

Curriculum Vitae

Taewook Nam, Ph.D.

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CURRENT POSITION

Yonsei University

Seoul, Korea

Postdoctoral Researcher in Nanodevice Laboratory (PI: Hyungjun Kim)

2018 – Present

EDUCATION

■ **Ph.D.** in Department of Electrical & Electronic Engineering, Yonsei University 2018

Supervisor: Prof. Hyungjun Kim GPA: 4.05 / 4.5

Dissertation: *Ultrathin Film Deposition using Atomic Layer Deposition for Diffusion and Moisture Barriers*

■ **M.S.** in Department of Electrical & Electronic Engineering, Yonsei University 2013

Supervisor: Prof. Hyungjun Kim GPA: 4.05 / 4.5

Thesis: *Atomic Layer Deposition and Characterization of Ga doped ZnO*

■ **B.S.** in Department of Electrical & Electronic Engineering, Yonsei University 2011

Supervisor: Prof. Hagbae Kim GPA: 3.7 / 4.5

TECHNICAL SKILLS & PROFICIENCIES

■ Thin Film/Nanostructured Material Deposition & Device Fabrication

- Extensive and in-depth experience with the film growth in atomic layer deposition (ALD)
→ **Metal oxide** (SiO₂, Al₂O₃, ZrO₂, HfO₂, ZnO, Ga₂O₃, In₂O₃, SnO_x, NiO, TiO₂, MoO_x),
metal (Pt, Ru, Co, Ni, W), **nitride** (SiN_x, TiN_x), and **2D TMDCs** (MoS₂, WS₂, WSe₂)
- Area-selective atomic layer deposition (AS-ALD) using surface inhibition
- Nanoscale film deposition by magnetron sputtering and thermal evaporation
- Surface treatment and modification by using plasma or self-assembled monolayer (SAM)
- Mechanical exfoliation of 2D material and characterization
- Diverse nanostructure fabrication (e.g. NW, AAO) & treatment (RTP, etc.)
- Fabrication of metal-oxide-semiconductor capacitor (MOSCAP), and thin film transistor (TFT)

■ Experimental Tool Design, Construction, and Maintenance

- Highly experienced in designing, manufacturing, and maintenance of ALD chamber
(for low-temperature specialized / for TMDCs / for high-throughput)
- Comprehensive understanding and experiences of vacuum system maintenance and replacement
(vacuum systems, mass flow controllers, exhaust treatment, and leak detection methods as they pertain to atomic vapor deposition reactors)
- Safety precautions for the operation and maintenance of systems that utilize toxic and explosive gas
(design and construction of scrubber and gas lines)

■ Ex-situ Film Analytical Equipment

- XPS, XRD, XRR, SEM with EDS, AFM, SIMS, OES, FT-IR with TR and ATR, contact angle measurement, ultraviolet-visible spectrophotometer (UV-Vis), spectroscopic ellipsometry (SE), and Raman analysis
- Synchrotron radiation experiments with simulation (Pohang Acceleration Laboratory 3D Beamline)
- Electrical characterization of device with C-V, I-V, 4-point probe, and Hall measurement

■ Software Tools

- **LabVIEW** for software development, ImageJ, MATLAB, and Gatan Microscopy Suite
(Certified LabVIEW Associate Developer (CLAD) from National Instrument (2012 – 2014))
- Rhinoceros and Sketchup for 3D modeling, and Keyshot and V-ray for 3D rendering ([Examples](#))

RESEARCH & PROFESSIONAL EXPERIENCE

- Mar. 2018 – Current: **Post-doc Researcher.** Electrical & Electronic Engineering, Yonsei University
 - Research Project:
 - “Development on precursors for carbon/halogen-free thin film and their delivery system for high-k/metal gate application” – Academic collaboration w/ **Hansol Chemical**
 - “Precursor evaluation for ALD synthesis of hydrogen-less SiN_x” – Academic collaboration w/ **Air Liquide**
 - “Hydrophobic SiO_x deposition by using ALD” – Academic collaboration w/ **Wonik Materials**
 - “Area-selective ALD (AS-ALD) using SiO_x as an Inhibitor”
 - “Vapor phase synthesis of metal-organic-framework (MOF) for highly efficient energy application”

- Mar. 2011 – Feb. 2018: **Research Assistant.** Electrical & Electronic Engineering, Yonsei University
 - Research Project:
 - “Transparent Conductive Oxides (TCOs) deposition by using ALD” – w/ **LG Electronics** (2011)
 - “Manufacture of ALD Apparatus for Low Temperature Process and High Throughput”- w/ **National Research Fund (NRF) of Korea** (2011 – 2013)
 - “Evaluation of High-throughput ALD Apparatus” – w/ **MTS Nanotech** (2013)
 - “Cu gate thin film transistor (TFT) fabrication” – w/ **LG Display** (2013 – 2014)
 - “Low temperature ALD Al₂O₃ for OLED encapsulation” – w/ **LG Display** (2014 – 2015)
 - “ALD-related Research” (*cannot be opened because of NDA*) – w/ **Samsung Electronics Semiconductor R&D Center** (2015 – 2017)
 - “Precursor evaluation for low temperature ALD SiO₂ & SiN_x for hard mask applications” – w/ **Wonik Materials** (2016 – 2018)
 - “Hydrogen barrier using ALD Al₂O₃” – w/ **LG Display** (2017)
 - “CVD/ALD-based interconnect and diffusion barrier development using transition metal” – Academic collaboration w/ **Dow Chemical**

- Sep. 2010 – Jun. 2012: **Teaching Assistant.** Electrical & Electronic Engineering, Yonsei University
 - Class:
 - “Semiconductor and Display Experiments” Spring 2012, Spring 2013, Spring 2014
 - “Semiconductor Physics” Fall 2011, “Junior Seminar: Modern physics” Fall 2010

SCOLARSHIP, HONOR, AND AWARDS

- Brain Korea 21 Plus (BK21 Plus) Fellowship (National Research Fund (NRF) of Korea), Mar. 2018 – Current
- Sponsorship Program at Samsung Electronics Semiconductor R&D Center, Mar. 2017 – May. 2018
- Best Presentation Award, The 23rd Korean Conference on Semiconductors (KCS 2016), Feb. 2016
- National Scholarship for Science and Engineering, 2007 – 2008

PUBLICATIONS (total citation: 1282, h index: 10, i10-index: 10)

1. “Moisture Barrier Properties of Low-temperature ALD Al₂O₃ using Various Oxidants”
Taewook Nam, Haksoo Lee, Sung Min Cho, Bonggeun Shong, Hyungjun Kim, and Han-Bo-Ram Lee
[Ceramics International \(2019\) Accepted](#)

2. “Hydrogen Barrier Performance of Lanthanum Oxide Deposited by Reactive Magnetron Sputtering”
Yujin Lee, Chong Hwon Lee, **Taewook Nam**, Sanghun Lee, et al.
[Journal of Material Science \(2019\) 54: 11145](#)

3. “Low-temperature, High-growth-rate ALD of SiO₂ using Novel Aminodisilane Precursor”
Taewook Nam, Hyunho Lee, Taejin Choi, Seunggi Seo, Chang Mo Yoon et al.
[Applied Surface Science, 485 \(2019\) 381-390](#)

4. “Molecular oxidation of surface -CH₃ during atomic layer deposition of Al₂O₃ with H₂O, H₂O₂, and O₃: A theoretical study”,
Seunggi Seo, **Taewook Nam**, Han-Bo-Ram Lee, Hyungjun Kim, and Bonggeun Shong
[Applied Surface Science, 457 \(2018\) 376-380](#)

5. "High-Performance Ink-Synthesized Cu-Gate Thin-Film Transistor with Diffusion Barrier Formation"
Whang Je Woo, **Taewook Nam**, Il-Kwon Oh, Wanjo Maeng, and Hyungjun Kim
[Metals and Materials International, 24 \(2018\) 652–656](#)

6. "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, and Hyungjun Kim
[Journal of Alloys and Compounds 737 \(2018\) 684-692](#)

7. "Surface-Localized Sealing of Porous Ultralow-k Dielectric Films with Ultrathin (< 2 nm) Polymer Coating"
Seong Jun Yoon, Kwanyong Pak, **Taewook Nam**, Alexander Yoon, Hyungjun Kim, Sung Gap Im, and Byung Jin Cho
[ACS nano, 2017, 11 \(8\), 7841-7847](#)

8. "A composite layer of atomic-layer-deposited Al₂O₃ and graphene for flexible moisture barrier"
Taewook Nam, Yong Ju Park, Haksoo Lee, Il-Kwon Oh, Jong-Hyun Ahn, Sung Min Cho, Hyungjun Kim, and Han-bo-ram Lee
[Carbon 116 \(2017\) 553-561](#)

9. "Effects of TaN Diffusion Barrier on Cu-Gate ZnO: N Thin-Film Transistors"
Whang Je Woo, **Taewook Nam**, Hanearl Jung, Il-Kwon Oh, Jeong-Gyu Song, Wanjo Maeng, and Hyungjun Kim
[IEEE Electron Device Letters 37 \(5\), 599-602 \(2016\)](#)

10. "High-performance Alternating Current Electroluminescent Layers Solution Blended with Mechanically and Electrically Robust Nonradiating Polymers"
Seong Soon Jo, Sung Hwan Cho, Hae Jin Kim, **Taewook Nam**, Ihn Hwang, et al.
[Journal of Polymer Science, Part B: Polymer Physics 53 \(2015\) 1629–1640](#)

11. "Growth Characteristics and Properties of Indium Oxide and Indium-doped Zinc Oxide by Atomic Layer Deposition"
Donghyun Kim, **Taewook Nam**, Jusang Park, Julien Gatineau, Hyungjun Kim
[Thin Solid Films 587 \(2015\) 83-87](#)

12. "Growth Characteristics and Properties of Ga-doped ZnO (GZO) Thin Films Grown by Thermal and Plasma-enhanced Atomic Layer Deposition"
Taewook Nam, Chang Wan Lee, Hyun Jae Kim, Hyungjun Kim
[Applied Surface Science 295 \(2014\) 260-265](#)

13. "Graphene as an Atomically Thin Barrier to Cu Diffusion into Si"
Juree Hong, Sanggeun Lee, Seulah Lee, Heetak Han, Chandreswar Mahata, Han-Wool Yeon, Bonwoong Koo, Seong-Il Kim, **Taewook Nam**, Kisik Byun, Byung-Wook Min, Young-Woon Kim, et al.
[Nanoscale, 2014, 6, 7503–7511](#)

14. "Direct Imprinting of MoS₂ Flakes on a Patterned Gate for Nanosheet Transistors"
Kyunghee Choi, Young Tack Lee, Sung-Wook Min, Hee Sung Lee, **Taewook Nam**, Hyungjun Kim and Seongil Im
[Journal of Materials Chemistry C, 2013, 1, 7803](#)

15. "Nanosheet Thickness-modulated MoS₂ Dielectric Property Evidenced by Field-effect Transistor Performance"
Sung-Wook Min, Hee Sung Lee, Hyoung Joon Choi, Min Kyu Park, **Taewook Nam**, Hyungjun Kim, Sunmin Ryu and Seongil Im
[Nanoscale 2013, 5, 548-551](#)

16. "MoS₂ Nanosheet Phototransistors with Thickness-Modulated Optical Energy Gap"
Hee Sung Lee, Sung-Wook Min, Youn-Gyung Chang, Min Kyu Park, **Taewook Nam**, Hyungjun Kim, Jae Hoon Kim, Sunmin Ryu, and Seongil Im
[Nano Letters, 2012, 12 \(7\), pp 3695–3700](#)

17. "Low-temperature Atomic Layer Deposition of TiO₂, Al₂O₃, and ZnO Thin Films"

Taewook Nam, Jae-Min Kim, Min-Kyu Kim, Woo-Hee Kim, Hyungjun Kim

[*Journal of the Korean Physical Society*, 59 \(2\), 2011, pp. 452-457](#)

18. "The Effects of Ultraviolet Exposure on the Device Characteristics of Atomic Layer Deposited-ZnO:N Thin Film Transistors"

Jae-Min Kim, S. J. Lim, **Taewook Nam**, Doyoung Kim, and Hyungjun Kim

[*Journal of The Electrochemical Society*, 158 \(5\) J150-J154 \(2011\)](#)

19. "Atomic Layer Deposition ZnO:N Flexible Thin Film Transistors and the Effects of Bending on Device Properties"

Jae-Min Kim, **Taewook Nam**, S. J. Lim, Y. G. Seol, N.-E. Lee, Doyoung Kim, and Hyungjun Kim

[*Applied Physics Letters* 98, 142113 \(2011\)](#)

PATENTS

1. (KR) "FORMATION OF GALLIUM OXIDE NANOWIRE USING ATOMIC LAYER DEPOSITION"

Hyungjun Kim, **Taewook Nam**

Granted (KR, Pending No. : 10-2012-0063701, Granted No. : 10-1452976)

2. (KR) "METHOD AND APPARATUS FOR FORMING OXIDE THIN FILM"

Hyungjun Kim and **Taewook Nam**

Granted (KR, Pending No. : 10-2015-0037374, Granted No. : 10-1727259)

3. (KR) "THIN FILM SURFACE TREATMENT"

Hyungjun Kim and **Taewook Nam**

Pending (KR, Pending No. : 10-2016-0024539)

4. (US) "METHOD AND APPARATUS FOR FORMING THIN OXIDE FILM"

Hyungjun Kim and **Taewook Nam**

Granted (US, Pending No. : 15/069,842, Granted No. : 9,611,547)

5. (KR) "FORMING METHOD FOR HYDROPHOBIC THIN FILM BASED ON AMINOSILANE PRECURSOR"

Hyungjun Kim and **Taewook Nam**

Pending (KR, Pending No. : 10-2019-0000628)

6. (KR) "METHOD FOR DEPOSITING THIN FILM USING TWO TYPE OF REDUCING AGENTS AND THIN FILM DEPOSITION STRUCTURE THEREOF"

Hyungjun Kim, **Taewook Nam**, and Yujin Lee

Pending (KR, Pending No. : 10-2019-0048208)

7. (KR) "A METHOD FOR ACHIEVING AREA-SELECTIVE GROWTH OF 2D DICHALCOGENIDE MATERIAL USING ATOMIC LAYER DEPOSITION"

Woohee Kim, Han-Bo-Ram Lee, and **Taewook Nam**

Pending.

8. (KR) "METHOD AND APPARATUS FOR AREA SELECTIVE DEPOSITION OF HYDROPHOBIC THIN FILM BASED ON LOW TEMPERATURE ATOMIC LAYER DEPOSITION"

Hyungjun Kim and **Taewook Nam**

Pending (KR, Pending No. : 10-2019-0115891)

CONFERENCE PRESENTATION (INTERNATIONAL)

1. "Low-Temperature Atomic Layer Deposition (LT-ALD) of TiO₂, Al₂O₃, and ZnO thin films for transparent conducting oxides (TCOs) applications"

Taewook Nam, Woo-Hee Kim, Min-Kyu Kim, and Hyungjun Kim

2011 MRS Spring Meeting and Exhibit, California, USA, 2011/4.

2. "Low temperature Atomic Layer Deposition of Al₂O₃ for Macroelectronics"
Taewook Nam, Woo-Hee Kim, Min-Kyu Kim, and Hyungjun Kim
The 11th International conference on Atomic Layer Deposition (ALD), Massachusetts, USA, 2011/6.
3. "Growth Characteristics and Films Properties of Ga doped ZnO (GZO) by Low Temperature Atomic Layer Deposition"
Taewook Nam, Won-Seon Lee, Chang Wan Lee, and Hyungjun Kim
American Vacuum Society (AVS) 58th International Symposium & Exhibition, Tennessee, USA, 2011/11.
4. "Studies on Ga doped ZnO (GZO) by Low Temperature Atomic Layer Deposition"
Taewook Nam, Won-Seon Lee, Chang Wan Lee, and Hyungjun Kim
2011 MRS Fall Meeting and Exhibit, Massachusetts, USA, 2011/11.
5. "Investigation of Growth Characteristics and Electronic Properties of In₂O₃ and In doped ZnO by Atomic Layer Deposition"
Donghyun Kim, **Taewook Nam**, and Hyungjun Kim
International Conference on Microelectronics and Plasma Technology (ICMPT) 2014, Gunsan, Korea, 2014/07.
6. "Bias Temperature Stress Tests on Cu Gate TFT with Al₂O₃ and HfO₂ gate Insulators and TaN Diffusion Barrier"
Whang je Woo, **Taewook Nam**, Haneral Jung, Il-Kwon Oh, and Hyungjun Kim
The 14th International Meeting on Information Display (iMiD) 2014, Daegu, Korea, 2014/08.
7. "Growth and Reduction Characteristics of ALD Nickel Oxide (NiO) using HPN Precursor"
Taewook Nam, and Hyungjun Kim
Atomic Layer Deposition (ALD) 2016, Dublin, Ireland, 2016/07.
8. "Characterization of Atomic Layer Deposited Nickel Oxide (NiO) by using HPN Precursor"
Taewook Nam, Donghyun Kim, Seungmin Yeo, Soo-hyun Kim, and Hyungjun Kim
The 20th International Vacuum Congress (IVC-20), Busan, Korea, 2016/08.
9. "Effects of Aminodisilane Precursor on Ozone-based Low-temperature Atomic Layer Deposition of SiO₂"
Taewook Nam, Hyunho Lee, Taejin Choi, Seunggi Seo, Chang Mo Yoon, Yunjung Choi, Heonjong Jeong, Hima K. Lingam, Venkateswara R. Chitturi, Andrey Korolev, Jong-Hyun Ahn, and Hyungjun Kim*
The 4th International Conference on ALD Applications & 2018 China ALD Conference, Shenzhen, China, 2018/10.
10. "Hydrophobic SiO_x Thin Film Deposition using Low-Temperature Atomic Layer Deposition"
Taewook Nam, and Hyungjun Kim
International Conference on Atomic Layer Deposition (ALD 2019), Bellevue, Washington, USA, 2019/07.
11. "Area-Selective Deposition Using a Atomic-Layer-Deposited Carbon, Fluorine-Free SiO_x as an Inhibitor"
Taewook Nam, Inkyu Sohn, Tatsuya Nakazawa, and Hyungjun Kim
2019 Materials Research Society (MRS) Fall Meeting & Exhibit, Boston, Massachusetts, USA, 2019/12

CONFERENCE PRESENTATION (DOMESTIC)

1. "Low-Temperature Atomic Layer Deposition (LT-ALD) of TiO₂, Al₂O₃, and ZnO thin films for transparent conducting oxides (TCOs) applications"
Taewook Nam, Jae-Min Kim, And Hyungjun Kim
The 18th Korean Conference on Semiconductors, Jeju, Korea, 2011/2
2. "Ga doped ZnO (GZO) by atomic layer deposition for Transparent Conducting Oxides"
Taewook Nam, Won-Seon Lee, Chang Wan Lee, and Hyungjun Kim
The 19th Korean Conference on Semiconductors, Seoul, Korea, 2012/2.
3. "Thickness Controlled, Exfoliated MoS₂ Transistors with High-k Dielectrics"
Wonseon Lee, Jusang Park, **Taewook Nam**, Minkyu Kim, and Hyungjun Kim
The Korean Institute of Metals and Materials Fall Exhibition and Conference, Changwon, Korea, 2012/10.

4. "Growth Characteristics and Electrical Properties of In_2O_3 and In doped ZnO by Atomic Layer Deposition for IZO TFT Applications"
Seonjo Kim, **Taewook Nam**, Wonseon Lee, Jusang Park, and Hyungjun Kim
MRS-K Fall, Kangwon, Korea, 2012/11.
5. "Fabrication of Transferrable Al_2O_3 Nanosheet using Atomic Layer Deposition"
Hanearl Jung, **Taewook Nam**, Il-Kwon Oh, Jae Seung Lee, and Hyungjun Kim
MRS-K Spring, Yeosu, Korea, 2013/5.
6. "Investigation about TaN diffusion barrier properties of Cu gate TFT with Al_2O_3 and HfO_2 gate insulator",
Donghyun Kim, Whang Je Woo, **Taewook Nam**, Hanearl Jung, and Hyungjun Kim
MRS-K FALL, Changwon, Korea, 2014/5.
7. "Atomic layer deposition (ALD) Al_2O_3 as a moisture barrier for organic light emitting diode (OLED)"
Taewook Nam, Donghyun Kim, and Hyungjun Kim
2014 MRS Korea (MRS-k), Daejeon Convention Center (DCC), Korea, 2014/11.
8. "Improved Electrical Properties in Cu gate TFT with Oxide Semiconductor by using TaN Diffusion Barrier"
Whang Je Woo, **Taewook Nam**, Hanearl Jung, Il-Kwon Oh, and Hyungjun Kim
International Technical Conference on Circuits Systems, Computers and Communications (ITC-CSCC), Seoul, Korea, 2015/6.
9. "Atomic Layer Deposition of Cobalt-based Bifunctional Layer for Cu Interconnect"
Taewook Nam, Soohyeon Kim, Chang Wan Lee, Daewon Hong, Oh Joong Kwon, Han-Bo-Ram Lee, and Hyungjun Kim
2015 Advanced Metallization Conference Plus (ADMETA Plus) 25th Asian Session, Seoul, Korea, 2015.9.
10. (*BEST POSTER AWARD*) "Cobalt Titanium Nitride Grown by Atomic Layer Deposition as a Diffusion Barrier for Cu Interconnect"
Taewook Nam, Soohyeon Kim, Chang Wan Lee, Daewon Hong, Han-Bo-Ram Lee, and Hyungjun Kim
The 23rd Korean Conference on Semiconductors (KCS 2016), Seoul, Korea, 2016/02.
11. "Improvements in Ink-synthesized Cu-gate Thin Film Transistor with TaN Diffusion Barrier"
Whang Je Woo, **Taewook Nam**, and Hyungjun Kim
The 23rd Korean Conference on Semiconductors (KCS 2016), Seoul, Korea, 2016/02.
12. "Characteristics of Ink-synthesized Cu-gate Thin Film Transistor with Diffusion Barrier"
Whang Je Woo, **Taewook Nam**, Hanearl Jung, and Hyungjun Kim
2016 MRS Korea (MRS-k) Spring, Yeosu, Korea, 2016/05.