DEPARTMENT NEWS

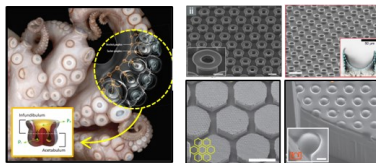### Prof. Sangyul Baik, appointed starting fall semester 2022

Hi! I am Sangyul Baik (백상열) who was appointed as an assistant professor in the Department of Mechanical Engineering at Sungkyunkwan University (SKKU) in September 2022. I gloriously received my B.S. (2015) and Ph.D. (2020) degrees in the Department of Chemical Engineering from the SKKU and then went to the Department of Mechanical Engineering at MIT for a postdoctoral associate (2022). During my trainee course, bioinspired systems with micro-/nano-scaled 3D architectures have been developed to skin-attachable, implantable, or ingestible bioelectronic devices for smart diagnostic and therapeutic purposes.

My vision for next advancement at SKKU is to develop soft active materials and robotic devices that can be actively/long-term installed and dynamically moved in a living body, integrated with my research background of (1) bioinspired interface design and structuring and (2) intelligent soft materials (e.g., the smart adhesives, multi-programming soft actuators, and soft nanocomposites for electrical and energy devices). Such fusion technology of new structures and materials can be widely applied to the biomedical industry, causing a large industrial impact and a new paradigm in various fields of new medical materials, bio-health devices, and new energy systems.
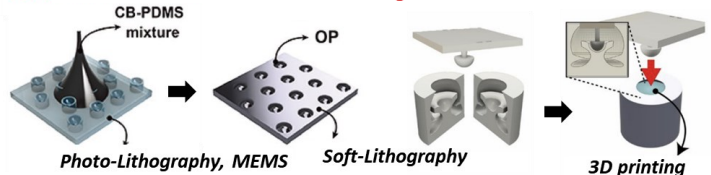
With great honor to start my research career at SKKU, I pursue to grow untiringly as a mentor and a peer researcher who inspires students, understands their struggles, and encourages them to obtain knowledge and to innovate. If interested in my research or lab, please do not hesitate to contact me at *bsy7863@skku.edu*.
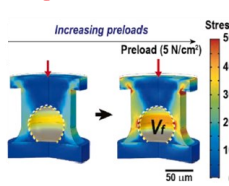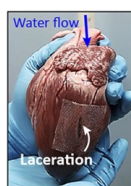
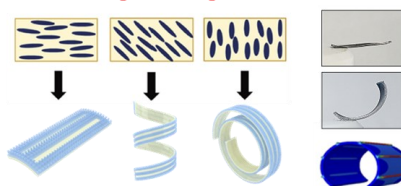**Bioinspired Interface Design & Structuring**

● **Bioinspired Multiscale Design**

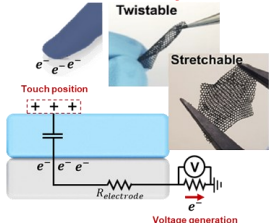● **Hierarchical Structure Manufacturing**

CB-PDMS mixture → OP

Photo-Lithography, MEMS *Soft-Lithography* *3D printing*

Intelligent Soft Materials

● **Controllable, Tough Bioadhesives**

Water flow

Increasing preloads — Preload (5 N/cm²)

Stress 500 400 300 200 100 0

Laceration V_i 50 μm

● **Multi-Programming Soft Actuators**

● **Soft Nanocomposites**

Twistable

Stretchable

Touch position

e^- e^- e^- $R_{electrode}$ e^- Voltage generation

Smart Devices with Functional Interfaces

● **Smart Devices with AI-Based Frameworks**

Intelligent pH evaluation
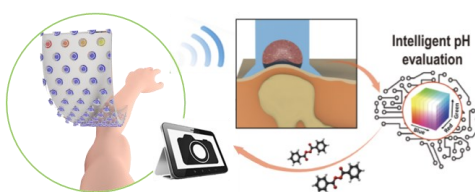
● **Biomedical Soft-, Small-Sized Robotics**

Irregular + Soft

Soft + Slippery

RESEARCH FOCUS

Prof. Taesung Kim receives funding, the Leader Research, from KRF. (800M Won/year for 9 years)

Prof. Taesung Kim's project on plasma process systemization received funding from the Leader Research project. In a chemical vapor deposition (CVD) process, which is a typical method for synthesizing a 2D-materials, necessary chemicals are decomposed by heat energy to produce gas species, which induce triangle shape nucleation at substrate, thereby having issues of low yield and uniformity. Since the chemicals inside the reactor are decomposed at a high temperature (600-900°C), it is impossible to deposit 2D materials on the flexible substrate (melting point under 200°C). Also, due to the high-temperature processes and monotonous parameters, limited synthesis of stable characteristics and shape is only available.

In this research proposal, Prof. Kim introduced plasma-assisted ion bombardment for low-temperature/large scale 2D-materials synthesis and aimed to implement plasma-control system for customized characteristics of 2D-materials. 2D-materials properties are modulated based on controllable plasma condition using diagnosis tool, and the correlation between 'plasma condition'-'materials properties'-'device performance' is analyzed with experimental and computational data. This research will be performed over the next 9 years and is expected to make a significant scientific advancement in commercialization of 2D-materials at semiconductor industry.
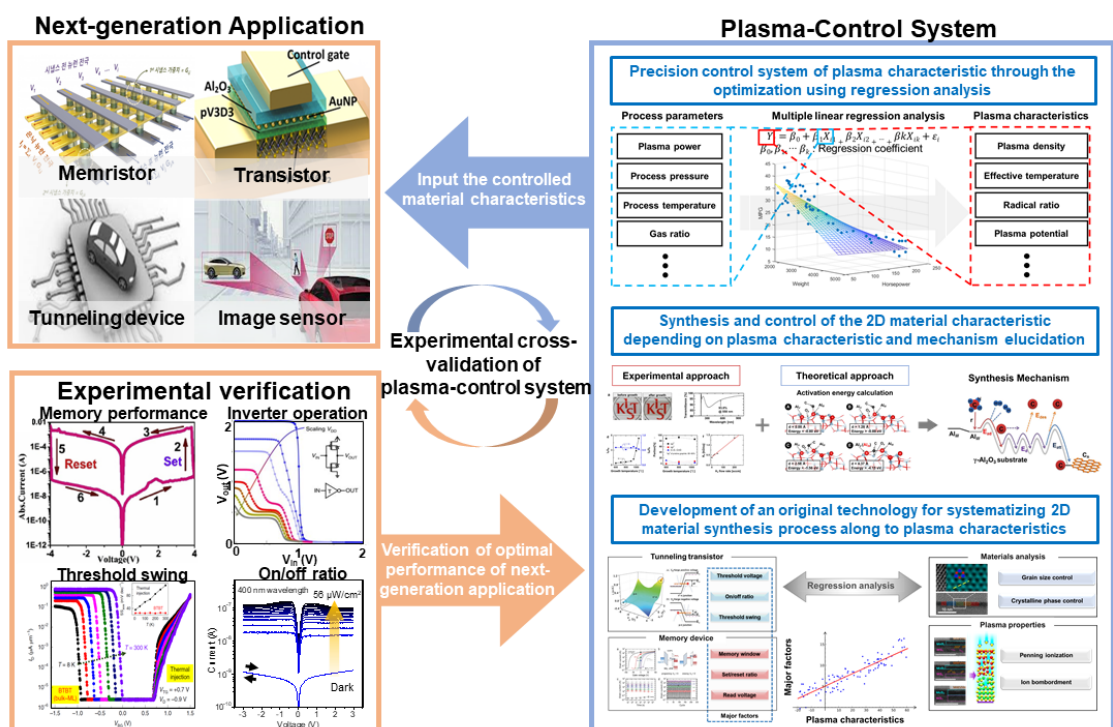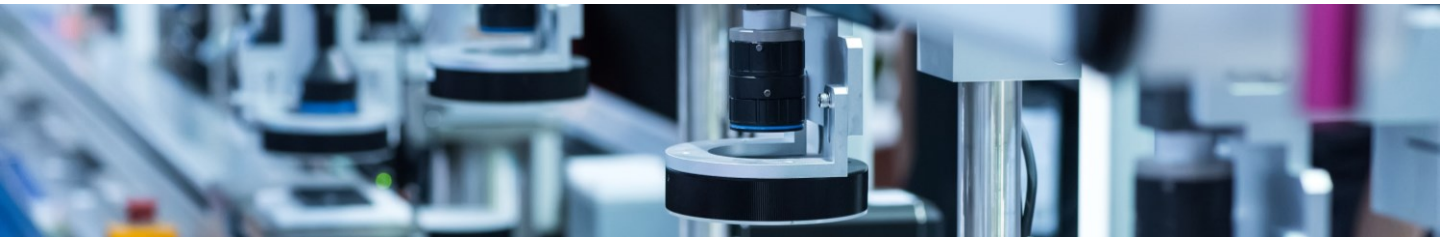
RESEARCH FOCUS

Gas Dynamics Laboratory selected as a for the development of core technologies in the construction of unconventional oil production plants

Gas dynamics laboratory whose advisor is Youn-Jea Kim, in our department was selected as a research institute to participate in the development of core technologies for construction of unconventional oil production plants, a national R&D project of the Ministry of Land, Infrastructure and Transport. The research topic is the collection and separation facility technology development of oil-containing multi-phase mixtures, and a total of 47 institutions, led by Sungkyunkwan University, will participate, and run for a total of seven years from April this year to 2028.

Unconventional oil refers to oil that is mined through a new method, away from the existing oil mining method, and includes shale oil and oil sands. Oil sands is extracted by adding high temperature steam in the form of a mixture of high viscosity bitumen and clay, and purified through desander, three-phase oil and water separator (a.k.a. FWKO), and desalter facilities.


The purpose of this project is to develop and demonstrate core technologies of unconventional oil production and transfer plants and secure technological competitiveness, to provide opportunities for entering the plant construction market of unconventional oil, establish energy security, and to solve exhaustion of fossil fuel.

Professor Youn-Jea Kim's laboratory participates in the collection of oil-containing multi-phase mixtures and the development of separation facilities technology among the main areas of this project. Gas dynamics lab will conduct the research on design technology development through flow analysis, securing design factors, DB construction, and optimization of three-phase oil and water separators.
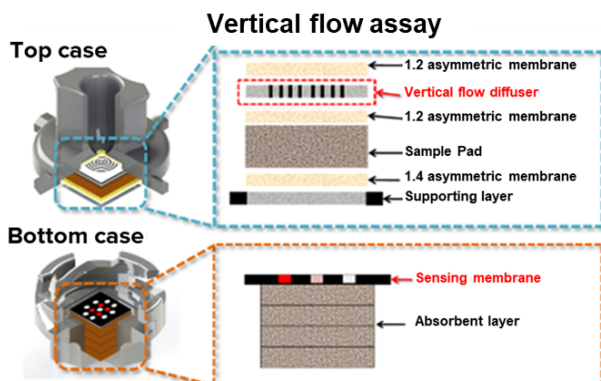
RESEARCH FOCUS

Internship by Jinseung Bae from Sungsu Park's lab at the Johannes Kepler University Linz

Jinseung Bae, a Ph. D student of Prof. Sungsu Park's lab, has been joining the Johannes Kepler University Linz (JKU Linz), Peter Hinterdorfer research group (PI: Peter Hinterdorfer) from July 1st, 2022, to December 31st, 2022. He is working on a project for Analysis of ozone plasma sterilization mechanism using AFM (atomic force microscope). He uses AFM to measure the surface analysis and functional groups of viruses and compares them with the functional groups of sterilized viruses after ozone plasma and UV-C treatment via surface imaging of viruses.
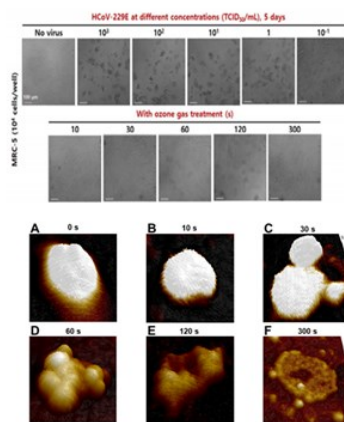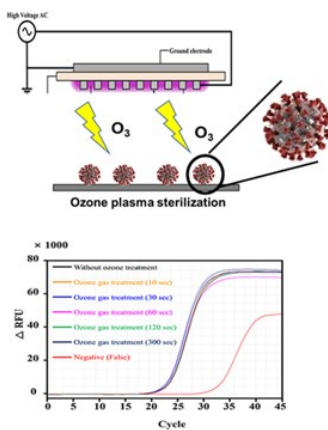
Internship by Jaehyung Jeon from Sungsu Park's lab at University of California, Los Angeles (ULCA)

Jaehyung Jeon, a Ph. D student of Prof. Sungsu Park's lab, has been joining the University of California Los Angeles (UCLA), Aydogan Ozcan and Dino Di Carlo research group (PI: Aydogan Ozcan and Dino Di Carlo) from April 12th, 2022, to October 12th, 2022. He is working on a project for the Optimization of paper-based multiplexed vertical flow assay. He has been developing a fluidic simulation model and experimental model for vertical flow assay with different membrane compressibility to improve sensing signal strength and signal uniformity.

RESEARCH FOCUS

Paper by Eun-Ho Lee's group selected as high-quality paper by the editor-in-chief of the International Journal of Precision Engineering and Manufacturing (IJPEM)

Jae-hyeok Lim, a Ph.D. student supervised by Prof. Lee, Eun-Ho, proposed a yield function that can take into account the anisotropic plasticity without optimization of the model parameters. The proposed yield function is simpler to use than other yield models, as it substitutes only the initial yield stress (0°, 45°, 90°, EB condition). No variable optimization required. The

developed model showed almost the same performance as the most widely used model 'Yld2000-2D'. Since this model can be applied with various forming limit diagrams (FLD, FLSD, EPS-FLD) that can evaluate the formability of metal plates, it is expected that comprehensive studies will be carried out by being utilized in both predictability and evaluation of formability as future works.
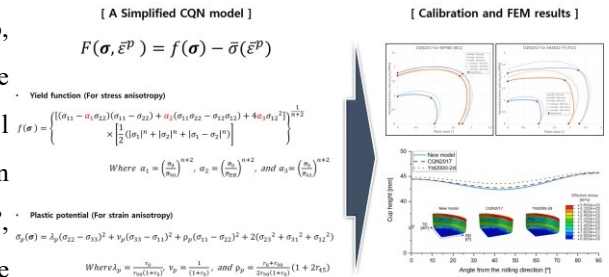
Paper by Hyungpil Moon's group selected as a candidate for the best paper award by the editorial board at Ubiquitous Robots 2022 (UR)
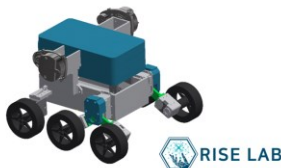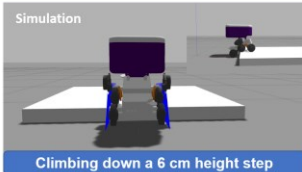
The 19th International Conference on Ubiquitous Robots (UR 2022) was held from July 4 to 6 at Ramada Plaza, Jeju, Korea. The Ubiquitous Robots has established itself as a leading robotics conference, bringing together robotics researchers from around the world who share the vision that robots will become ubiquitous in our daily lives, helping to connect and empower humans.

Ph.D. student Nabih Pico et al. from Sungkyunkwan University and Robot and Intelligent Systems Laboratory (RISE) presented a paper titled "Terrain Recognition based on the Wheel Contact Angle Measurement using Laser Scanners for Six-Wheel Mobile Robot," which was selected as one of the five best papers based on their originality and technical significance to the robot field according to the conference Editorial Board (CEB) and the award committee. This work presents a mobile robot for delivery services that use laser scanning sensors to recognize the local geometry of the terrain in real-time and detect when the wheel loses contact with the ground to create a proper robot control according to the terrain. Therefore, the robot climbs up and down steps safely.

RESEARCH FOCUS

Internship by Saebom Lee from Ault Fluids Lab. at Brown University

Saebom Lee, graduate student of Prof. Jinkee Lee's Lab. has joined the Ault fluids lab. (PI: Prof. Jesse T. Ault) at Brown university from June 1, 2022 to August 31, 2022. She has been working on the international collaborative project for understanding diffusiophoresis-driven particle transport via numerical simulations and experiment. Through simulations, dynamics of particle movement has been predicted considering the potential variations. And experiments were done to manipulate the movement of particles on an evaporating sessile drop.

Internship by Seongsu Cho from Bose Laboratory for Colloids and Interfaces at University of Rhode Island
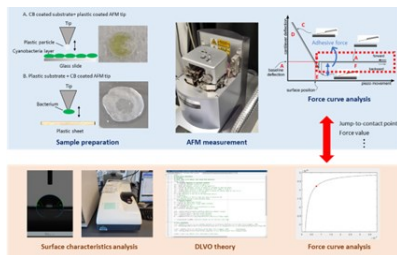
Seongu Cho, graduate student of Prof. Jinkee Lee's Lab. had joined the Bose Laboratory for Colloids and Interfaces (PI: Prof. Arijit Bose) at University of Rhode Island from May 13, 2022 to August 6, 2022. He is working on a project for figuring out the interaction between cyanobacteria and microplastic using AFM. He has compared the experiment result to the predicted result based on DLVO theory.

Jinseok Lee from MiCON Lab. receives scholarship from Hyundai Motor Chung Mong-Koo Foundation

Jinseok Lee, a graduate student from Microfluidic Convergence Laboratory supervised by Prof. Jinkee Lee, received a scholarship from Hyundai Motor Chung Mong-Koo Foundation. He is working on 'Development of eco-friendly nanobubble injector to control green algae using lead-free ultrasound piezo transducer inspired by the characteristics of pistol shrimp's claw' project, funded by the Korea Ministry of Environment. His research is on the biological applications of the nanobubbles.

Jinseok Lee, Seonghun Shin, and Jihyeong Lee from MiCON Lab. received 2022 spring conference awards

Jinseok Lee and Seonghun Shin, graduate students from Microfluidic Convergence Laboratory supervised by Prof. Jinkee Lee, have received best paper awards from 2022 spring conferences held by The Korean Society of Mechanical Engineering (Bioengineering division) and National Congress on Fluids Engineering (12NCFE) respectively. And Jihyeong Lee, also a graduate student from MiCON Lab., received best poster presentation award at the 2022 spring conference of The Korean Biochip Society.

Jinseok Lee

Seonghun Shin

Jihyeong Lee

ALUMNI NEWS

Dr. Mingi Choi from Energy Conversion Laboratory joins Seoul National University of Science and Technology as Assistant Professor

Dr. Mingi Choi from Energy Conversion Laboratory supervised by Prof. Wonyoung Lee joins Seoul National University of Science and Technology as Assistant Professor from this fall semester. During his M.S./Ph.D. and postdoctoral fellow at SKKU, he developed electrochemical energy devices such as solid oxide fuel cells and electrolysis cells for electricity generation and CO_2 reduction. He is a recipient of the Research grant for Ph.D. students from NRF in 2019, the best Ph.D. dissertation award from KSME in 2021, and Sejong Science Fellowship from NRF in 2021.

Dr. Minki Lee from MiCON Lab. joins University of Pennsylvania as Postdoctoral Fellow

Dr. Minki Lee from the Microfluidic Convergence Laboratory supervised by Prof. Jinkee Lee started his post-doctoral fellowship with the Osuji Lab. at University of Pennsylvania under Prof. Chinedum Osuji. Dr. Lee specializes in projects that deal with biomimetics. He developed a highly scalable, cost-effective, 3D topological liquid capillary diode capable of efficient liquid transport.

Dr. Cheonji Lee from MiCON Lab. received 2022 KSME Bioengineering division best Ph.D. dissertation award

Dr. Cheonji Lee from Microfluidic Convergence Laboratory supervised by Prof. Jinkee Lee has received best Ph.D. dissertation award from KSME Bioengineering division in 2022. Dr. Lee specializes in interfacial science and microfluidics. He studied the effects of wettability on water condensation for heat exchanger, water harvesting, and gas sensor. Dr. Lee is currently working for LG chemicals as senior research engineer.

Dr. Ryungeun Song from MiCON Lab. received 2022 KSME Fluid Engineering division best Ph.D. dissertation award

Dr. Ryungeun Song from Microfluidic Convergence Laboratory supervised by Prof. Jinkee Lee has received best Ph.D. dissertation award from KSME Fluid engineering division in 2022. He specializes in interfacial science, electrohydrodynamics, and microfluidics. He studied the generic effect on the small-scale flows through visualization and scaling analysis. Dr. Song is currently on his post-doctoral fellowship with the Complex Fluids Group at Princeton University under Prof. Howard A. Stone.
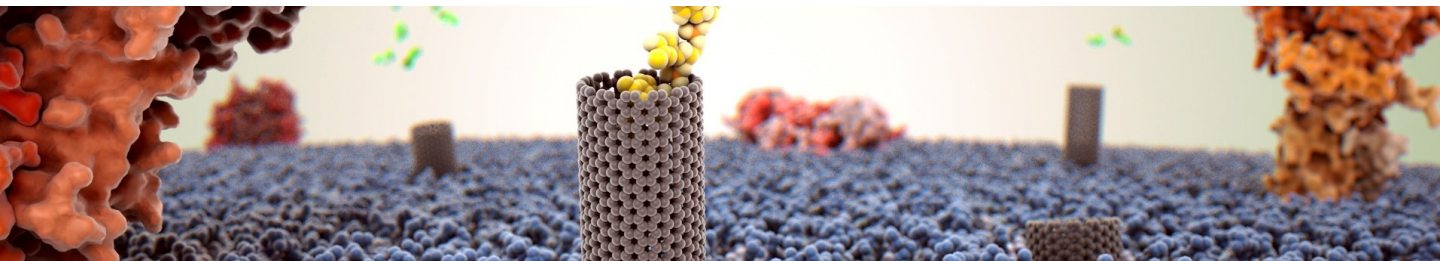
ALUMNI NEWS

Employment news

In August 2022, 46 students graduated from our department, of these 32 MS students and 14 Ph.D. students.

Degree	Name	Advisor	Employment agency
Ph.D.	Jae Won Lee	Han Seo Ko	SK Hynix
Ph.D.	Woo Yul Kim	Sung Min Kim	Hyundai Motors, Chassis System R&D
Ph.D.	Kyungho Hwang	Taesung Kim	SK Hynix
Ph.D.	Giho Kang	Doyoung Byun	Samsung Display, Research Center
Ph.D.	Kyung Tae Yang	Jonghwan Suhr	LG Electronics
Ph.D.	Sung Ho Yang	Changsung Seok	Korea Electric Power Corporation (KEPCO)
Ph.D.	Jong Se Lee	Moon Soo Bak	Agency for Defense Development (ADD)
Ph.D.	Song Seung Hwan	Hyouk Ryeol Choi	Agency for Defense Development (ADD)
Ph.D.	Dong Yoen Yo	Sung Ho Hwang	Hyundai Motors, Advanced Technology Institute
Ph.D.	Jungwun Lee	Moon Soo Bak	Samsung Electronics, Memory Division
Ph.D.	Seunghan Yoo	Changkook Ryu	SK Innovation
Ph.D.	Yun Jeong Park	Kyunghoon Kim	UC Santa Cruz, Postdoctoral Researcher
Ph.D.	Ketebo Abdurazak Aman	Sungsu Park	Temple University, Postdoctoral Researcher
Ph.D.	Ryungeun Song	Jinkee Lee	Princeton University, Postdoctoral Researcher
M.S.	Sungsoo Jang	Youn-Jae Kim	Korea Institute of Science and Technology (KIST)
M.S.	Jongmin Baek	Wonyoung Lee	Institute for Advanced Engineering (IAE)
M.S.	Sungho Jung	Jaeboong Choi	Samsung Medical Center, AI Research Center

Other M.S. employment news:

Hyundai Motors: Jeongyoon Choi (S.H. Hwang), Ik Hyeon An (S.H. Hwang), Tae Yu Kim (H.R. Choi), Yeongkwan Cho (T. Kim), Min Seob Shin (S.M. Kim), *Hyundai Electric*: Junam Park (J. Choi), *Hyundai Rotem*: Soon Woong Cha (H. Kim), *Samsung Electronics*: Hyeon Min Seo (T. Kim), Junyoung Bae (J. Cho), Kangsan Kim (D. Lee), Jun Hee Lee (D. Lee), Junbyeong Lee (S. Baik), Heo Seonil (M.S. Bak), *Samsung Electro-Mechanics*: Jae Hun Jeon (S. Lee), *Samsung SDI*: So Yeon Kim (W. Lee), *SEMES*: Deok Yoon Kim (W. Lee), Sung Yeon Kim (Y.J. Kim), SK Siltron: Junho Yun (T. Kim), *Doosan Heavy Industries*: Sungwook Jin (Y.J. Kim), *GM Korea*: Youn Min Sik (Y.J. Kim), *Altsoft*: Seok Beom Yun (Y.J. Kim), *Mando*: Taehoon Kim (S.H. Hwang), *Korea Instruments*: Youngjun Park (J. Choi), Young Jin Kim (J. Suhr), *Lam Research Korea*: Jung Ryul Lee (T. Kim)