

Hyungtak Seo

Associate Professor
Dept. of Materials Science and Engineering
Ajou University
San 5, Woncheon-Dong, Yeongtong-Gu
Suwon 443-749, Korea
Tel: +82-31-219-3532
Fax: +82-31-219-1613
Cell:+82-10-8592-5793
E-mail : hseo@ajou.ac.kr
Group Website: aeem.ajou.ac.kr

Education

North Carolina State University

Ph.D. in *Electrical Engineering*, August, 17, 2004–December, 17, 2008

Membership at NC State Chapter of The Honor Society of Phi Kappa Phi

Ph.D. Thesis Title: “Characterization of High-k Dielectrics and Interfaces on Device Reliability”

Hanyang University, Seoul, Korea

M.S. in *Materials Science and Metallurgical Engineering*, March, 02, 2000-February, 21, 2002

M.S. Thesis Title: “Remote RF Plasma Cleaning for The Removal on RIE-induced Organic Impurity and Native Oxide”

Hanyang University, Seoul, Korea

B.S. in *Materials and Metallurgical Engineering*, March, 02, 1995-February, 25, 2000

Employment History

Ajou University, Suwon, Republic of Korea

Dept of Materials Science and Engineering (Undergraduate), Dept of Energy Systems Research (Graduate, BK program) Assistant Professor Sep. 01, 2011 – Aug, 31, 2015, Associate Professor Sep. 01, 2015 – currently

- Principal Investigator for Advanced Electronic and Energy Materials Lab

Lawrence Berkeley National Laboratory, Berkeley, CA

Chemical Sciences Division, Surface Catalysis Lab. Feb, 05, 2009 – May, 31, 2011

Postdoctoral Fellow in Prof. Gabor Somorjai’s group

(Joint affiliation with Dept. of Chemistry in UC Berkeley)

- Study on the hot electron surface catalytic energy conversion device and surface plasmon assisted oxide thin film photovoltaic devices: *Research Project funded by US Department of Energy.*
- Study on the control of catalytic reaction using hot carriers generated by nano-scale metal/semiconductor PV diodes
- Developing optical and chemical doping techniques of metal-oxide semiconductors and Graphene for electronic devices
- Conducting research project on surface optimization of the capping layers on Si/Mo multilayered masks for the Extreme Ultra-Violet lithography: *Research Project funded by Intel (collaborations).*

North Carolina State University, Raleigh, NC

Post Doctoral Research Associate, Oct. 15, 2008 – Jan. 15, 2009

Graduate Research Assistant (Ph.D.) in Dr. Lucovsky's group, Aug. 2004 – Dec. 17, 2008

- Study on the effect of defect in the high-k gate dielectric stacks on the device reliability and performance for scaled down MOSFETs and advanced functional devices: *Research Projects funded by U.S. Army Research Office, U.S. Naval Research Office, SEMATECH/Semiconductor Research Cooperation, Samsung Electronics. Collaborators are Researchers at Stanford Univ., IMEC, KIST, KU Leuven, Penn State Univ.*

IMEC, Leuven, Belgium

Visiting researcher, May. 24, 2007 – Aug. 14, 2007

- Advanced MOSFET reliability research on metal/high-k gate stacks with various electrical measurements such as charge pumping spectroscopy, CV/IV.
- Study on interface and metal/high-k gate stacks on Ge-channel MOSFETs.

Korea Research Institute of Standards and Science, Daejeon, Korea

Researcher, Sep., 15, 2003 – June, 28, 2004

- Investigator for plasma diagnosis with cut-off and Langmuir Probe, ion detecting Quadrupole Mass Spectrometer (QMS) and Laser Induced Fluorescence connected to sputter, PECVD and plasma enhanced ALD for high-k gate dielectrics (HfO₂ and ZrO₂) and diffusion barrier (TiN) deposition in cooperative effort with Hanyang University.
- Research for property and chemical reaction of amorphous Carbon Nitride thin film deposition in magnetron sputter and Inductive Coupled Plasma (ICP) reactor

Korea Atomic Energy Research Institute, Daejeon, Korea

Researcher, June 2003 – Aug. 2003

- Operating High Resolution Powder Diffraction (HRPD) using neutron scattering generated from High-flux Advanced Neutron Application Reactor. Main responsibility for analysis of users' various samples such as magnetic, alloy, and semiconductor materials.

Research Institute of Industrial Science, Hanyang University, Seoul, Korea

Researcher, March, 01, 2002-May, 31, 2003

- Investigator for remote plasma cleaning of Indium Tin Oxide surface for Organic Light Emitting Diode application in cooperative effort with LG Electronics. Effort included examination of chemical and electrical property change of samples processed under varying processing conditions.

Department of Materials Science and Engineering, Hanyang University, Seoul, Korea

Graduate Research Assistant (M.S.), Semiconductor Materials Laboratory, Mar. 02, 2000-Feb. 21, 2002

- Investigator for remote plasma cleaning in Si based Dynamic Random Access Memory (DRAM) process in cooperative effort with Samsung Electronics. Effort included examination of chemical and electrical properties of cleaned Reactive Ion Etching (RIE) samples with high aspect ratio contact and via holes under varying processing conditions.
- Research in development of new wet cleaning process for high aspect ratio Chemical Mechanical Polishing process and via holes in backend process of DRAM device co-worked with Samsung. Effort included analysis of chemical and electrical properties of samples.
- Participant of project of design and production of surface analysis and plasma cleaning equipment. Omicron surface analysis system (AES, XPS and Scanning Tunneling Microscope (STM)) was connected to remote plasma cleaning chamber in the way of in-situ connection.

Publications

• SCI Journal papers (Total No of Paper: 117)

Total Citation: 1813, h-index: 23, i-index: 58 (from Google Scholar)

Selected Paper Lists:

- 1) Il-Han Yoo, Shankara S. Kalanur, and **Hyungtak Seo***, "A nanoscale p/n junction photoelectrode consisting of an NiO_x layer on a TiO₂/CdS nanorod core-shell structure for highly efficient solar watersplitting" *Applied Catalysis B: Environmental* **250**, 5, 200 – 212 (2019) (Published on 1 August 2019, IF=11.698)
- 2) Shankara S. Kalanur, and **Hyungtak Seo***, "Facile growth of compositionally tuned copper vanadate nanostructured thin films for efficient photoelectrochemical water splitting", *Applied Catalysis B: Environmental* **249**, 5, 235 – 245 (2019) (Published on 1 July 2019, IF=11.698)
- 3) Young-Ahn Lee, Seung-Ik Han, Hanju Rhee and **Hyungtak Seo***, "Correlation between excited d-orbital electron lifetime in polaron dynamics and coloration of WO₃ upon ultraviolet exposure" *Applied Surface Science*, **440**, 1244-1251 (2018). (Published on 15 May 2018)
- 4) Seokjae Won, Sang Yeon Lee, Jungyeon Hwang, Jucheol Park, and **Hyungtak Seo***, "Electric Field-Triggered Metal-Insulator Transition Resistive Switching of Bilayered Multiphase VO_x" *Electron. Mater. Lett.* **14**, 14-22 (2018), (Front Cover, Published on 10 January 2018).
- 5) Sang Yeon Lee, Jinseo Kim, Ayoung Park, Jucheol Park and **Hyungtak Seo***, "Creation of a Short-Range Ordered Two-Dimensional Electron Gas Channel in Al₂O₃/In₂O₃ Interfaces" *ACS Nano*, **11**, 6, 6040-6047 (2018)(Published May 18, 2017)
- 6) Seokjae Won, Sang Yeon Lee, Jucheol Park & **Hyungtak Seo***, "Forming-less and Non-Volatile Resistive Switching in WO_x by Oxygen Vacancy Control at Interfaces", *Sci. Rep.* **7**, 10186 (2017) (Published 31 August 2017)
- 7) Kiryung Eom, Uisik Kwon, Shankara S. Kalanur, Hui Joon Park* and **Hyungtak Seo***, "Depth-resolved band alignments of perovskite solar cells with significant interfacial effects" *Journal of Materials Chemistry A* **5**. 2563-2571 (2017) (Published 7th February 2017)
- 8) Shankara S. Kalanur, Il-Han Yoo, Jucheol Park and **Hyungtak Seo**, "Insights into the electronic bands of WO₃/BiVO₄/TiO₂, revealing high solar water splitting efficiency", *Journal of Materials Chemistry A* (2017) **5**. 1455 – 1461. (Front Cover, Published on 28 January 2017).
- 9) Young-Ahn Lee, Shankara S. Kalanura, Gowoon Shima, Jucheol Park, **Hyungtak Seo**, "Highly sensitive gasochromic H₂ sensing by nano – columnal WO₃ – Pd films with surface moisture", *Sensors and Actuators B* **238** (2017) 111 – 119. (Published on 13 July 2016)
- 10) Kalimuthu Vijayarangamuthu, Seungbae- Ahn, **Hyungtak Seo**, Sang-Hee Yoon, Cheol-Min Park, and Ki-Joon Jeon, "Temporpspatial Control of Graphene Wettability", *Adv. Mater.* **2016**, **28**, 661 – 667. (Front Cover, on January 27 2016)
- 11) Myeong-Ho Kim, Young-Ahn Lee, Jinseo Kim, Jucheol Park, Seungbae Ahn, Ki-Joon Jeon, Jeong Won Kim, Duck-Kyun Choi and **Hyungtak Seo**, "Photochemical Hydrogen Doping Induced Embedded Two-Dimensional Metallic Channel Formation in InGaZnO at Room Temperature", *ACS Nano*, **VOL. 9**, **No. 10**, pp. 9964 – 9973 (2015). (*Corresponding Author, Published on September 29, 2015).
- 12) S. Lee, J. Chang, Y. Kim, H. Lim, H. Jeon* and **H. Seo***, "Depth resolved band alignments of ultrathin TiN/ZrO₂ and TiN/ZrO₂-Al₂O₃-ZrO₂ dynamic random access memory capacitors", *Appl. Phys. Lett.* **105**, 201603 (2014). (*Corresponding author, Published on 11/18/2014).
- 13) **H. Seo***, S. Ahn, J. Kim, Y. A. Lee, K. H. Chung, K. J. Jeon*, "Multi-resistive Reduced Graphene Oxide Diode with Reversible Electrochemical Manipulation of Electronic State", *Sci. Rep.* **4**, 5642 (2014). (*Co-corresponding author, Published on 7/10/2014).
- 14) G. Ham, S. Shin, J. Park, H. Choi, Y. A. Lee, **H. Seo***, and H. Jeon*, "Tuning the Electronic Structure of Tin Sulfides Grown by Atomic Layer Deposition", *ACS Appl. Mat. & Int.* **5** (18), 8889–8896 (2013). (*Co-corresponding author, Published on 8/30/2013).
- 15) M. Han , H. Kim , **H. Seo**, B. Ma , and J. W. Park, "Photovoltaic Efficiency Enhancement by the Generation of an Embedded Silica-Like Passivation Layer along the P3HT/PCBM Interface Using an Asymmetric Block-Copolymer Additive " *Adv. Mat.* **24** (47) 6311-6317 (2012). (Published on 09/13/2012)
- 16) Y. K. Lee, C. H. Jung, J. Park, **H. Seo**, G. A. Somorjai, and J. Y. Park, "Surface Plasmon-Driven Hot Electron Flow Probed with Metal-Semiconductor Nanodiodes", *Nano Lett.* **11** (10) 4251-4255 (2011). (Published on 11/09/2011)

- 17) **H. Seo**, L. R. Baker*, A. Hervier, J. Kim, J. L. Whitten, and G. A. Somorjai, "Generation of Highly n-Type Titanium Oxide Using Plasma Fluorine Insertion", *Nano Lett.* **11**, 751-756 (2011). (*Equal Contribution, Published on 12/22/2010)
- 18) **H. Seo**, Y.-J. Cho, J. Kim, S. M. bobade, K.-Y. Park, J. Lee, and D.-K. Choi, "Permanent Optical Doping of Amorphous Metal Oxide Semiconductors by Deep Ultraviolet Irradiation at Room Temperature", *Appl. Phys. Lett.* **96**, 222101-1~3 (2010). (published on 05/31/10)
- 19) **H. Seo**, J. Y. Park, T. Liang, and G. A. Somorjai, "Electrochemically Enhanced Wet Cleaning of Ru Capping Thin Film for EUV Lithography Reflector", *J. Electrochem. Soc.* **157** (11), H414~419 (2010). (published on 02/18/2010)
- 20) **H. Seo**, F. Bellenger, K. B. Chung, M. Houssa, M. Meuris, M. Heyns, and G. Lucovsky, "Extrinsic defects at interfaces of GeO_x/HfO₂ and Al₂O₃ gate stacks on Ge (100) substrates", *J. Appl. Phys.* **106**, 044909 (2009). (Published on 8/26/2009)
- 21) **H. Seo**, G. Lucovsky, L. B. Fleming, M. D. Ulrich, J. Lüning, G. Koster, and T. H. Geballe, "Length scales for coherent π -bonding interactions in complex high-k oxide dielectrics and their interfaces", *Microelec. Eng.* **84** 2298~2301 (2007). (published on 09/01/07)

• Domestic Journal papers (Total No: 7)

Conference Presentations

- 1) International: Total 68
- 2) Domestic: Total 40

Project Funding Accomplishments

Government Funding

1. Development of Foldable Transparent Logic Materials & Devices using Quasi Two-Dimensional Electron Gas Nanocrystalline Semiconductor (준-이차원 전자구름 나노결정 반도체 기반 폴더블 투명 로직 소재 및 소자 개발, 중견연구) Korean National Research Foundation (한국연구재단) 2019.03.01 2024.02.29
2. Wearable sensor platform integrated with deformable and multimodal energy harvesters for Internet-of-Things applications (해외우수신진) Korean National Research Foundation 2018.08.01 2022.12.31
3. Development of Multi-Modal Hydrogen Sensor Applicable to Liquid and Gas Phase (액상과 기상에 동시 적용이 가능한 다중모드 수소센서 모듈 개발, R&D 재발견사업) KIAT (한국산업기술진흥원) 2018.06.01 2019.05.31
4. Development of Hydrogen Safety Sensor Module for Fuel Cell Power Generator (발전형 연료 전지용 수소 안전 센서 모듈 개발/연구성과사업화지원 기술업그레이드 R&D) 연구성과실용화진흥원 2016.06.29 2018.06.28
5. Eye-readable chemochromic liquid/gas leak detection sensor (육안식별용 화학착색식 누수/누설 다중 안전 센서 개발, 기술이전개발사업) 중소기업청 2015.11.01 2017.10.31
6. Development of High Concentration Hydrogen Sensor and Real-time Hydrogen Gas Monitoring System(울산지역주력산업육성과제, Completed Project) 산업통상자원부 2015.08.01 2017.07.31
7. Development of Plasmonic Hot Carrier Solar Cell using Low-Dimension Nanoscale Inorganic Semiconductors (중견연구사업, Completed Project) National Research Funding 2015.05.01 2018.04.30
8. Development of Large Area and Low Temperature Process and 3D Hybrid Device Integration for 2D Materials (나노소재원천과제) Korean National Research Funding 2014.09.01 2019.08.31
- 2 Development of Doping Techniques and Applications for Nanostructured Oxide Semiconductor for Solar Energy Harvesting (Completed Project) Korean National Research Funding 2013.05.01 2015.04.30

Private Company Funding

1. Consulting on development of materials for automated systems (자동화 시스템의 소재 개발에 관한 기술자문) STI. Co. Ltd., (주) STI 2018.04.01 2019.03.31
2. Processing Development of Hydrogen-Detecting Chemochromic Thin Films Applicable as Fuel Cell Vehicle Parts (연료전지 자동차 부품개발 적용을 위한 수소 착색필름 양산공정 개발 자문) Kolon Central Research Center 2016.07.01 2016.12.31
3. Process and Analysis technique Development for enhancing TiN Electrode-based Capacitor Property (Completed Project) Samsung Electronics 2014.03.01 2016.02.29
4. Research on analysis of front-end unit devices and defects using next generation wafer(Completed Project) LG Siltron 2013.06.01 2014.05.31
5. Development of Hydrogen-Detecting Chemochromic Thin Films (Completed project) 현대 NGV 2013.03.01 2015.02.28
6. Analysis of Electronic band structure and band-offset of Buffer Layer to improve CIGS solar cell efficiency (Completed Project) LG 이노텍 2013.03.01 2013.12.31

Patent & Technology Transfer

- 1) Domestic Patents: Registered 19
- 2) International Patents: Registered 3
- 3) [Technology Transfer: Domestic 4 \(Gaon Industry Co., Ltd., Rayence Co., Ltd., Grademis Co. Ltd, NexusBe Co. Ltd: Accumulative Transfer Charge Deposit: 130,000,000 KRW\)](#)

Awards, Honors, and Activities

- 1) Best Research-Performing Faculty in 2017/2018 [Grantor: College of Engineering, Ajou University] (2018/2019)
- 2) Best 100 Future Technologies and Inventors for Korea, 2025 [Grantor: The National Academy of Engineering of Korea] (2017)
- 3) Best Faculty in Technical Transfer [Grantor: Ajou University] (2016)
- 4) Editorial Board Member for Korean Journal of Materials Research (2016-)
- 5) Best Presentation Award in IUMRS-ICAM 2014 [Grantor: IUMRS] (2014)
- 6) Best 100 National R&D Award [Grantor: Ministry of Education and Science & Technology] (2013)
- 7) Membership at NC State Chapter of *The Honor Society of Phi Kappa Phi*. (2005. 10. 31~)
- 8) National scholarship awarded to abroad graduate student [Grantor: Korean Ministry of Science and Technology] (2004. 8 – 2006. 8)
- 9) 한국재료학회, 편집이사 (2016-현재)
- 10) 한국센서학회, 산합협력이사 (2019-현재)