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Education

- **Ph.D.** (Advanced Materials Science and Engineering, Sungkyunkwan University, South Korea)
 - (1) Period: (March, 2015 – February, 2018)
 - (2) Advisor: Prof. Geun Young Yeom
- **M.S.** (Advanced Materials Science and Engineering, Sungkyunkwan University, South Korea)
 - (1) Period: (March, 2013 – February, 2015)
 - (2) Advisor: Prof. Geun Young Yeom
- **B.S.** (School of Electronic Materials Engineering, Suwon University, South Korea)
 - (1) Period: (March, 2007 – February, 2013)

Research Experiences

- **Research Scientist**
(Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, MA, USA)
 - (1) Period: (August, 2023 – Present)

- **Postdoctoral Associate**
(Research Laboratory of Electronics, Massachusetts Institute of Technology, Cambridge, MA, USA)
 - (1) Period: (February, 2020 – July, 2023)
 - (2) Advisor: Prof. Jeehwan Kim
(Research Center for Advanced Materials Technology, Sungkyunkwan University, South Korea)
 - (3) Period: (March, 2018 – January 2020)
 - (4) Advisor: Prof. Geun Young Yeom

Research Interest

- **Seamless monolithic 3D integration of single-crystalline films**
- **Vertical CMOS Architecture (Complementary-FET, Ring Oscillators, SRAM)**
- **Fabrication of 3D multi-nano-bridge structures and BEOL compatible synthesis of 2D/3D materials**

Technical Skills

Monolithic 3D integration

- **[Channel Growth]**
 - (1) Non-epitaxial wafer-scale single-crystalline 2D/3D materials growth
 - CVD, LPCVD, MOCVD and PECVD
 - (2) BEOL compatible (<400 °C) single-crystalline 2D growth
 - CVD and MOCVD with confined trenches
 - **[Device/Array Fabrication]**
 - (1) Fabrication of high-density vertical CMOS (Complementary-FET, Ring Oscillators, SRAM)
 - AS200 i-line Stepper, MLA150 Maskless Aligner, and SUSS MA6 Mask Aligner
 - (2) Fabrication of 3D multi-nano-bridge structure and low-thermal-budget synthesis (MBCFET)
 - Selective patterning, deposition, etching, and contact
 - **[Etching / Doping / Deposition]**
 - (1) Damage-free selective atomic layer etching of 2D/3D materials
 - Lateral heterojunction and recess process
 - (2) Doping (Amorphization/Recrystallization with dopant layer)
 - Well-doping (V_{th} control) and highly-doping (I_{on} , SS)
 - (3) Thin film deposition (Si_3N_4 , SiO_2 , poly-Si, Al_2O_3 , and HfO_2)
 - CVD, PECVD, very high frequency (VHF)-PECVD, laser assisted (LA)-PECVD, ALD, and PEALD
 - **[Development of Semiconductor Processing Equipment]**
 - (1) Development of dry etching system
 - ICP/CCP-type, VHF (30~162MHz), dual frequency (2 MHz and 13.56 MHz), and pulsed system
 - (2) Development of deposition system
 - Large-area, low- T , high density, and remote (multi-tile push-pull) plasma system
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Journal Publications

[1st author, † Equal contribution, *Corresponding]

1. *Nature* (under revision)
Seamless monolithic three-dimensional integration of single-crystalline films by growth
[Ki Seok Kim](#)†, Seunghwan Seo†, Junyoung Kwon†, Doyoon Lee†, Changhyun Kim†, Jung-El Ryu, Jekyung Kim, Jun Min Suh, Hang-Gyo Jung, Youhwan Jo, June-Chul Shin, Min-Kyu Song, Jin Feng, Hogeun Ahn, Sangho Lee, Kyeongjae Cho, Jongwook Jeon, Minsu Seol, Jin-Hong Park, Sang Won Kim, and Jeehwan Kim*
2. *Nature Nanotechnology* (online publish) doi.org/10.1038/s41565-024-01695-1
The future of 2D semiconductors beyond Moore's law
[Ki Seok Kim](#)†, Junyoung Kwon†, Huije Ryu†, Changhyun Kim†, Hyunseok Kim†, Eun-Kyu Lee, Doyoon Lee, Seunghwan Seo, Ne Myo Han, Jun Min Suh, Jekyung Kim, Min-Kyu Song, Sangho Lee, Minsu Seol, and Jeehwan Kim*
3. *Nature Electronics* 7, 416-418 (2024)
2D materials unlock single-crystal-based monolithic 3D integration
Kuangye Lu^{1,2}, Jaewoo Shim^{3,4}, [Ki Seok Kim](#)*, Sang Won Kim* and Jeehwan Kim*
4. *Nature Materials* 22, 1470-1477 (2023), selected as a front cover
Monolithic 3D integration of 2D materials-based electronics towards ultimate edge computing solutions
Ji-Hoon Kang†, Heechang Shin†, [Ki Seok Kim](#)†, Min-Kyu Song†, Doyoon Lee, Yuan Meng, Chanyeol Choi, Jun Min Suh, Beom Jin Kim, Hyunseok Kim, Anh Tuan Hoang, Bo-In Park, Guanyu Zhou, Suresh Sundaram, Jiho Shin, Jinyeong Choe, Zhihao Xu, Rehan Younas, Justin S. Kim, Sangmoon Han, Sangho Lee, Beomseok Kang, Seungju Seo, Hyojung Ahn, Seunghwan Seo, Hyun S. Kum, Peng Lin, Christopher Hinkle, Abdallah Ougazzaden, Jong-Hyun Ahn, Jeehwan Kim, and Sang-Hoon Bae
5. *Science Advances* 9, eadj5379 (2023)
Remote epitaxial interaction through graphene
Celesta S. Chang†, [Ki Seok Kim](#)†, Bo-In Park†, Joonghoon Choi†, Hyunseok Kim, Junseok Jeong, Matthew Barone, Nicholas Parker, Sangho Lee, Kuangye Lu, Junmin Suh, Jekyung Kim, Doyoon Lee, Ne Myo Han, Mingi Moon, Yun Seog Lee, Dong-Hwan Kim, Darrell G. Schlom, Young Joon Hong, and Jeehwan Kim
6. *Nature* 618, 88-94 (2023)
Non-epitaxial single-crystal 2D material growth by geometrical confinement
[Ki Seok Kim](#)†, Doyoon Lee†, Celesta S. Chang†, Seunghwan Seo, Yaoqiao Hu, Soonyoung Cha, Hyunseok Kim, Jiho Shin, Ju-Hee Lee, Sangho Lee, Justin S. Kim, Ki Hyun Kim, Jun Min Suh, Yuan Meng, Bo-In Park, Jung-Hoon Lee, Hyung-Sang Park, Hyun S. Kum, Moon-Ho Jo, Geun Young Yeom, Kyeongjae Cho, Jin-Hong Park, Sang-Hoon Bae and Jeehwan Kim

7. *Nature Communications* 10, 4701 (2019)
Ultrasensitive MoS₂ photodetector by serial nano-bridge multi-heterojunction
[Ki Seok Kim](#)[†], You Jin Ji[†], Ki Hyun Kim, Seunghyuk Choi, Dong-Ho Kang, Keun Heo, Seongjae Cho, Soonmin Yim, Sungjoo Lee, Jin-Hong Park, Yeon Sik Jung, Geun Young Yeom
8. *ACS Applied Electronic Materials* 4, 3794-3800 (2022)
Atomic Layer Engineering of TMDs by Modulation of Top Chalcogen Atoms: For Electrical Contact and Chemical Doping
[Ki Seok Kim](#)[†], Ki Hyun Kim[†], Ji Eung Kang, Ju-Hee Lee, You Jin Ji, and Geun Young Yeom
9. *APL Materials* 10, 041105, (2022)
Atomic layer-by-layer etching of graphene directly grown on SrTiO₃ substrates for high-yield remote epitaxy and lift-off
[Ki Seok Kim](#)[†], Ji Eun Kang[†], Peng Chen[†], Sungkyu Kim, Jongho Ji, Geun Young Yeom, Jeehwan Kim, and Hyun S. Kum
10. *Micromachines* 13, 173 (2022)
Deposition of very-low-hydrogen-containing silicon at a low temperature using very-high-frequency (162 MHz) SiH₄ plasma
[Ki Seok Kim](#)[†], You Jin Ji[†], Ki Hyun Kim[†], Ji Eung Kang, Albert Rogers Ellingboe, and Geun Young Yeom
11. *Applied Surface Science* 541, 148313 (2021)
Silicon nitride deposited by laser assisted plasma enhanced chemical vapor deposition for next generation organic electronic devices
Ki Hyun Kim[†], [Ki Seok Kim](#)[†], You Jin Ji, Ji Eung Kang, Geun Young Yeom
12. *Applied Surface Science* 506, 144904 (2020)
Nitriding process for next-generation semiconductor devices by VHF (162 MHz) multi-tile push-pull plasma source
You Jin Ji[†], [Ki Seok Kim](#)[†], Ki Hyun Kim, Albert Rogers Ellingboe, Geun Young Yeom
13. *ECS Transactions* 86, 69-74 (2018)
Layer Control of 2D-MoS₂ by Atomic Layer Etching and Its Device Characteristics
[Ki Seok Kim](#), Ki Hyun Kim, You Jin Ji, and Geun Young Yeom
14. *Scientific Reports* 7, 13585 (2017)
Silicon nitride deposition for flexible organic electronic devices by VHF (162 MHz)-PECVD using a multi-tile push-pull plasma source
[Ki Seok Kim](#)[†], Ki Hyun Kim[†], You Jin Ji, Jin Woo Park, Jae Hee Shin, Albert Rogers Ellingboe, Geun Young Yeom
15. *Scientific Reports* 7, 2462 (2017)

Atomic layer etching of graphene through controlled ion beam for graphene-based electronics

[Ki Seok Kim](#), You Jin Ji, Yeonsig Nam, Ki Hyun Kim, Eric Singh, Jin Yong Lee, and Geun Young Yeom

16. *ACS Applied Materials & Interfaces* 9, 11967-11976 (2017)

Atomic Layer Etching Mechanism of MoS₂ for Nanodevices

[Ki Seok Kim](#), Ki Hyun Kim, Yeonsig Nam, Jaeho Jeon, Soonmin Yim, Eric Singh, Jin Yong Lee, Sung Joo Lee, Yeon Sik Jung, Geun Young Yeom, Dong Woo Kim

17. *Journal of Physics D: Applied Physics* 49, 395201 (2016)

Characteristics of silicon nitride deposited by VHF (162 MHz)-plasma enhanced chemical vapor deposition using a multi-tile push-pull plasma source

[Ki Seok Kim](#), Nishant Sirse, Ki Hyun Kim, Albert Rogers Ellingboe, Kyong Nam Kim, and Geun Young Yeom

18. *Carbon* 104, 119-124 (2016)

Surface treatment process applicable to next generation graphene-based electronics

[Ki Seok Kim](#), Hyo-Ki Hong, Hanearl Jung, Il-Kwon Oh, Zonghoon Lee, Hyungjun Kim, Geun Young Yeom, and Kyong Nam Kim

19. *Applied Physics Letters* 108, 213102 (2016)

Atomic layer deposition of HfO₂ on graphene through controlled ion beam treatment

[Ki Seok Kim](#), Il-Kwon Oh, Hanearl Jung, Hyungjun Kim, Geun Young Yeom, and Kyong Nam Kim

[Co-author]

20. *Advanced Materials* 2310015 (2024)

Junctionless Negative-Differential-Resistance Device using 2D Van-Der-Waals Layered Materials for Ternary Parallel Computing

Taeran Lee, Kil-Su Jung, Seunghwan Seo, Junseo Lee, Jihye Park, Sumin Kang, Jeongwon Park, Juncheol Kang, Hogeun Ahn, Suhyun Kim, Hae Won Lee, Doyoon Lee, [Ki Seok Kim](#), Hyunseok Kim, Keun Heo, Sunmean Kim, Sang-Hoon Bae, Seokhyeong Kang, Kibum Kang, Jeehwan Kim, Jin-Hong Park

21. *Nature Nanotechnology* 18, 464-470 (2023)

High-throughput manufacturing of epitaxial membranes from a single wafer by 2D materials-based layer transfer process

Hyunseok Kim[†], Yunpeng Liu[†], Kuangye Lu[†], Celesta S. Chang[†], Dongchul Sung, Marx Akl, Kuan Qiao, [Ki Seok Kim](#), Bo-In Park, Menglin Zhu, Jun Min Suh, Jekyung Kim, Junseok Jeong, Yongmin Baek, You Jin Ji, Sungsu Kang, Sangho Lee, Ne Myo Han, Chansoo Kim, Chanyeol Choi, Xinyuan Zhang, Hyeong-Kyu Choi, Yanming Zhang, Haozhe Wang, Lingping Kong, Nordin Noor Afeefah, Mohamed Nainar Mohamed Ansari, Jungwon Park, Kyusang Lee, Geun Young Yeom, Sungkyu Kim, Jinwoo Hwang, Jing Kong, Sang-Hoon Bae,

Yunfeng Shi, Suklyun Hong, Wei Kong, and Jeehwan Kim.

22. *Nature* 614, 81-87 (2023)

Vertical full-colour micro-LEDs via 2D materials-based layer transfer

Jiho Shin†, Hyunseok Kim†, Suresh Sundaram†, Junseok Jeong†, Bo-In Park, Celesta S. Chang, Joonghoon Choi, Taemin Kim, Mayuran Saravanapavanantham, Kuangye Lu, Sungkyu Kim, Jun Min Suh, **Ki Seok Kim**, Min-Kyu Song, Yunpeng Liu, Kuan Qiao, Jae Hwan Kim, Yeongin Kim, Ji-Hoon Kang, Jekyung Kim, Doeon Lee, Jaeyong Lee, Justin S. Kim, Han Eol Lee, Hanwool Yeon, Hyun S. Kum, Sang-Hoon Bae, Vladimir Bulovic, Ki Jun Yu, Kyusang Lee, Kwanghun Chung, Young Joon Hong, Abdallah Ougazzaden, and Jeehwan Kim.

23. *Nature Nanotechnology* 17, 1054-1059, (2022)

Graphene nanopattern as a universal epitaxy platform for single-crystal membrane production and defect reduction

Hyunseok Kim†, Sangho Lee†, Jiho Shin†, Menglin Zhu, Marx Akl, Kuangye Lu, Ne Myo Han, Yongmin Baek, Celesta S. Chang, Jun Min Suh, **Ki Seok Kim**, Bo-In Park, Yanming Zhang, Chanyeol Choi, Heechang Shin, He Yu, Yuan Meng, Seung-Il Kim, Seungju Seo, Kyusang Lee, Hyun S. Kum, Jae-Hyun Lee, Jong-Hyun Ahn, Sang-Hoon Bae, Jinwoo Hwang, Yunfeng Shi, and Jeehwan Kim.

24. *Surfaces and Interfaces* 33, 102219, (2022)

Low temperature silicon nitride grown by very high frequency (VHF, 162 MHz) plasma enhanced atomic layer deposition with floating multi-tile electrode

You Jin Ji, Hae In Kim, Ki Hyun Kim, Ji Eun Kang, Doo San Kim, **Ki Seok Kim**, AR Ellingboe, Dong Woo Kim, and Geun Young Yeom.

25. *Advanced Materials* 34, 2202799, (2022)

A Van Der Waals Reconfigurable Multi-Valued Logic Device and Circuit Based on Tunable Negative-Differential-Resistance Phenomenon

Seunghwan Seo†, Jeong-Ick Cho†, Kil-Su Jung†, Maksim Andreev, Ju-Hee Lee, Hogeun Ahn, Sooyoung Jung, Taeran Lee, Byeongchan Kim, Seojoo Lee, Juncheol Kang, Kyeong-Bae Lee, Ho-Jun Lee, **Ki Seok Kim**, Geun Young Yeom, Keun Heo, and Jin-Hong Park.

26. *Scientific Reports*, 12, 5703, (2022)

Selective etching of silicon nitride over silicon oxide using ClF_3/H_2 remote plasma

Won Oh Lee†, Ki Hyun Kim†, Doo San Kim, You Jin Ji, Ji Eun Kang, Hyun Woo Tak, Jin Woo Park, Han Dock Song, **Ki Seok Kim**, Byeong Ok Cho, Young Lae Kim, and Geun Young Yeom.

27. *Advanced Materials* 33, 2102980 (2021)

An Optogenetics-Inspired Flexible van der Waals Optoelectronic Synapse and its Application to a Convolutional Neural Network

Seunghwan Seo, Je-Jun Lee, Ryong-Gyu Lee, Tae Hyung Kim, Sangyong Park, Kil-Su Jung, Seyong Oh,

Ho-Jun Lee, Hyun-Kyu Lee, **Ki Seok Kim**, Geun Young Yeom, Young-Hoon Kim, and Jin-Hong Park.

28. *ACS Nano* 15, 10587-10596 (2021)

Impact of 2D–3D Heterointerface on Remote Epitaxial Interaction through Graphene

Hyunseok Kim, Kuangye Lu, Yunpeng Liu, Hyun S Kum, **Ki Seok Kim**, Kuan Qiao, Sang-Hoon Bae, Sangho Lee, You Jin Ji, Ki Hyun Kim, Hanjong Paik, Saien Xie, Heechang Shin, Chanyeol Choi, June Hyuk Lee, Chengye Dong, Joshua A Robinson, Jae-Hyun Lee, Jong-Hyun Ahn, Geun Young Yeom, Darrell G Schlom, and Jeehwan Kim.

29. *Nanotechnology* 32, 075706 (2020)

Characteristics of Silicon Nitride Deposited by Very High Frequency (162 MHz)-Plasma Enhanced Atomic Layer Deposition using Bis (diethylamino) silane

Ji Young Byun, You Jin Ji, Ki Hyun Kim, **Ki Seok Kim**, Hyun Woo Tak, Albert Rogers Ellingboe, and Geun Young Yeom.

30. *Advanced Science* 7, 2000991 (2020)

Double Negative Differential Resistance Device Based on Hafnium Disulfide/Pentacene Hybrid Structure

Kil-Su Jung†, Keun Heo†, Min-Je Kim, Maksim Andreev, Seunghwan Seo, Jin-Ok Kim, Ji-Hye Lim, Kwan-Ho Kim, Sungho Kim, **Ki Seok Kim**, Geun Young Yeom, Jeong Ho Cho, and Jin-Hong Park.

31. *Small* 16, 1905000 (2020)

Wafer-Scale and Low-Temperature Growth of 1T-WS₂ Film for Efficient and Stable Hydrogen Evolution Reaction

Hyeong-U Kim, Vinit Kanade, Mansu Kim, **Ki Seok Kim**, Beyeong-Seon An, Hyunho Seok, Hocheon Yoo, Seung-Il Kim, Cheol-Woong Yang, Geun Yong Yeom, Dongmok Whang, Jae-Hyun Lee, and Taesung Kim.

32. *Journal of Materials Chemistry C* 8, 1846-1851 (2020)

Effect of large work function modulation of MoS₂ by controllable chlorine doping using a remote plasma

Ki Hyun Kim, **Ki Seok Kim**, You Jin Ji, Inyong Moon, Keun Heo, Dong-Ho Kang, Kyong Nam Kim, Won Jong Yoo, Jin-Hong Park, and Geun Young Yeom.

33. *Applied Surface Science* 470, 129-134 (2019)

Low-temperature wafer-scale growth of MoS₂-graphene heterostructures

Hyeong-U Kim, Mansu Kim, Yinhua Jin, Yuhwan Hyeon, **Ki Seok Kim**, Byeong-Seon An, Cheol-Woong Yang, Vinit Kanade, Ji-Yun Moon, Geun Yong Yeom, Dongmok Whang, Jae-Hyun Lee, and Taesung Kim.

34. *ACS Applied Materials & Interfaces* 11, 11061-11105 (2019)

Flexible Molybdenum Disulfide (MoS₂) Atomic Layers for Wearable Electronics and Optoelectronics

Eric Singh, Pragya Singh, **Ki Seok Kim**, Geun Young Yeom, and Hari Singh Nalwa.

35. *RSC Advances* 8, 39749-39755 (2018)
Hierarchical nanostructures of nitrogen-doped molybdenum sulphide for supercapacitors
Chaitanya Kanade, Sudhir Arbuj, Kaluram Kanade, **Ki Seok Kim**, Geun Young Yeom, Taesung Kim, and Bharat Kale.
36. *Journal of Physics D: Applied Physics* 50, 254007 (2017)
Atomic layer etching of InGaAs by controlled ion beam
Jin Woo Park, Doo San Kim, Mu Kyeom Mun, Won Oh Lee, **Ki Seok Kim**, and Geun Young Yeom.
37. *Nanotechnology* 28, 175601 (2017)
Highly uniform wafer-scale synthesis of α -MoO₃ by plasma enhanced chemical vapor deposition
Hyeong-U Kim, Juhyun Son, Atul Kulkarni, Chisung Ahn, **Ki Seok Kim**, Dongjoo Shin, Geun Yong Yeom, and Taesung Kim.
38. *ACS Applied Materials & Interfaces* 9, 3223-3245 (2017)
Atomically Thin-Layered Molybdenum Disulfide (MoS₂) for Bulk-Heterojunction Solar Cells
Eric Singh, **Ki Seok Kim**, Geun Young Yeom, and Hari Singh Nalwa.
39. *Journal of Materials Chemistry C* (2017)
Layer-controlled thinning of black phosphorus by an Ar ion beam
Jin Woo Park, Sung Kyu Jang, Dong Ho Kang, Doo San Kim, Min Hwan Jeon, Won Oh Lee, **Ki Seok Kim**, Sung Joo Lee, Jin-Hong Park, Kyong Nam Kim, and Geun Young Yeom.
40. *RSC Advances* 7, 28234-28290 (2017)
Two-dimensional transition metal dichalcogenide-based counter electrodes for dye-sensitized solar cells
Eric Singh, **Ki Seok Kim**, Geun Young Yeom, and Hari Singh Nalwa.
41. *Science of Advanced Materials* 8, 884-890 (2016)
Low energy BCl₃ plasma doping of few-layer graphene
Viet Phuong Pham, Doo San Kim, **Ki Seok Kim**, Jin Woo Park, Kyung Chae Yang, Se Han Lee, Geun Young Yeom, and Kyong Nam Kim.
42. *Japanese Journal of Applied Physics* 54, 01AA10 (2014)
Characteristics of pulsed dual frequency inductively coupled plasma
Jin Seok Seo, Kyong Nam Kim, **Ki Seok Kim**, Tae Hyung Kim, and Geun Young Yeom.
43. *Journal of nanoscience and nanotechnology* 14, 9108-9113 (2014)
Graphene treatment using a very low energy Ar⁺ ion beam for residue removal
Kyoung Seok Min, **Ki Seok Kim**, Kyong Nam Kim, Anurag Mishra, and Geun Young Yeom.
44. *Nanoscale* 6, 15301-15308 (2014)
Cyclic chlorine trap-doping for transparent, conductive, thermally stable and damage-free graphene

Viet Phuong Pham, Kyong Nam Kim, Min Hwan Jeon, **Ki Seok Kim**, and Geun Young Yeom.

45. *Journal of nanoscience and nanotechnology* 13, 8064-8069 (2013)

Enhanced Light Extraction from GaN-Based Vertical Light-Emitting Diodes with a Nano-Roughened N-GaN Surface Using Dual-Etch

Tae Hyung Kim, Kyong Nam Kim, Jin Seok Seo, **Ki Seok Kim**, Jeong Oun Bae, and Geun Young Yeom.

46. *Journal of nanoscience and nanotechnology* 13, 8106-8109 (2013)

Formation of Gallium Vacancies and Their Effects on the Nanostructure of Pd/Ir/Au Ohmic Contact to p-Type GaN

Kyong Nam Kim, Tae Hyung Kim, Jin Seok Seo, **Ki Seok Kim**, Jeong Woon Bae, and Geun Young Yeom.

Patents (USA and South Korea)

(Patent Grant)

1. (USA) “Confined growth of 2D materials and their heterostructures” Jeehwan Kim, Kiseok Kim, Sanghoon Bae, **US 2024/0071759 A1**, (February 29, 2024)
2. (USA) “Photoelectronic device, photodiode, and phototransistor” Geun Young Yeom, **Ki Seok Kim**, Ki Hyun Kim, You Jin Ji, Ji Young Byun, **US16800121**, (August 23, 2022)
3. (USA) “Plasma source and plasma generation apparatus using the same” Geun Young Yeom, Ki Hyun Kim, **Ki Seok Kim**, You Jin Ji, Jin Woo Park, Doo San KIM, Won Oh Lee, Chang Hoon Song, Ji Young Byun, Ji Soo Oh, Hyun Woo Tak, **US11127570**, (September 21, 2021)
4. (USA) “Ion beam etching apparatus” Geun Young Yeom, Jin Woo Park, Doo San Kim, Jong Sik Oh, Da In Sung, You Jin Ji, Won Oh Lee, Mu Kyeom Mun, Kyung Chae Yang, **Ki Seok Kim**, Ji Soo Oh, Ki Hyun Kim, **US11120975**, (September 14, 2021)
5. (South Korea) “PHOTOELECTRONIC DEVICE, PHOTODIODE, AND PHOTOTRANSISTOR” Geun Young Yeom, **Ki Seok Kim**, Ki Hyun Kim, You Jin Ji, Ji Young Byun, **KR10-2214673**, (February 4, 2021)
6. (South Korea) “PELLICLE STRUCTURE AND METHOD OF MANUFACTURING THE PELLICLE STRUCTURE” Geun Young Yeom, **Ki Seok Kim**, Jong Sik Oh, Ki Hyun Kim, You Jin Ji, Ji Young Byun, Jin Woo Park, Doo San Kim, Won Oh Lee, **KR10-2247692**, (April 27, 2021)
7. (USA) “Semiconductor device, photoelectronic device, and method for manufacturing transition-metal dichalcogenide thin film” Geun Youn Yeom, **Ki Seok Kim**, Ki Hyun Kim, Jin Woo Park, Doo San Kim, You Jin Ji, **US10593819**, (March 17, 2020)

8. (South Korea) “Ion beam etching apparatus”, Geun Youn Yeom, Jin Woo Park, Doo San Kim, Jong Sik Oh, Da In Sung, You Jin Ji, Won Oh Lee, Mu Kyeom Mun, Kyung Chae Yang, **Ki Seok Kim**, Ji Soo Oh, Ki Hyun Kim, **KR10-1939481**, (January 10, 2019)
9. (South Korea) “Semiconductor device, photoelectronic device, and method of manufacturing transition metal dichalcogenide thin film” Geun Youn Yeom, **Ki Seok Kim**, Ki Hyun Kim, Jin Woo Park, Doo San Kim, You Jin Ji, **KR10-1853588**, (April 24, 2018)
10. (South Korea) “Plasma source and plasma generation apparatus using the same” Geun Youn Yeom, Ki Hyun Kim, **Ki Seok Kim**, You Jin Ji, Jin Woo Park, Doo San Kim, Won Oh Lee, **KR10-1932859**, (December 19, 2018)
11. (South Korea) “Method for hardening surface of block copolymer” Geun Youn Yeom, Kyong Nam Kim, **Ki Seok Kim**, Ji Soo Oh, Sang Wook Choi, **KR10-1843622**, (March 23, 2018)
12. (South Korea) “Inductively coupled plasma source for improving sputter yield and apparatus for sputtering using the same” Geun Youn Yeom, Kyong Nam Kim, Tae Hyung Kim, Jin Seok Seo, **Ki Seok Kim**, **KR10-1556830**, (September 23, 2015)
13. (South Korea) “Low-damage plasma processing apparatus” Geun Youn Yeom, **Ki Seok Kim**, Kyong Nam Kim, Tae Hyung Kim, Tai Zhe Lin, Jae Hee Shin, Ki Hyun Kim, Doo San Kim, **KR10-1547066**, (August 18, 2015)

(Patent Application)

14. (USA) “Method of etching atomic layer” Geun Young Yeom, Kyong Nam Kim, **Ki Seok Kim**, Mu Kyeom Mun, Jun Woo Park, Deok Hyeon Yun, Jo Won Lee, **US15/498, 680**, (November 02, 2017)