Nanohybrid Process," Hyungjun Kim, **Han-Bo-Ram Lee**, Woo-Hee Kim, Sang-Joon Park, and In Chan Hwang, *IEEE Nanotechnology Materials and Devices Conference 2009*, 5167578, 3-4(2009)
2. "The Benefits of Atomic Layer Deposition in Non-Semiconductor Applications; Producing Metallic Nanomaterials and Fabrication of Flexible Display," Hyungjun Kim, Woo-Hee Kim, **Han-Bo-Ram Lee**, and S. J. Lim, *ECS Transactions*, 25, 101(2009)

3. "Formation of Silicide Nanowires by Annealing of Atomic Layer Deposition Cobalt/Silicon Core-Shell Nanowires," **Han-Bo-Ram Lee**, Kwang Heo, Seunghun Hong, and Hyungjun Kim, ECS Transactions, **25**, 175(2009)
4. **(Invited)** "Atomic Layer Deposition for Nanoscale Contact Applications," **Han-Bo-Ram Lee** and Hyungjun Kim, 25th International VLSI/ULSI Multilevel Interconnection Conference Proceeding, 39(2008)
5. "Area Selective Atomic Layer Deposition of Cobalt Thin Films", **Han-Bo-Ram Lee** and Hyungjun Kim, ECS Transactions, **16**, 219(2008)

Conference Presentations (International)

1. **(Invited)** "The Applications of Atomic Layer Deposition of Cobalt for Nanoscale Devices," **Han-Bo-Ram Lee** and Hyungjun Kim, International Conference on Nano Science and Nano Technology 2009, Mokpo, Korea, 2009.11
2. "Plasma-Enhanced Atomic Layer Deposition of Ni," **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, Advanced Metallization Conference 2009, Tokyo, Japan, 2009.10
3. "Atomic Layer Deposition of Nickel Thin Films and Application to Area Selective Deposition," Woo-Hee Kim, **Han-Bo-Ram Lee**, Kwang Heo, Seunghun Hong, and Hyungjun Kim, Advanced Metallization Conference 2009, Tokyo, Japan, 2009.10
4. "Low Temperature Plasma-Enhanced Atomic Layer Deposition Co," Jae-Min Kim, **Han-Bo-Ram Lee**, Clement Lansalot, Christian Dussarrat, Julien Gatineau, and Hyungjun Kim, Advanced Metallization Conference 2009, Tokyo, Japan, 2009.10
5. "Formation of Silicide Nanowires by Atomic layer Deposition of Cobalt," **Han-Bo-Ram Lee** and Hyungjun Kim, Electrochemical Society 216th Meeting, Vienna, Austria, 2009.10
6. "The Benefits of Atomic Layer Deposition in Non-Semiconductor Applications; Producing Metallic Nanomaterials and Fabrication of Flexible Display," Hyungjun Kim, Woo-Hee Kim, **Han-Bo-Ram Lee**, and S. J. Lim, Electrochemical Society 216th Meeting, Vienna, Austria, 2009.10
7. "Area Selective Atomic Layer Deposition of Transition Metals," **Han-Bo-Ram Lee**, Woo-Hee Kim, and Hyungjun Kim, 9th International Conference on Atomic Layer Deposition, Monterey, CA, 2009.7
8. "Nanomaterials Fabrication using Advanced Thin Film Deposition and Nanohybrid Process," Hyungjun Kim, **Han-Bo-Ram Lee**, Woo-Hee Kim, Sang-Joon Park, and In Chan Hwang, IEEE Nanotechnology Materials and Devices Conference 2009, Traverse City, MI, 2009.6
9. "Cobalt and Nickel Atomic Layer Depositions for Contact Applications," **Han-Bo-Ram Lee**, Woo-Hee Kim, Yongjun Park, Sunggi Baik, and Hyungjun Kim, The 2009 IEEE International Interconnect Technology Conference, Sapporo, Japan, 2009.6
10. "*In situ* Synchrotron X-ray Scattering Study on The Initial Structure of Ru Metal Atomic Layer Deposition Films for The Electronic Devices," Yong Jun Park, **Han-Bo-Ram Lee**, Woo Hee Kim, Dong-Ryeol Lee, Hyungjun Kim, Shi-Woo Rhee, and Sunggi Baik, Material Research Society 2009 Spring Meeting, San Francisco, CA, 2009.4

11. "Study on Co Atomic Layer Deposition with Various Reactants and Application to Area Selective Deposition," **Han-Bo-Ram Lee**, Woo-Hee Kim, Jeong Won Lee, Kwang Heo, In Chan Hwang, Sang-Joon Park, Seunghun Hong, and Hyungjun Kim, International Semiconductor Technology Conference 2009, Shanghai, China, 2009.3
12. "Atomic Structure and Composition at the Interface of Epitaxial CoSi₂ on Si (001)," G. H. Gu, **Han-Bo-Ram Lee**, Hyungjun Kim, and C. G. Park, The 9th Asia-Pacific Microscopy Conference, Jeju, Korea, 2008.11
13. **(Invited)** "Atomic Layer Deposition for Nanoscale Contact Applications", **Han-Bo-Ram Lee** and Hyungjun Kim, 25th International VLSI/ULSI Multilevel Interconnection Conference, Fremont, CA, 2008.10
14. "Area Selective Atomic Layer Deposition Co," **Han-Bo-Ram Lee**, Woo-Hee Kim, J. W. Lee, K. Heo, I. C. Whang, Sang-Joon Park, S. Hong, and Hyungjun Kim, PRiME 2008 Electrochemical Society 214th Meeting, Honolulu, HI, 2008.10
15. "Atomic Layer Deposition of Ruthenium and Ruthenium Oxide Thin Films on Ta₂O₅ Substrate," Woo-Hee Kim, Sang-Joon Park, **Han-Bo-Ram Lee**, and Hyungjun Kim, Advanced Metallization Conference 2008, Tokyo, Japan, 2008.10
16. **(Invited)** "Synchrotron X-ray Scattering Study on the Initial Growth of Atomic Layer Deposition Thin Films for the Next Generation MOSFET," Hyungjun Kim, **Han-Bo-Ram Lee**, Yong Jun Park, Dong Ryeol Lee, Moon-Kyun Song, Woo-Hee Kim, Shi-Woo Rhee, and Sunggi Baik, Electroceramics XI, Manchester, UK, 2008.9
17. "Quantitative Atomic-Scale Analysis of Interface Structure of CoSi₂ on polycrystalline and single crystalline silicon using by STEM-HAADF and 3D-AP," G. H. Gu, **Han-Bo-Ram Lee**, Hyungjun Kim, and C. G. Park, The International Union of Crystallography, Nagoya, Japan, 2008.9
18. "Atomic Layer Deposition of Ruthenium and Ruthenium Oxide Thin Films on Ta₂O₅ Substrate," Woo-Hee Kim, Sang-Joon Park, **Han-Bo-Ram Lee**, W. J. Maeng, and Hyungjun Kim, The 14th International Symposium on the Physics of Semiconductors and Applications, Jeju, Korea; 2008. 8
19. "Cobalt Atomic Layer Deposition for Nanoscale Contact Applications," **Han-Bo-Ram Lee** and Hyungjun Kim, 1st International Conference on Microelectronics and Plasma Technology, Jeju, Korea, 2008.8
20. "Spontaneous Formation of Metal Nanorods by PE-ALD," **Han-Bo-Ram Lee**, Gil Ho Gu, J.Y. Son, C.G. Park, and Hyungjun Kim, 8th International Conference on Atomic Layer Deposition, Bruges, Belgium, 2008.7
21. "Cobalt and Nickel Thin Films by Plasma-Enhanced Atomic Layer Deposition," Sung-Hwan Bang, **Han-Bo-Ram Lee**, and Hyungjun Kim, 8th International Conference on Atomic Layer Deposition, Bruges, Belgium, 2008.7
22. "Nickel and Cobalt Thin Films by Plasma-Enhanced Atomic Layer Deposition," Sung-Hwan Bang, **Han-Bo-Ram Lee**, Young Kuk Lee, Taek-Mo Chung, Chang Gyoung Kim, and Hyungjun Kim, Material Research Society 2008 Spring Meeting, San Francisco, CA, 2008.3
23. "High Quality Epitaxial CoSi₂ using Plasma Nitridation-mediated Epitaxy; The Effects of Capping Layer," **Han-Bo-Ram Lee**, Gil Ho Gu, J.Y. Son, C.G. Park, and Hyungjun Kim, Material Research Society 2008 Spring Meeting, San Francisco, CA, 2008.3
24. "Cobalt Atomic Layer Deposition for Contact Applications of Nanoscale Devices," **Han-Bo-Ram Lee**, Gil Ho Gu, C.G. Park, and Hyungjun Kim, International Semiconductor Technology Conference 2008, Shanghai, China, 2008.3

25. "Analytical Study on Initial Growth Stage of Metal Atomic Layer Deposition by Synchrotron Radiation X-Ray Reflectivity Analysis," **Han-Bo-Ram Lee**, Woo Hee Kim, Yong Jun Park, Sunggi Baik, and Hyungjun Kim, Material Research Society 2007 Fall Meeting, Boston, MA, 2007.11
26. "Atomic Layer Deposition of Metal Films for Contact Applications of Nanoscale Devices," Sung-Hwan Bang, **Han-Bo-Ram Lee**, and Hyungjun Kim, Advanced Metallization Conference 2007, Tokyo, Japan, 2007.10
27. "STEM-HAADF Analysis of High Quality Epitaxial CoSi_2 Grown on Si(001) by using Plasma Nitridation-Mediated Epitaxy," Gil Ho Gu, **Han-Bo-Ram Lee**, Hyungjun Kim, and Chan Gyung Park, The 11th Frontiers of Electron Microscopy in Materials Science Conference 2007, Sonoma, CA, 2007.9
28. "Epitaxial CoSi_2 Growth from PE-ALD Co Films through Nitride-Mediated Epitaxy," **Han-Bo-Ram Lee**, and Hyungjun Kim, Material Research Society 2007 Spring Meeting, San Francisco, CA, 2007.4
29. "High Density Magnetic Co Nanodot Array Fabrication using Self-Assembled Diblock Copolymer," S. J. Kim, W. J. Maeng, **Han-Bo-Ram Lee**, D. H. Park, Byeong-Hyeok Sohn, and Hyungjun Kim, Material Research Society 2006 Fall Meeting, Boston, MA, 2006.11
30. "Ru Thin Films Growth by Atomic Layer Deposition and Electrical Properties," Sang-Joon Park, Woo-Hee Kim, **Han-Bo-Ram Lee**, W. J. Maeng, and Hyungjun Kim, The 8th Cross Straits Symposium on Materials, Energy and Environmental Engineering, Pusan, Korea, 2006.11
31. "Co and CoSi_2 Films Prepared by Plasma-Enhanced Atomic Layer Deposition for Contact Applications," **Han-Bo-Ram Lee** and Hyungjun Kim, American Vacuum Society 53rd International Conference, San Francisco, CA, 2006.11
32. "Ru ALD: Comparative Studies between RuCp_2 and $\text{Ru}(\text{EtCp})_2$," Sang-Joon Park, **Han-Bo-Ram Lee**, W. J. Maeng, and Hyungjun Kim, 6th International Conference on Atomic Layer Deposition 2006, Seoul, Korea, 2006.7
33. "Low Resistivity Cobalt Thin Films Prepared by Plasma-Enhanced Atomic Layer Deposition," **Han-Bo-Ram Lee** and Hyungjun Kim, 6th International Conference on Atomic Layer Deposition 2006, Seoul, Korea, 2006.7
34. "Ru ALD and Applications for Advanced Devices," **Han-Bo-Ram Lee**, Sang-Joon Park, W.J. Maeng, Y.S. Yang, C.G. Park and Hyungjun Kim, American Vacuum Society 52nd International Conference, Boston, MA, 2005.11
35. "The ALD of Various Oxides from Alkylamide Precursors: the Growth and Film Properties," W.J. Maeng, S.J. Lim, **Han-Bo-Ram Lee**, J.S. Park, and Hyungjun Kim, 5th International Conference on Atomic Layer Deposition, San Jose, CA, 2005.8

Conference Presentations (Korean)

1. "Atomic Layer Deposition of Cobalt using a Novel Precursor," Jae-Min Kim, **Han-Bo-Ram Lee**, Clement Lansalot, Christian Dussarrat, Julien Gatineau, and Hyungjun Kim, The Materials Research Society of Korea 2009 Fall Meeting, Pohang, Korea, 2009.11
2. "Surface Modification for Block Copolymer Nanolithography on Gold Surface," Inchan Hwang, Sung-Hwan Bang, **Han-Bo-Ram Lee**, and Hyungjun Kim, Korean Ceramic Society Fall Meeting 2009, Pohang, Korea, 2009.4

3. "Area Selective Atomic Layer Deposition of Cobalt," **Han-Bo-Ram Lee**, Woo-Hee Kim, Jeong Won Lee, Kwang Heo, In Chan Hwang, Sang-Joon Park, Seunghun Hong, and Hyungjun Kim, The 16th Korean Conference on Semiconductors, Daejun, Korea, 2009.2
4. "Synchrotron X-ray Reflectivity Study on the Initial Growth of Atomic Layer Deposition Thin Films," **Han-Bo-Ram Lee**, Woo-Hee Kim, Moon-Kyun Song, Yong Jun Park, Shi-Woo Rhee, Dong Ryeol Lee, Sunggi Baik, and Hyungjun Kim, 20th Korean Synchrotron Radiation User's Association, Pohang, Korea, 2008.11
5. "Nanomaterials fabrication using atomic layer deposition," Hyungjun Kim, Woo-Hee Kim, **Han-Bo-Ram Lee**, Sung-Hwan Bang, J.Y. Son, Gil Ho Gu, and C.G. Park, The Korean Institute of Metals and Materials, Daejun, Korea, 2008.4
6. "High Quality Epitaxial CoSi₂ Using Plasma Nitridation-Mediated Epitaxy," **Han-Bo-Ram Lee**, Gil Ho Gu, Jong Yeog Son, Chan Gyung Park, and Hyungjun Kim, The 15th Korean Conference on Semiconductors, Pyeongchang, Korea, 2008.2
7. "Plasma Enhanced Atomic Layer Deposition of Ni", S.H. Bang, **Han-Bo-Ram Lee** and Hyungjun Kim," The Materials Research Society of Korea 2007 Fall Meeting, Suwon, Korea, 2007.11
8. "Co and CoSi₂ by PE-ALD for Contact Applications," **Han-Bo-Ram Lee** and Hyungjun Kim, The 14th Korean Conference on Semiconductor, Jeju, Korea, 2007.2
9. "Ru ALD on ALD Ta₂O₅ Substrates for Device Fabrication," **Han-Bo-Ram Lee**, Sang-Joon Park, W. J. Maeng, Y. S. Yang, C. G. Park, and Hyungjun Kim, The 13th Korean Conference on Semiconductors, Jeju, Korea, 2006.2

Patents

1. (Granted) "Method for forming metal-silicide layer in semiconductor devices using plasma nitridation," **Han-Bo-Ram Lee**, Gil Ho Gu, C.G. Park, Hyungjun Kim, KR 0872801
2. (Granted) "Manufacturing method of metal silicide by plasma-enhanced atomic layer deposition for contact application in semiconductor devices," **Han-Bo-Ram Lee**, J.Y. Son, Hyungjun Kim, KR 0872799
3. (Granted) "Transistor and Nonvolatile Memory using Deformation Resistivity of Carbon Nanotube and Piezoelectric Effect," Hyungjun Kim, Y.H. Shin, Y.S. Woo, **Han-Bo-Ram Lee**, J.Y. Son, KR 0848813
4. (Pending) "Method for fabricating semiconductor device," H.S. Kim, S.W. Lee, Hyungjun Kim, **Han-Bo-Ram Lee**, KR 2007-097188
5. (Pending) "Manufacturing Method of Metal Silicide Thin Layer by Plasma-Enhanced Atomic Layer Deposition without Annealing," **Han-Bo-Ram Lee**, J.Y. Son, Hyungjun Kim, KR 2007-0098812
6. (Pending) "Fabrication Method of Catalyst-less Metal Nanorods by Plasma-Enhanced Atomic Layer Deposition and A Semiconductor Element," **Han-Bo-Ram Lee**, Gil Ho Gu, C.G. Park, J.Y. Son, Hyungjun Kim, KR 2007-0100430
7. (Pending) "Manufacturing Method of Metal Nanostructures," **Han-Bo-Ram Lee**, Gil Ho Gu, C.G. Park, Hyungjun Kim, KR 2008-0060662
8. (Pending) "Method for Forming Contacts of Semiconductor Devices using The Selective Deposition," **Han-Bo-Ram Lee**, Woo-Hee Kim, Hyungjun Kim, KR 2009-0025405

9. (Pending) "Method for Fabrication of Metal Nanostructures by using Supercritical Fluid Deposition," **Han-Bo-Ram Lee**, Jaemin Kim, Jeong Won Lee, Heung-Soon Lee, Hyungjun Kim, KR 2009-0041171

Thesis

1. "Atomic Layer Deposition of Cobalt," Ph. D. Thesis, POSTECH, 2009
2. "Atomic Layer Deposition and Application to Area-Selective Growth," B.S. Thesis, Sungkyunkwan University, 2005.