Curriculum Vitae

Taewook Nam, Ph.D.

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CURRENT POSITION

Postdoctoral Research Associate
University of Colorado Boulder (PI: Steven M. George) 2019.11 – 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

EXPERTISE & PROFICIENCIES

■ **Next-generation Semiconductor Device Fabrication using Atomic Layer Process**

- Fabrication of nanosheet-based or gate-all-around devices using **atomic layer deposition (ALD)** and **atomic layer etching (ALE)**
- Sub-10 nm III-V nanowire device fabrication for the tunneling field effect transistor (TFET) using **thermal ALE**
- Ferroelectric tunneling device fabrication with thinner dielectric using thermal ALE
- Layer selective, lateral etching process development of 2-dimensional transition metal dichalcogenides (2D TMDs) (e.g. MoS_2, WSe_2, etc.) for sub-Å scale FET fabrication
- Low leakage current and high dielectric constant dielectric deposition using capping layer by ALD
- Area-selective atomic layer deposition (AS-ALD) using surface inhibition and reactivation

■ **Thin Film Deposition and Etching Process Development**

- Process development of deposition and etching for binary, ternary, and quaternary materials using *in situ* apparatus (e.g. quadruple mass spectrometry (QMS), Fourier transform infrared spectroscopy (FTIR), etc.)
  → Metal oxide (SiO_2, Al_2O_3, ZrO_2, HfO_2, ZnO, Ga_2O_3, In_2O_3, SnO_x, NiO, TiO_2, MoO_x), metal (Pt, Ru, Co, Ni, W), nitride (SiN_x, TiN_x), and 2D TMDCs (MoS_2, WS_2, WSe_2)
- Novel metal etching (Pt, Ru, etc.) using thermal ALE for the catalyst and energy applications

Recent 5-yrs PUBLICATIONS (5-yrs citation: 1188, h index: 14, i10-index: 19)

1. "Thermal Atomic Layer Etching of Molybdenum Using Sequential Oxidation and Deoxychlorination Reactions"
Taewook Nam, Troy A. Colleran, Jonathan L. Partridge, Andrew S. Cavanagh, and Steven M. George
Chemistry of Materials (2023), In revision (Minor revision)

2. "Atomic Layer Deposition of Pt Nanoparticles Using Dimethyl (N, N-dimethyl-3-butene-1-amine-N) Platinum and H_2 Reactant and Its Application to 2D WS_2 Photodetectors"
Dain Shin, Inkyu Sohn, Donghyun Kim, Jaehyeok Kim, **Taewook Nam**, Youngjun Kim, Jusang Park, Tatsuya Nakazawa, Seung-min Chung, and Hyungjun Kim
Journal of Vacuum Science and Technology A, Accepted

3. "Thermal Atomic Layer Etching of Zinc Sulfide Using Sequential Trimethylaluminum and Hydrogen Fluoride Exposures: Evidence for a Conversion Mechanism"
Taewook Nam, Jonathan L. Partridge, and Steven M. George
Chemistry of Materials (2023), 35, 6671-6681

4. "Growth mechanism and electrical properties of tungsten films deposited by plasma-enhanced atomic layer deposition with chloride and metal organic precursors"
Yujin Lee, Seunggi Seo, **Taewook Nam**, Hyunho Lee, Hwi Yoon, Sangkyu Sun, Il-Kwon Oh, Sanghun Lee, Bonggeun Shong, Jin Hyung Seo, Jang Hyeon Seok, and Hyungjun Kim
Applied Surface Science (2021) 568, 150939

5. (Selected as a cover) "Hydrogen Barrier based on Chemical Trapping using Chemically–modulated Al_2O_3 grown by Atomic Layer Deposition for InGaZnO Thin Film Transistor"
Yujin Lee[#], **Taewook Nam[#]**, Seunggi Seo, Hwi Yoon, Chong Hwon Lee, Hyukjoon Yoo, Hyun Jae Kim, Wonjun Choi, Seongil Im, Joon Young Yang, Dong Wook Choi, Choongkeun Yoo, Ho-jin Kim, and Hyungjun Kim
#These authors contributed equally.
ACS Applied Materials & Interfaces, 2021, 13, 17, 20349-20360.

6. "Two-Dimensional MoS_2 Charge Injection Memory Transistors Utilizing Hetero-stack SiO_2/HfO_2 Dielectrics and Oxide Interface Traps"
Livia Janice Widiapradja[#], **Taewook Nam[#]**, Heesun Bae, Yeonsu Jeong, Hye-Jin Jin, Yangjin Lee, Kwanpyo Kim, Sangyoon Lee, Hyungjun Kim, and Seongil Im
[#]These authors contributed equally.
Advanced Electronic Materials, 2021, 2100074

7. "MoS2 Doping by Atomic Layer Deposition of High-k Dielectrics using Alcohol as Process Oxidants"
Whang Je Woo, Seunggi Seo, **Taewook Nam**, Youngjun Kim, Donghyun Kim, Jeong-Gyu Song, Jun Hyung Lim, Hyung-Jun Kim, and Hyungjun Kim
Applied Surface Science, 541 (2021) 148504

8. *(Invited paper) (Selected as a Featured Article)* "Atomic layer deposition of a uniform thin film on 2-dimensional transition metal dichalcogenides"
Taewook Nam, Seunggi Seo, and Hyungjun Kim
Journal of Vacuum Science and Technology A, 38, 030803 (2020)

9. "Comparative Study on Atomic Layer Deposition of HfO2 via Substitution of Ligand Structure with Cyclopentadiene"
Sungmin Park,[a#] Bo-Eun Park,[a#] Hwi Yoon,[a] Sanghun Lee,[a] **Taewook Nam**,[a] Taehoon Cheon,[b] SooHyun Kim,[b] Hwansung Cheon,[c] Sangkyun Im,[c] Taegeun Seong[c] and Hyungjun Kim[a*]
Journal of Materials Chemistry C (2020), 8, 1344-1352

10. (Invited paper) "Atomic layer deposition for nonconventional nanomaterials and their applications"
Taewook Nam and Hyungjun Kim*
*Journal of Materials Research **35**, 656-680 (2020)*

11. "Moisture Barrier Properties of Low-temperature ALD Al_2O_3 using Various Oxidants"
Taewook Nam, Haksoo Lee, Sung Min Cho, Bonggeun Shong, Hyungjun Kim, and Han-Bo-Ram Lee
Ceramics International (2019), 45, 19105–19112

12. "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

13. "Low-temperature, High-growth-rate ALD of SiO_2 using Novel Aminodisilane Precursor"
Taewook Nam, Hyunho Lee, Taejin Choi, Seunggi Seo, Chang Mo Yoon et al.
Applied Surface Science, 485 (2019) 381-390

PATENTS (Granted only) (Domestic: 8. International (US): 1)

1. (KR) "METHOD FOR FORMING HIGH-EFFICIENCY HYDROGEN BARRIER CONTROL FILM THROUGH ARTIFICIAL COMPOSITION CONTROL IN THIN FILM BASED ON ATOMIC LAYER DEPOSITION"
Hyungjun Kim, **Taewook Nam**, and Yujin Lee
Granted (KR, Pending No. : 10-2021-0044610, Granted No. : 10-2563859)

2. (KR) "METHOD OF SYNTHESIZING ORGANOMETALLIC COMPOUND AND THIN FILM USING THEREOF"
Jinhyung Seo, Mira Park, Janghyeon Seok, Jungwoo Park, Hyungjun Kim, **Taewook Nam**, and Yujin Lee
Granted (KR, Pending No. : 10-2021-0052409, Granted No. : 10-2022-0145619)

3. (KR) "METHOD AND APPARATUS FOR AREA SELECTIVE DEPOSITION OF HYDROPHOBIC THIN FILM BASED ON LOW TEMPERATURE ATOMIC LAYER DEPOSITION"
Hyungjun Kim and **Taewook Nam**
Granted (KR, Pending No. : 10-2019-0115891, Granted No. : 10-2291965)

4. (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
Granted (KR, Pending No. : 10-2019-0048208, Granted No. : 10-2260968)

5. (KR) "FORMING METHOD FOR HYDROPHOBIC THIN FILM BASED ON AMINOSILANE PRECURSOR"
Hyungjun Kim and **Taewook Nam**
Granted (KR, Pending No. : 10-2019-0000628, Granted No. : 10-2273964)

6. (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)

7.(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)

8. (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)

RESEARCH & PROFESSIONAL EXPERIENCE

■ Mar. 2018 – Oct. 2019**: 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 Al_2O_3 for OLED encapsulation" – w/ ***LG Display*** *(2014 – 2015)*
  "Capping layer for the DRAM applications using ALD" – w/ ***Samsung Electronics Semiconductor R&D Center*** *(2015 – 2017)*
  "Precursor evaluation for low temperature ALD SiO_2 & SiN_x for hard mask applications" – w/ ***Wonik Materials*** *(2016 – 2018)*
  "Hydrogen barrier using ALD Al_2O_3" – 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

Journal Review Activities

Chemistry of Materials
ACS Applied Materials & Interfaces
Journal of Electrical Engineering & Technology
Vacuum