KAIST Institute, 291 Daehak-ro, Yuseong-gu, Daejeon, Republic of Korea
T. +82-42-350-2381~3 F. +82-42-350-2080
http://kis.kaist.ac.kr

2016 ANNUAL REPORT

KAIST INSTITUTE

2016 KAIST INSTITUTE ANNUAL REPORT

KAIST **INSTITUTE**

Contents

History

2006
Established KAIST Institute
Established KIB, KIITC, KIDCS
Established KIEE, KINC

2007
Established KIEcoE, KIUSS
Established KIOST

2010
Completion of KI B/D

2012
Closed KIEE, KIEcoE

2013
Closed KIUSS,
Established Saudi Aramco-KAIST CO_2 Management Center

2014
Established KIDS

2015
Closed KIDS

2016
Changed the name of Institute from KIOST to KIHST
Changed the name of Institute from KIDCS to KIR

Contributors

PUBLIC CHARITY AND SOCIAL ACTIVITIES

Establishment of Chunghi & Byiung Jun Park Korea-US Female Engineer Scholarship
Establishment of Chunghi & Byiung Jun Park Scholarship Funds for Chuncheon Girls' High School
Establishment of Marine Scholarship Foundation in Chuncheon Province
Donation of funds for the construction of Chunghi & Byiung Jun Park Innovation Lecture Room at MIT
Artemis G. Pazianos M.D. Research Funds provided to Lahey Clinic in the US
Chunghi & Byiung Jun Park Scholarship Funds provided to MIT
Establishment of Chunghi & Byiung Jun Park Scholarship Foundation for Seoul National University High School
Chunghi & Byiung Jun Park Cancer Research and Education Center established at Lahey Clinic
Chunghi & Byiung Jun Park Development Funds provided to the Department of Engineering, Seoul National University
Research Funds provided to Tufts University
Research Funds provided to the University of Connecticut
Development Funds provided to KAIST for the construction of (Chunghi & Byiung Jun Park KAIST Institutes Building)

Donations for the Future of KAIST

Dr. Byiung Jun Park and his wife, Ms. Chunghi Park generously donated 10 million dollars in 2007 for the construction of the KI Building in hopes that KAIST would become the greatest university in the world. Based on their wish, the construction of the KI Building was completed in 2010. At present, around 400 professors, researchers, and graduate students are working in this beautiful research space, fully devoting themselves to the development of impactful innovative technologies.

Byiung Jun (BJ) Park

Dr. Byiung Jun (BJ) Park is a successful entrepreneur and international businessman. Interested in textiles and the mechanical properties of fabric, Dr. Park attended the Rhode Island School of Design for textile engineering, then MIT for his SM degree in Mechanical Engineering, and finally Leeds University for a PhD degree in textile engineering. Dr. Park founded a highly successful company called Merchandise Testing Laboratories (MTL) in Brockton, MA in 1988, which grew to become a global leader in consumer product testing, inspection, and social accountability for products shipped to the US from overseas. Under his leadership, MTL garnered prestigious customers such as Ann Taylor, the Gap, Target, and other noteworthy retailers, manufacturers, and importers with product testing operation locations worldwide. In May 2001, MTL was successfully acquired by the $1.3 billion international quality and safety assurance giant, Bureau Veritas. Dr. Park was a member of KAIST President's Advisory Council from 2007 to 2012, and a member of the KAIST Board Directors from 2009 to 2012.

Chunghi Park

Byiung Jun (BJ) Park

Greetings

President of KAIST
Sung-Mo Steve Kang

KAIST IS
THE DRIVING FORCE
BEHIND THE FUTURE
OF KOREA

KAIST has led Korea's remarkable progress in science and technology industry over the past 40 years, joining the list of the world's leading research universities. It is growing into one of the world's most highly-trusted research universities, with a research focus on the 6T's, IT (information technology), BT (biotechnology), NT (nano-technology, ST (aerospace technology), ET (environmental technology) and CT (cultural technology). In particular, the KAIST Institute (KI) has produced outstanding results in convergent research through operations of its five research institutes (KI for BioCentury, KI for IT Convergence, KI for the NanoCentury, KI for Optical Science & Technology and KI for Design of Complex Systems) and the Saudi Aramco-KAIST CO_2 Management Center. The research outcomes presented in this annual report are products created through the sweat and toil of all KI researchers. KI's noteworthy research outcomes of the last year cover a wide variety of areas including such cutting-edge technologies for the future as 3D shape restoration using unmanned surface vehicle (USV) and next generation 5G mobile communication featuring a pattern/polarization beam division multiple access system; eco-friendly technologies such as isolation of carbon dioxide through cement; and healthcare technology such as a three dimensional retinal microvascular distribution structure OCT system.
KAIST's research capabilities now stand on par with those of the world's leading universities. KAIST's innovative education and research capabilities, which have been demonstrated through Capstone Design, Education 3.0, and KOOC, have already been recognized by such international ranking agencies as QS and THE. Reuters ranked KAIST the world's sixth most innovative university. KI represents the future of KAIST and the driving force behind Korea. I want to encourage each researcher of KI to have even bigger dreams of contributing to the development of mankind and their country. I believe they will do their best to fulfill their dreams based on the progress they have made so far. I hope that 2017 will be a fruitful year for all members of the KAIST community. I support your efforts in helping this university meet the challenge of becoming a 'hub of the fourth industrial revolution' and a 'student-centered, faculty-driven, world-best research university'.
Thank you.

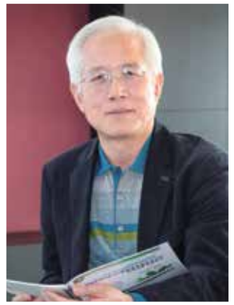
Dean of KAIST Institute
Yun C. Chung

KI WILL EMERGE
AS A GLOBAL CENTER
FOR INTERDISCIPLINARY
RESEARCH, CONTRIBUTING
TO THE FUTURE OF
HUMANKIND AND
THE DEVELOPMENT
OF THE NATION

Marking its 10th anniversary in 2016, the KAIST Institute (KI) has established new development strategies to take another leap forward, and has implemented various institutional changes and innovations to support those goals. For example, the KI for Design of Complex Systems and the KI for Optical Science and Technology have been reorganized and renamed as the KI for Robotics and the KI for Health Science and Technology, respectively. In addition, the main research topics to be intensively cultivated over the next several years have been identified for each research institute of the KI, and new systems for securing outstanding researchers have been adopted, including the KI Fellow, KI Postdoc and KI Scholarship programs. Further, for the first time since its inception, the KI has set up an International Advisory Committee by inviting five internationally renowned scholars with rich experiences in operating university research institutes, who have highly evaluated the KI's past achievements and new development strategies.
The KI is striving to identify and foster the future-oriented interdisciplinary research programs which are both creative and impactful. In particular, last year, the KI supported a number of new interdisciplinary research projects, including the research on pine wilt disease control using predatory fungi, the development of a deep-tissue biopsy needle microscope, the development of ultrahigh-performance self-driving electric vehicles, and so on, through the KI's program for developing its core competencies. Also, the KI has been searching for new creative solutions to revolutionize the healthcare, robotics, and autonomous driving technologies by using artificial intelligence.
In addition, we devoted a lot of effort to strengthen our cooperation with related industries. As a result, we could successfully launch the "Dr. M research consortium" last year with relevant industries, hospitals, and welfare facilities for the elderly, etc. It is also expected that several other research programs, including the high-performance self-driving electric vehicles, will soon receive industrial supports. This year, we will further strengthen such industry-university cooperation and establish various research consortiums with relevant industries for every main research area of the KI. I am confident that the KI has now grown to be the center of KAIST's interdisciplinary research programs, where experts from various fields can come together to discuss and study any specific subject side by side. Going forward, we will continue to carry out innovative interdisciplinary research that can contribute to the future of the humankind and the development of the nation. Thank you for your interest and support.

KAIST Institute Overview

KI for the BioCentury



Director
Kim, Sun Chang
sunkim@kaist.ac.kr

VISION

KI for the BioCentury plays a central role in the field of bio-fusion research, achieving world-class research outcomes and creating a new growth engine for national development.

KI for the BioCentury was established with the goal of combining various related disciplines into one core field based on research capacity in bio-fusion. KI for the BioCentury has focused on the development of excellent research capacity by considering global trends and has helped to realize a creative bio-industry through new interdisciplinary research and academic interfaces in order to lead the global market.

CORE COMPETENCE

Cancer Metastasis Control
- R&D of mechanisms, targets, and bio-markers for the metastasis of cancer
- Establishment of the base for the development of new medicines through the structural analysis of targets to control cancer metastasis
- Analysis of the effect of natural products on cancer metastasis Innovative Technology Center for Novel Biomaterials
- Design of artificial synthetic genomes for the development of highly

Brain cognitive function control
- Understanding the fundamental neural mechanisms underlying brain cognitive functions
- Developing innovative therapeutical approaches for restoring impaired brain cognitive functions

Human Microbiome Control
- Understanding the human microbiome patterns underlying ageing process and related diseases
- Developing innovative analysis tools for elucidating human microbiome patterns
- Developing next-generation therapeutic approaches for the healthy ageing

KI for IT Convergence

Director
Hong, Songcheol
schong1234@kaist.ac.kr

VISION

KAIST Institute for Information Technology Convergence conducts global-leading multidisciplinary research and industrialization with the aid of information technologies.

- Cultivate global-leading multidisciplinary research groups including full-time researchers, students, and professors
- Create open innovation environments with complementary roles of departments in KAIST

CORE COMPETENCE

5G mobile communications
- Antenna/RF technology
- Beamforming technology
- Millimeter band technology

IoT/ WoT
- IoT/WoT interworking framework
- IoT data stream analysis/machine learning for situation awareness
- Identification and tracking for real-world objects
- Augmented Reality·Augmented Human

Integrated sensors
- Smart integrated sensors and networks
- Remote sensor and applications
- Mobile healthcare sensors

KI for Robotics

Director
Oh, Jun-Ho
jhoh8@kaist.ac.kr

VISION

Robots that think!

- Focuses on the research toward highly intelligent robots that can reliably operate in real world.
- Promotes synergy on interdisciplinary collaboration between electrical engineering, mechanical engineering, aerospace engineering, civil engineering and computer science.

CORE COMPETENCE

RTOS for Humanoid Robots
- Development of intelligent real-time robot operating system for accurate humanoid control
- Software architecture that allows multiple developers can simultaneously program

Al for Cooperative Robots
- Research on of learning algorithms for Al
- Coordination of multiple/heterogeneous unmanned agents

Mobile intelligence
- Development of mobile robot platforms
- Active real-time SLAM and recognition techniques

KI for the NanoCentury

Director
Jung, Hee-Tae
ooem@kaist.ac.kr

VISION

The World-class University Hub of Nano Convergence Research.

With an aim to promote and advance the multidisciplinary nature of nanotechnology, KI for the NanoCentury targets on becoming a glob-ally leading laboratory in various fields of nanotechnology by creatively overcoming the boundaries of different areas.

- Creativity through Interdisciplinary Research
- Fusion Research for Synergistic Effects
- Win-Win through Cooperation

CORE COMPETENCE

NT for Climate Change
- Nanotechnology for Advanced Battery
- Nanotechnology for Environmental Applications, Water, and Energy
- Efficient Processes for CO_2 Emission

NT for Healthcare
- Nanotechnology Systems for Diagnosis of Infections
- Health Electronics and Sensor Technology

NT for Advanced Opto-Electronics
- Nanotechnology for Advanced Display
- Nanotechnology for Wearable Electronics

KI for Health Science and Technology

Director
Jeong, Yong
yong@kaist.ac.kr

VISION

KI for Health Science and Technology aims to develop new high-impact technologies through combination of medicine and engineering to lead the future healthcare markets.

- Developing a variety of advanced technologies in the field of health science and playing a pioneering role in the future healthcare industry and market by creating a new value through the combination of these technologies.
- Providing a platform for interdisciplinary research of medicine and engineering to support the development and utilization of new healthcare technologies reflecting the clinical needs in hospital.
- Building an infra to facilitate a synergistic combination of academia and industry R&D activity in the field of health science to develop an innovative future healthcare technology.

CORE COMPETENCE

Neuroimaging & Neuromodulation
- Neuroimaging-based brain circuit & network analysis
- Novel neuromodulation technique
- Biomarker for brain disorder diagnosis
- Neuromodulation for brain disorder treatment

Biophotonis
- Cutting-edge Intravital microscopy/endo-microscopy
- Advanced photo-therapy for human disease
- Laser-holography-based high-resolution imaging
- Clinical optical imaging system

Therapeutic Bioengineering
- Biological analysis of disease environment
- High-precision monitoring technology for human disease
- Personalized smart therapy

Smart Healthcare
- Development of key technology for mobile healthcare system Establishment of mobile healthcare ecosystem and its validation

Saudi Aramco-KAIST CO_2 Management Center

Director
Lee, Jay Hyung
jayhlee@kaist.ac.kr

VISION

Research activities of this center have primarily focused on the process of capturing CO_2 and innovative methods of reducing CO_2 emissions. Another important area of research is the transformation of CO_2 into valuable chemicals and materials in an economically-feasible manner.

- Within 10 years of its establishment, Saudi Aramco-KAIST CO_2 Management Center will become one of the world's most recognized research centers in the field.
- By focusing on the conversion of CO_2 into high value-added materials and chemicals, the Saudi Aramco-KAIST CO_2 Management Center will build a unique identity in the landscape of CO_2 research.
- Various technology rights with high potential commercial power will be obtained.
- Commercialization will be promoted through collaboration with Saudi Aramco.

CORE COMPETENCE

Advanced materials for CO_2 capture
- Porous solids (MOFs, COFs, COPs)
- Functional sorbent
- Advanced solvents (ILs, Amine-based)

Efficient processes for CO_2 conversion
- Photo/electro-chemical approach
- Mineralization & carbonization
- Homogenous catalysis
- Carbonization of cement using CO_2

CO_2 reduction via efficiency improvement
- Auxiliary power units using direct liquid hydrocarbon SOFC
- Supercritical CO_2 based bottoming cycle

Statistics

FACULTY

As of Dec 2016

	KIB	KIITC	KIR	KINC	KIHST	CO_2	Total
Professor	27	23	10	83	31	14	188
Research Professor (KI Fellow)	6 (1)	6 (1)	-	2 (1)	-	-	14 (3)
Adjunct Professor	-	7	-	-	-	-	7
Total	33	36	10	85	31	14	209 (3)

PAPERS - TOTAL (SCI)

	KIB	KIITC	KIR	KINC	KIHST	CO_2	Total
2008	19 (19)	23 (3)	17 (1)	17 (17)	68 (68)	-	144 (108)
2009	16 (16)	20 (6)	2 (0)	7 (7)	139 (34)	-	184 (63)
2010	75 (71)	-	7 (1)	11 (11)	53 (49)	-	146 (132)
2011	7 (0)	-	10 (0)	9 (9)	12 (12)	-	38 (21)
2012	3 (3)	18 (5)	84 (20)	28 (18)	49 (45)	-	182 (91)
2013	15 (14)	34 (10)	87 (17)	75 (71)	42 (34)	-	253 (146)
2014	54 (19)	21 (9)	106 (28)	69 (43)	180 (61)	1 (1)	431 (161)
2015	32 (29)	10 (8)	40 (34)	69 (63)	70 (66)	2 (2)	223 (202)
2016	75 (74)	37 (35)	22 (21)	49 (47)	56 (52)	12 (11)	251 (240)

PATENTS - TOTAL (INTERNATIONAL)

	KIB		KIITC		KIR		KINC		KIHST		CO_2		Total	
	Pending	Registration	Pending	Registration	Pending	Registration	Pending	Registration	Pending	Registration	Pending	Registration	Pending	Registration
2008	5	4	24 (3)	-	5	-	6	7	6 (4)	-	-	-	46 (7)	11
2009	-	-	5	1	-	-	4	-	13 (5)	3 (3)	-	-	22 (5)	4 (3)
2010	24	3	3	-	-	-	5 (1)	1	15	2 (1)	-	-	47 (1)	6 (1)
2011	1	-	5	-	-	-	1	-	6	-	-	-	13	-
2012	-	-	2	-	13	14	7	-	11 (1)	6	-	-	33 (1)	20
2013	1	-	7	-	20	5 (1)	26	12 (1)	28 (6)	3 (2)	-	-	82 (6)	20 (4)
2014	3	5	9	-	6	24	10 (3)	4	31 (10)	3	-	-	59 (13)	36
2015	10	-	8 (1)	-	10 (2)	-	18 (2)	2 (2)	33 (5)	2 (2)	-	-	79 (10)	4 (4)
2016	-	-	9 (4)	1	3	-	8 (1)	-	2	-	4 (1)	-	26 (6)	1

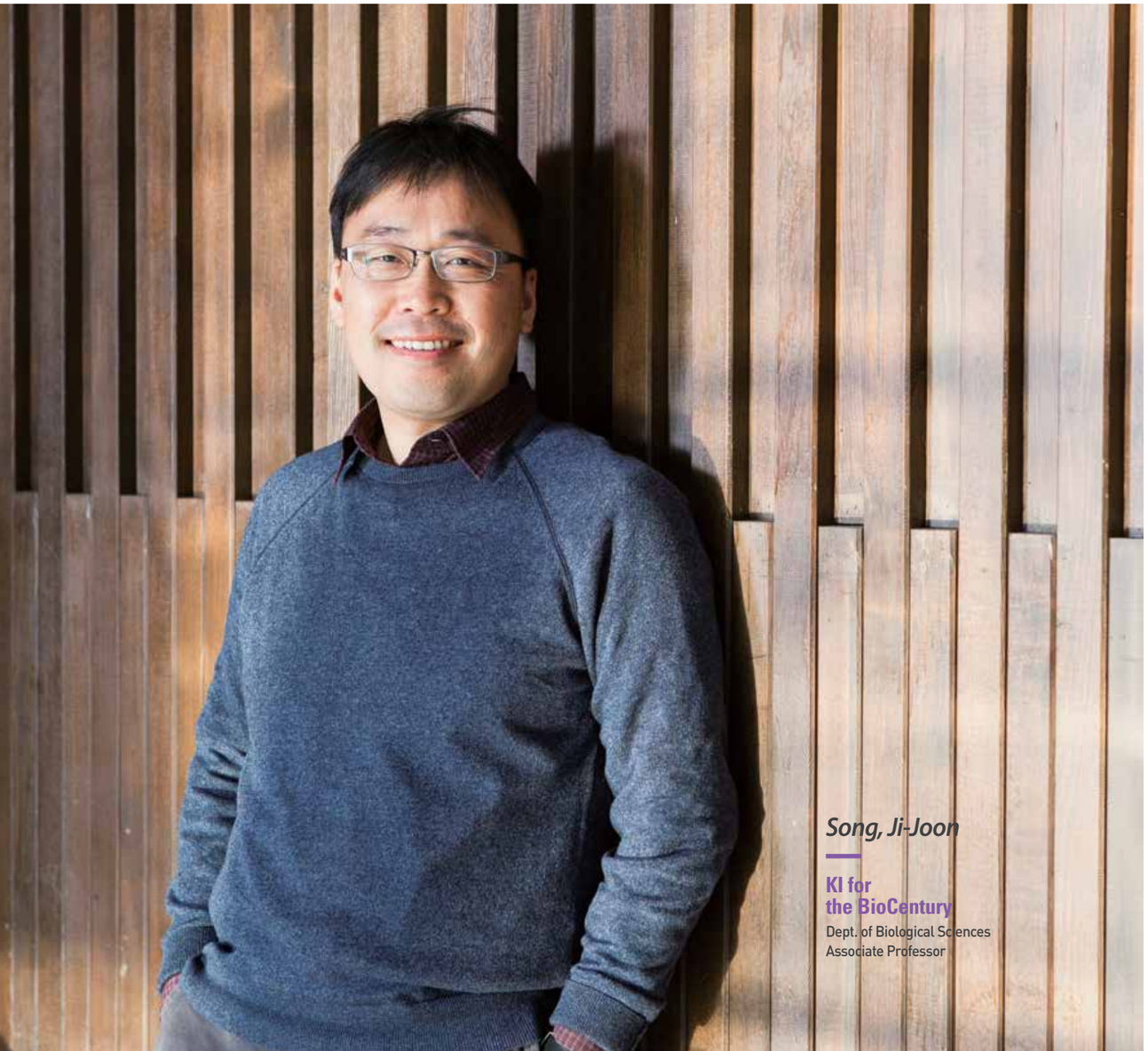
FUNDING & PROJECT

Unit : KRW Million

	KIB		KIITC		KIR		KINC		KIHST		CO_2		Total	
	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects
2008	4,012	24	11,787	54	1,380	13	5,479	32	250	1	-	-	22,908	124
2009	11,851	49	12,016	63	786	9	17,349	39	782	8	-	-	42,784	168
2010	9,297	44	9,704	46	990	12	6,127	38	1,074	7	-	-	27,192	147
2011	8,205	41	11,469	71	1,956	16	7,116	46	3,856	23	-	-	32,602	197
2012	14,641	75	13,980	76	2,135	17	9,453	62	5,019	21	-	-	45,228	251
2013	10,715	51	9,947	54	1,695	17	9,952	67	4,813	20	670	4	37,792	213
2014	7,955	43	7,907	50	3,057	20	9,877	67	4,776	18	4,173	16	37,745	214
2015	7,633	44	12,130	60	4,104	21	10,238	74	5,329	30	2,127	14	41,561	243
2016	8,209	32	6,279	46	9,452	58	4,753	21	6,882	21	3,030	23	38,605	201

Research Highlights

DETERMINATION OF HUNTINGTON'S DISEASE PROTEIN



Song, Ji-Joon

KI for the BioCentury

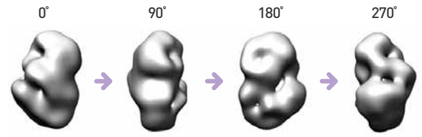
Dept. of Biological Sciences
Associate Professor

"Efforts to Develop Treatments for Huntington's Disease using Research on the 3D Structure of the Huntingtin Protein"

Previously, research on the protein causing Huntington's disease had not been conducted on the full-length Huntingtin protein due to its large size of the protein composed of more than 3,000 amino acids, which makes it difficult to obtain a protein that can be biochemically analyzed. In this research, we have elucidated the 3D structure of the full-length Huntingtin protein for the first time in the world, and demonstrated the link between the expansion of glutamine at the amino terminus and changes in the structure of the protein. This study is expected to deepen our understanding on the mechanisms of other degenerative brain diseases and to help develop a treatment for Huntington's disease.

Study on the 3D Structure of the Huntington Protein Using Electron Microscopy

Huntington's disease, also known as Huntington's chorea, is a type of degenerative brain disease that occurs due to the expansion of polyglutamine at the amino terminus of the Huntingtin protein, which causes problems with the autonomic nervous system. Symptoms of the disease include jerky dancelike movements of the hands and feet. Huntington's disease, whose symptoms usually begin between 30 and 50 years of age, is a dominant genetic disease caused by a gene on chromosome 4.
The disease often results in unstable gait due to lack of coordination and problems with mental abilities. In severe cases, physical abilities begin to deteriorate and symptoms of dementia develop. The first evidence of neurodegeneration is damage to neurons, which results in the partial elimination of inhibitory signals transmitted to the premotor and supplementary motor areas of the frontal lobe, causing jerky body movements. As Huntington's disease continues, neural degeneration is found in other areas of the brain, including the cerebral cortex.



▲ Three-dimensional structure of Huntington's disease protein observed under an electron microscope

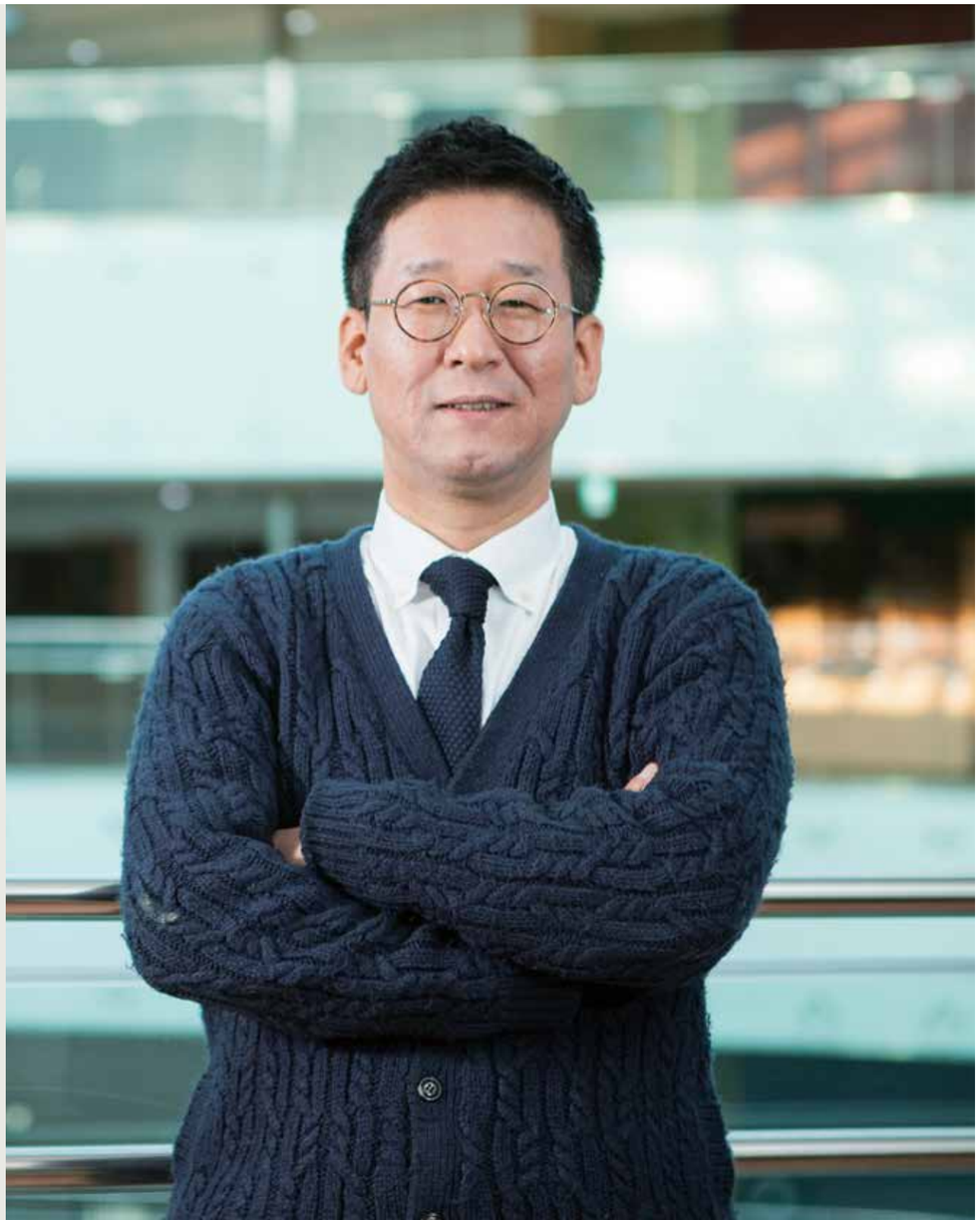
▲ Schematic diagram of overall domain structure of Huntington's protein and of the effects of polyglutamine expansion

A study conducted in 1993 found that Huntington's degenerative brain disease was caused by a expansion of polyglutamine in the Huntingtin protein. The Huntingtin protein is very large in size, consisting of more than 3,000 amino acids, and it has never been studied previously for its molecular structure or biochemistry. In 2005, however, professor Ji-Joon Song of KAIST, who is specialized in protein structure determination, started his research jointly with professor Ihn-Sik Seong of Harvard Medical School, an expert on Huntington's disease. Based on their joint research, in 2010, they succeeded in producing the ful-length Huntingtin protein for the first time in the world, and published a paper on its structural and biochemical functions. The joint research continued after professor Song was appointed to KAIST in 2009, and professor Seong at Harvard Medical School in 2012. A breakthrough in the research came when professor Ji-Joon Song joined, during his sabbatical year in 2013, professor Hans Hebert's research group at Karolinska Institutet in Sweden, an institution in charge of selecting the Nobel Prize in Physiology or Medicine.
While working to analyze protein structures using an electron microscope, he determined the 3D structure of the Huntingtin protein and successfully concluded his research in close collaboration with the research team of professor Seong at Harvard Medical School. "Previously, the impacts of polyglutamine expansion, which causes the disease, on the Huntingtin protein were not clear, and the biochemical properties of the Huntingtin protein were not known either. And this was the area we decided to focus our research on. In this study, we used a transmission electron microscope to produce a 3D structure of the protein using shapes gained by transmitting protein samples and projecting the resulting shapes."

Determining the Cause of the Disease by Analyzing Polyglutamine Expansion

Polyglutamine, which consists of glutamine amino acids linked in succession, has not been studied for its effects even though its expansion is known to be a cause of many degenerative brain diseases. In recognition of this, in their study, the authors aimed to analyze the entire Huntingtin protein, which is affected by polyglutamine expansion, for the first time in the world, in order to understand the impacts of the expansion on the amino terminus. The authors found that the huge Huntingtin protein consists of five domains and has a circular shape due to the phenomenon of protein folding. In particular, they explained that the increase in the length of the polyglutamine at the amino terminus of the Huntingtin protein leads to changes in its entire structure. Through this study, the research team of professor Ji-Joon Song has paved the way for the development of a treatment regimen for Huntington's disease, and helped to explain the mechanisms behind degenerative brain diseases caused by polyglutamine expansion, like ataxia. Going forward, the research team aims to demonstrate the 3D structure of the entire Huntingtin protein at atomic-level resolution, and develop a treatment for Huntington's disease. The study was conducted through multi-national collaboration, applying various methodologies of various research groups in Korea, the U.S., Sweden, Switzerland, etc. The findings of the study were published in eLife, a prestigious journal on molecular biology, jointly issued by Germany (Max Planck Institute), the U.S. (Howard Hughes Medical Institute), and the U.K. (Wellcome Trust).

IDENTIFICATION OF MECHANISM FOR GENE EXPRESSION REGULATION BY TRANSCRIPTS AND TRANSLATORS AT GENOME LEVEL



Cho, Byung-Kwan

KI for the BioCentury

Dept. of Biological Sciences
Associate Professor

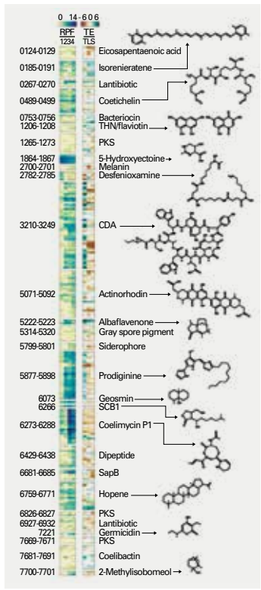
"Identification of Genes of Actinomycetes Used for Antibiotic Biosynthesis, Paving the Way for the Mass Production of Antibiotics"

Surprisingly, over 70% of the world's antibiotics are produced using a microorganism called actinomycetes. For antibiotic biosynthesis, the expression of the related genes is required, for which the regulation of the intracellular transcription level is known to be important. However, the importance of regulating gene expression after transcription, such as the level of translation, is relatively unknown. This study, which has secured a large amount of information that can be utilized in manipulating the actinomycete genome, is expected to greatly contribute to the large-scale production of antibiotics. In addition, this study introduces the possibility of increasing the production of antibiotics by engineering the genes regulating the biosynthesis of antibiotics, which are controlled by the translation level, using synthetic biology technology.

Identification of Gene Structure in Actinomycetes Using Next-Generation Research Technology

This study was conducted to identify the overall flow of gene expression from primary transcripts to translators by applying three types of next-generation sequencing technology, transcription start point sequencing, RNA sequencing, and ribosome profiling, and conducting a comprehensive analysis. The three techniques correspond to the growth stages of actinomycetes, a kind of microorganism used for the biosynthesis of antibiotics. Actinomycetes have around 200 secondary metabolites involved in various antibiotic biosynthesis. The biosynthesis of these metabolites includes a physiological change from primary metabolism to secondary metabolism as well as morphological differentiation, based on a regulatory mechanism linking transcription, translation, and post-translation.

The research team of professor Cho Byung-Kwan conducted a comprehensive analysis based on the "sequencing of gene expression initiation points," which is a technology for detecting the first position where RNA is synthesized from DNA; and an analysis of "ribosome-binding RNA sequencing data," which can be used to observe whether a gene is actually translated into a protein. Professor Cho commented that this study resulting in the clarification of the gene-regulating mechanism of actinomycetes, and a large amount of data was secured which can be utilized in manipulating the genome of actinomycetes for the mass production of various antibiotics. Summarizing the study, professor Cho explained, "The study aimed to show the overall flow of gene expression by applying three analysis techniques of the next-generation sequencing technology, which is developing at a rapid pace, based on the growth stages of S. coelicolor, one type of actinomycetes, and by performing a system-level analysis on the results of their application. The three analysis techniques applied in this study are the sequencing of gene expression initiation points, RNA sequencing, and ribosome binding RNA sequencing. Further, the study identified and secured various genetic data which can be used to build an actinomycete cell plant for the mass production of antibiotics, through the sequencing of gene expression initiation points. This study demonstrated that the genes related to antibiotic biosynthesis are regulated during the translation of the protein from mRNA.



▲ Expression of genes related to secondary metabolites and analysis of translation efficiency

Age of Mass Production of Antibiotics

Genetic structure information obtained at the genome level was used to compare gene expressions between the levels of transcription and translation. As a result of the comparison, a phenomenon known as translational buffering was found. This means that the translation rate at which protein is produced from mRNA, is significantly slower than the transcription rate at which mRNA is made from DNA. This indicates that it is necessary to consider not only the level of transcription but also the level of translation when constructing an actinomycete cell plant capable of mass production of antibiotics. Based on the expression patterns of the genes that specifically control the antibiotic gene cluster, it was learned that while the quantity of transcripts increased steadily with the growth stages, the level of translation increased rapidly only at a certain stage of growth. These findings showed that antibiotic biosynthetic regulatory genes can be regulated at a certain stage of growth by the level of translation, and this understanding is expected to be useful when a cell plant for the mass production of antibiotics is to be built. "Since the genome of actinomycetes has a very high content of GC, general molecular biology techniques did not work well in most cases. So we struggled to optimize each next-generation sequencing technology for its application to actinomycetes," said professor Cho. He noted that, "Based on the results of this study, we will aim to establish foundations for the mass production and commercialization of high-value-added compounds." In particular, the results of this study represent a step forward in the era of mass production of antibiotics. The information gained on the entire genome level through the use of various next-generation sequencing techniques will be an important reference for future molecular genetic and systematic studies. Also, a great deal of the collected information on the DNA structure and on transcripts and translators can be used for the construction of an actinomycete cell plant, and is expected to be useful in selecting engineering targets. Further, this study also opens the possibility of increasing the production of antibiotics using synthetic biology technology, by engineering the genes regulating the biosynthesis of antibiotics, which are controlled by the translation level. The findings of this study were published June 2in the online edition of Nature Communications dated, the leading authoritative biotechnology journal.

DEVELOPMENT OF ULTRA-SMALL 3-ELECTRODE SENSORS AND DRIVER IC FOR EXPIRATORY ANALYSIS

Park, Chong-Ook

KI for IT Convergence

Dept. of Materials Science Engineering
Professor

"Changing the Framework of Sensors!"

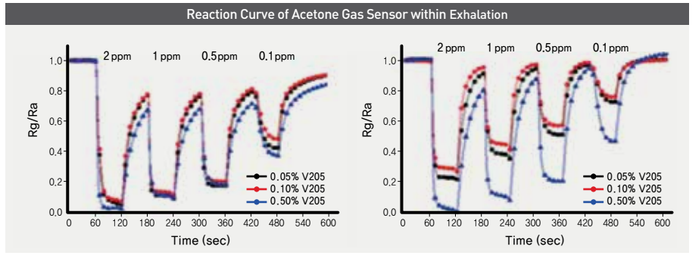
The organic compounds found in gases from human exhalation can provide important clues that can be checked for the presence of a disease, and research is being actively conducted around the world to develop related biosensor technology. Many efforts have been devoted to developing these new biosensor technologies in South Korea as well, but selectively detecting target gases has been a challenge, because of their very low content level in exhaled air. In this respect, the high-sensitivity sensing material developed by this study will likely provide the key to overcoming the limitations of the existing technology. Further, the three-electrode sensor and driver IC, which were also developed through this study, are expected to pave the way for new innovative applications in both the bio and IT industries, when they are combined with various smart devices.

Development of Multi-Channel Electrode Sensors for Medical Applications

The exhalation of air that comes out when a person breathes out includes various organic compound gases from the body. Some of these gases vary in concentration depending on the health condition of the person. For example, toluene, which is a marker for lung cancer, is detected at only about 20ppb in the exhalation of healthy persons, but at more than 100ppb in the case of lung cancer patients. Acetone, a diabetic marker, is found at 0.80ppm in the exhalation of healthy persons but 1.71ppm or more in the exhalation of diabetic patients. Accurately analyzing the concentration of specific gases will make it possible to diagnose a disease cheaply and easily without the need for blood test or magnetic resonance imaging (MRI). In fact, disease-detecting biosensor technologies based on this principle are already being developed, and related research is being actively carried out around the world. However, these technologies still have some limitations in selectively detecting target gases, because of their very low content level and interference from various other gases contained in the breath.

The research team led by professor Park Chong-Ook has long worked on developing an expiration analysis sensor with high sensitivity and selectivity in order to overcome these challenges. The research team has developed a high-sensitivity sensing material with a special combination that increases the response sensitivity to gas, thereby raising the threshold for detection. In addition, by newly designing a new 3-electrode sensor to replace the existing 4-electrode sensor, the research team successfully minimized the size of the unit sensor as well as its power consumption. To solve the problem of selectivity, which is a persistent problem of this type of sensor, four 3-electrode sensors were connected to an array sensor, and pattern recognition technology was applied. Further, in order to deal with various driver-related problems caused by the special characteristics of a three-electrode sensor, the research team designed new driving circuit units.

The newly adopted 3-electrode structure in this study is particularly significant, since it moves away from the existing frame of 4-electrode sensor technology which is used in advanced countries such as Japan and Germany, thereby establishing a foundation for competing with advanced countries based on the new framework. The 3-electrode sensors, which are characterized by their miniaturization and low power consumption, can also be applied to various devices requiring miniaturization and portability. Indeed, by overcoming many of the limitations of the existing technology, whose use was limited for industrial purposes, this technology is anticipated to emerge as one of the key devices for advanced next generation systems, in applications in such diverse fields as medical treatment, household appliances, IOT, etc.



▲ Properties of the developed materials, and the Interface IC which has been developed

▲ INTERFACE IC

DEVELOPMENT OF PATTERN/POLARIZATION BEAM-DIVISION MULTIPLE ACCESS METHOD FOR 5G MOBILE COMMUNICATIONS TECHNOLOGY

The world's first pattern-polarization beam-division multiple access technology, which was developed through this research, represents an advance in existing mobile communication technologies. The technology dramatically enhanced the capacity of existing MIMO system in a line-of-sight environment, using multiple beams and pattern-polarization antennas integrated in half-wavelength space. In the fields of academic research focused on improving 5G spectrum efficiency, this study introduces a new direction in technology which overcomes the limitations of the existing mobile communication systems. When the pattern-polarization beam-division multiple access technology and the integrated antenna technology are applied to various kinds of mobile devices and systems in the future, it will become possible for South Korea to lead the global mobile communication market and secure competitiveness.

Cho, Dong Ho

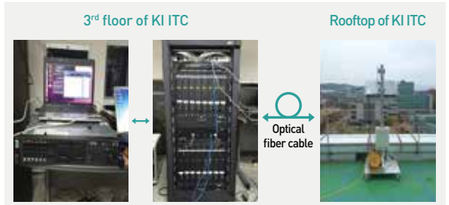
KI for IT Convergence

School of Electrical Engineering
Professor

"Source of Competitiveness in the Leading Global Mobile Communications Market!"

Development of Pattern-Polarization Beam-Division Multiple Access Technology That Can Achieve Beam Gain and MIMO Gain Simultaneously

Previously, much of the research on mobile communication technology was based on the MIMO technology, which uses several antennas at the transmitting and receiving systems to increase capacity. If the distance between antennas is large enough in a non-line-of-sight environment, this technology can be used to create independent paths between transmitting and receiving antennas, increasing capacity by simultaneously transmitting various data. However, the MIMO technology has some limitations. Most notably, the size of the antenna becomes too large if it is used together with the beam forming technique, and creating an independent path in a line-of-sight environment becomes challenging, making it difficult to enhance capacity. In recognition of this, the research team led by professor Cho Dong-Ho embarked on studies to develop a pattern-polarization beam-division multiple access technology that places multiple antennas with sufficiently different radiation patterns in a narrow space. This configuration achieves beam gain by using multiple beams, and MIMO gain within each beam, at the same time. First, the research team developed pattern-polarization antennas capable of achieving large multipath gains in a line-of-sight environment based on different phases, and then successfully developed a technique of integrating pattern-polarization antennas in a narrow half-wavelength space, ensuring low interference.



▲ Structure of BDMA Test Bed

▲ BDMA Test Environment

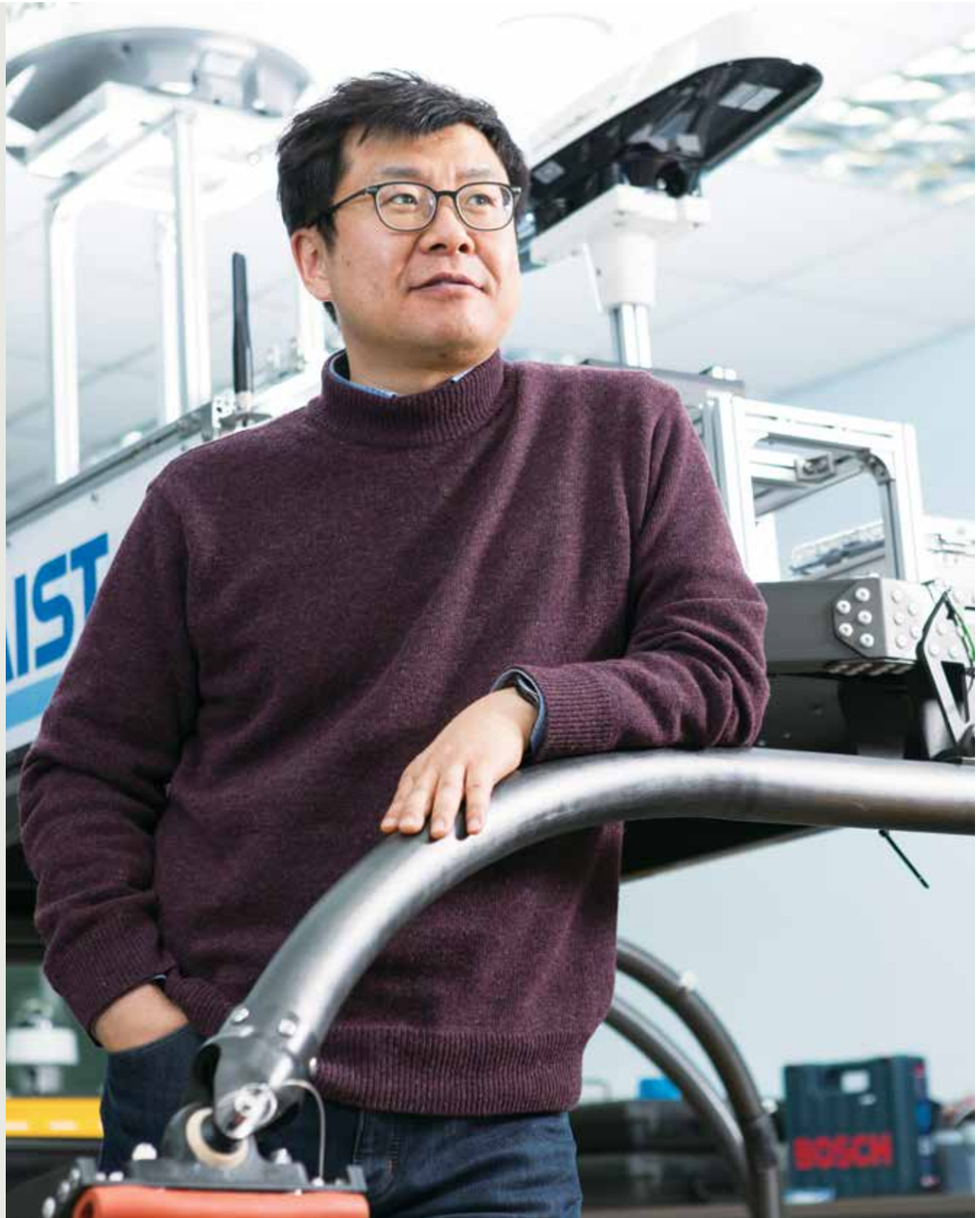
▲ Demonstrating the Technology for Vice Minister Choi Jae-You of Science, ICT and Future Planning

A number of pattern-polarization antennas were arrayed at half-wavelength intervals to develop a pattern-polarization array antenna with low interference. Then, multiple beams were formed where each beam had multiple pattern-polarization antenna radiation patterns integrated in it. Using several pattern-polarization antennas in each beam, multi stream MIMO signals were transmitted. In this way, the research team developed a pattern-polarization beam-division multiple access technology that is capable of achieving beam gain and MIMO gain based on pattern-polarization antennas at the same time in a line-of-sight environment, which was obtained by dividing the space into multiple beam areas and using multiple pattern-polarization antennas for each individual beam.

The findings of the study show that with an optimal design, the beam gain and MIMO gain can be maximized simultaneously, because the beam gain and the pattern-polarization gain are not completely independent of each other. To validate the pattern-polarization beam-division multiple access technology, a base station was built by using a commercial EPC, commercial LTE modem, digital beam former, and pattern-polarization array antennas. Then a test bed was implemented by using developed base stations and commercial terminals. As a result, it was found that the 2×2 MIMO gain was achieved in each of the 12 beams. The research team is currently working on improving the completeness of the pattern-polarization beam-division multiple access technology through subsequent optimization studies, such as optimum multi-beam generation, beam compensation in consideration of antenna coupling and RF element degradation, etc. In addition, the research team plans to demonstrate the technology's innovative improvement in wireless communication capacity by operating a millimeter wave adaptive pattern-polarization beam-division beam-forming system during a technology demonstration at the Pyeong Chang Olympic Winter Games.

The development of this technology is of great significance at the national level as well. This is because this study has laid the foundation to secure a technological lead in the 5G mobile communications age by applying the original and core technologies of the pattern-polarization beam-division multiple access system to the standards for the 5G mobile communications. The selection of this technology as one of the top 100 R&D projects in 2016 by the Ministry of Science, Information and Communications Technology (ICT) and Future Planning reflects the importance of the technology. Going forward, as companies develop commercial systems and provide ultra-high-capacity communication services for the original and core technologies of the pattern-polarization beam-division multiple access system developed in this study, the technology is expected to greatly contribute to the promotion of future mobile communication, manufacturing, and service industries.

RESEARCH ON TECHNOLOGY FOR THREE-DIMENSIONAL(3D) SHAPE RECONSTRUCTION OF OFFSHORE STRUCTURES



Kim, Jin Whan

KI for Robotics

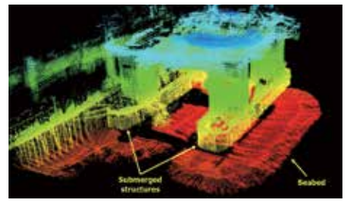
Dept. of Mechanical Engineering
Associate Professor

"3D Shape Reconstruction Using Unmanned Surface Vessels (USVs)"

With recent advances in robotics and autonomous navigation technology, vigorous research involving unmanned surface vessels (USVs) is on-going worldwide, and active attempts are being made at utilizing USVs to perform various maritime duties that would have previously required manned vessels. In particular, USVs offer many advantages when used for the safety inspection of offshore structures such as bridges, port facilities, and offshore oil rig platforms. Offshore structures require periodical safety inspections and examinations as they may suffer structural damage caused by repetitive wave loads, as well as natural disasters like typhoons and tidal waves. Currently, visual examination by person is the most common method used for this purpose, but this presents several issues as it requires a lot of time and effort and may expose the person performing the examination to risks. The technology to reconstruct 3D shapes of offshore structures using USVs proposed and validated by this study can be applied to examining various types of offshore structures, and is expected to enhance the safety and efficiency of the examination work as a result.

Precision Navigation is the Key to 3D Shape Reconstruction

With recent advances in robotics and autonomous navigation technology, vigorous research is being carried out globally on the use of unmanned surface vessels (USVs), not only in dangerous maritime duties that would previously have required manned vessels, but also in various other tasks such as long-term maritime survey and reconnaissance and surveillance. In particular, USVs can be utilized for surveying damage in costal marine environments in the aftermath of massive disasters such as typhoons or tidal waves, and for performing physical safety inspections of offshore structures such as bridges, port facilities, and offshore oil rig platforms. For successful 3D shape reconstruction of a surrounding environment, it is essential to identify the exact location of a USV equipped with an instrumentation device, and this requires a high level of precision in navigation.



▲ Shape reconstruction of semi-submersible marine structure

▲ Unmanned surface vessel developed by the team

Limitations of Existing Navigation Equipment and Shape Reconstruction

A GPS/INS system, in which GPS is integrated with an inertial navigation system (INS), is the most commonly used navigation system for USVs today. Sometimes, however, GPS signals are not received successfully, not only in indoor environments but also in areas where high-rise buildings are densely located, and its use is substantially limited in and around large-scale offshore structures such as bridges and floating offshore plants. Precision navigation of USVs in an environment where GPS-based navigation is limited requires a method of obtaining separate information for location correction. In principle, it is possible to extract and use relative position information from the location and shape information of structural components that exist in the surrounding environment such as bridge piers or hull structures of a floating offshore platform. To obtain shape information of the surrounding environment, it is common to use a light detection and ranging (lidar) system capable of providing the relative distance between the sensor and the surrounding environment, as well as their bearing information. It is possible to obtain point cloud information and to reconstruct a 3D shape by scanning various parts of the surrounding environment. However, most research on 3D shape reconstruction is premised on the use of a ground vehicle that is in a stationary state or is able to move after stopping with position information from GPS or external beacons. As such, this may present much greater challenges to reconstructing 3D shapes with precision in a marine environment where influences of relatively bigger disturbances such as tidal currents and waves occur continuously with no external position fixes from GPS.

3D Shape Reconstruction through Relative Navigation and Sensor Fusion

A research team led by Professor Kim Jinwhan of the Department of Mechanical Engineering at KAIST is garnering much attention, as they have successfully developed a technology to perform precision 3D shape reconstruction in a marine environment using a newly invented navigation algorithm and sensor fusion techniques. The research team configured a relative navigation algorithm using the relative location information of offshore structures along with inertial sensors and Doppler velocity log (DVL) information to estimate the location of a USV around an offshore structure such as a bridge. In addition, the team proposed an algorithm and procedure that can be used to reconstruct 3D shapes simultaneously above and beneath the surface by combining the information from lidar and sonar systems installed on a vessel. Furthermore, the researchers validated the usefulness of the proposed algorithm by successfully performing outdoor experiments using the team's own USV in an actual bridge and semi-submerged offshore structure environment. As mentioned above, this technology can be utilized in performing safety inspections and external inspections for the structural stability of large offshore structures such as bridges and floating structures. This is anticipated to be especially useful in natural disaster-prone areas or regions experiencing leakage of dangerous material, where it is difficult for people to perform such tasks. The research outcome earned high recognition by winning third place at the Student Poster Competition, which was held as part of the "2016 MTS/IEEE Oceans" conference, the biggest academic symposium in the field of marine IT, co-sponsored by the Marine Technology Society (MTS) and the Institute of Electrical and Electronics Engineers (IEEE).

STUDY ON AUTOMATIC FLYING TECHNOLOGY USING INTELLIGENT PILOT ROBOTS

Shim, Hyun Chul

KI for Robotics

Dept. of Aerospace Engineering
Associate Professor

"Any Type of Vehicles Can Be Automated"

The industry for unmanned vehicles, such as drones, autonomous vehicles, etc., is growing rapidly every year, and it is drawing much attention as a key new industry for the future. Keeping pace with this trend, many countries around the world are actively developing various types of unmanned vehicles. In this study, instead of developing another specialized unmanned mobile object, the authors focused on developing a general purpose technology that could be used to automate any type of vehicle already in use, by using a humanoid robot. The authors successfully developed a humanoid robot capable of piloting a small airplane, and further, demonstrated its ability to drive a car through re-engineering. Their humanoid robot is expected to be used for diverse purposes, as it can operate just about any vehicle which currently requires human control, including an airplane.

The Unmanned Vehicle Industry Is the New Growth Engine for Future

According to 2016 data from the Ministry of Science, Information and Communications Technology (ICT) and Future Planning, the global market for unmanned vehicles is expected to grow at an average annual rate of 22% from $24.8 billion in 2015 to $67.3 billion in 2020. As unmanned vehicles will likely be used in various fields, when all the related industries are taken into account, they are expected to emerge as a very important new growth engine for future. Thomas Frey, a prominent futurist, has mentioned commercial drones and unmanned vehicles as one of the new core industries for the next generation. Keeping pace with this global trend, South Korea has formulated the "Five-Year Plan for Unmanned Vehicle Development (2016 to 2020)" in order to enhance its technological competitiveness for unmanned vehicles, and various research institutions in the country are working strenuously to develop related technologies. At the heart of the development of future unmanned vehicle technology is the goal of developing a common technology that can be applied integrally without distinction to the army, navy, and air force. In fact, the United States, the European Union, etc. have already established and are currently implementing integrated strategies for developing unmanned vehicles for the use by all of their armed forces.


▲ DRIBOT


▲ PIBOT

Advantages of Automation of Existing Vehicles

Basically, when it comes to the research and development of unmanned vehicles, it is usually appropriate to focus on the development of individual use technologies, where individual objects are developed for each specific purpose. However, if a humanoid robot could be installed on the existing vehicle platforms used for unmanned operations, it would become possible to more effectively utilize all of the platforms and related infrastructure that have already been developed for various purposes. This approach has many advantages in terms of the scope of utilization and economic feasibility. For example, when a humanoid robot is used, it is possible to get to the site of disaster using existing vehicles, in disaster situations which can put a driver in serious danger, as was the case with the 2011 Great Earthquake in Eastern Japan, which exposed people to intense radiation during fire-fighting operations. In economic terms, a humanoid robot used for the unmanned operation of an existing airplane can do so at a cost that is one-fiftieth that of an unmanned reconnaissance aircraft. The biggest advantage is that the automation can be applied to just about any device that a person can sit at and control. However, the actual realization of this approach requires diverse technologies in diverse fields, including console recognition technology, console device operation technology, motion state measurement technology, communication technology, control technology, mission designation technology, and emergency response technology, and so forth.

Successful Development of Intelligent Pilot Robots

Professor Shim Hyun-Chul's research team at the KI for Robotics has received much attention for its outstanding research accomplishments in the field of unmanned operation of existing vehicles, a unique and creative field in the research for unmanned vehicles. In particular, this study included the development of a humanoid robot capable of operating small airplanes, which can be programmed to control every function of an airplane as well as its stabilization. The robot can recognize the complex configuration of the cockpit and using the cameras mounted on its arms, accurately control various switches. For the actual flight control of the aircraft, the data provided from the sensors mounted on the robot as well as data from the aircraft are used. The flight control generates control commands necessary for stabilization and guidance of the aircraft, and for their implementation, the control commands for and between the controllers are issued. What is most impressive about this technology is that there is no need to fix or add any part to the airplane for the pilot robot. The robot can use all the existing switches and levers, including the steering wheel, fuel throttle valve, rudder pedals, etc. in the regular airplane cockpit. In addition to flying an airplane, at Creative Economy 2016, the research team successfully demonstrated the robot's automatic manipulation of the Hyundai Ionic Electric Vehicle by modifying it to be able to drive a car. Like the pilot robot, the car-driving robot can be used for any existing vehicle without any modification. As mentioned above, the research and development of pilot robots can lead to very useful outcomes, given the wide scope of its applications: when a pilot robot is used, the existing manned airplanes which account for the vast majority of airplanes in the aviation industry can be automatically controlled. Further, any car, ship, etc. which is controlled by a person inside can be automated. For this reason, there are high expectations for the R&D activities of professor Shin's research team. The robot developed in this research was introduced at the Annual Meeting of New World Champions of the World Economic Forum in June, 2016, and in August of the same year, it was intensively reviewed as a new innovative technology in the influential magazine, "Economist." The technology has been highly recognized globally, as demonstrated by its coverage in IEEE Spectrum and Discovery Channel's Daily Planet.

DEVELOPMENT OF LIFE EXTENSION TECHNOLOGY FOR NEXT GENERATION LITHIUM AIR BATTERIES

Kim, Hee Tak

KI for the NanoCentury

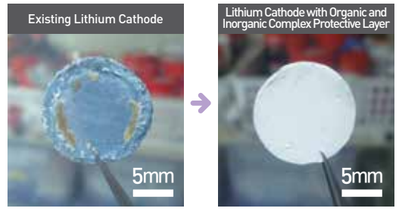
Dept. of Chemical and Biomolecular Engineering
Associate Professor

"Lithium Air Batteries: A way to overcome the limitations lurking in next-generation batteries"

Electric vehicles (EV) using existing lithium ion batteries have a limited battery capacity and thus a relatively shorter driving distance than that of oil-fueled vehicles, which makes them difficult to popularize and commercialize. Recently, lithium air batteries have been attracting attention from around the world as a next-generation high capacity battery that can overcome this limitation. However, lithium air batteries have considerable disadvantages such as low energy efficiency and rapid lifetime degradation due to a low reversibility at the air positive electrode and a high reactivity at the Li metal negative electrode. The low reversibility has improved thanks to a redox mediator, but the chemical degradation of the redox mediator at the Li metal electrode has prevented its practical usage. Against this backdrop, the technology developed in this research is expected to be a useful strategy for commercializing lithium air batteries, as it succeeded in extending the life of the battery by three times through covering the surface of the lithium metal electrode with an organic-inorganic hybrid protective layer.

Next generation large capacity batteries: A key to the popularity of EVs

Historically, automobiles were a measure and an aggregate of an era's technology. Today, electric vehicles, or EVs, are also a collection of state-of-the-art technologies and an icon of eco-friendly technology. EVs have various advantages over conventional internal combustion engine cars such as no exhaust gas and a remarkably low level of noise. Several companies around the world have been involved in the development of EVs, and some of them have also launched commercial products. The core of EV technology is the battery, which serves as the vehicle's power source. Currently, most of the EVs employ lithium-ion batteries, but their capacities are reaching their limits, making it impossible for the EVs' driving distance to match that of existing vehicles, even when the lithium battery of maximum capacity to date is used. The introduction of next-generation high-capacity batteries, therefore, have become an indispensable element in popularization and distribution of the EVs.



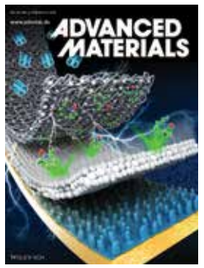
▲ Front inside cover image of the study, Advanced Materials

Lithium air batteries: The next big thing in the next generation battery market

Currently, various next-generation high-capacity batteries that exceed the limitations of existing ones are being developed, and the most notable among those are lithium air batteries. Also known as next-generation dream cells, lithium air batteries are secondary batteries that generate and store electricity through the electrochemical reaction of lithium and oxygen in the air. Lithium air batteries are expected to be the ultimate secondary battery that enable the EVs to overcome their short driving distance. This is because, theoretically, lithium air batteries can achieve an energy density 5 to 10 times higher than that of conventional secondary batteries with a 5 to 6 times lower energy generation cost. However, lithium air batteries have two significant disadvantages such as a low energy efficiency and rapid lifetime degradation due to lithium having a low reversibility at the positive electrode and a high reactivity at the negative electrode. Among the two limitations, the low reversibility in the positive electrode has been remarkably improved as a new method was suggested where a liquid catalyst called the "redox mediator" is introduced into the electrolyte. However, the rapid decrease in the lifespan due to the loss of mediators from the reaction between the mediators and lithium metal electrode still remains unresolved.

Significant increase in the lifetime of lithium air batteries

Against this backdrop, a technology that can solve the short lifetime of lithium air batteries has been developed by domestic researchers. Prof. Hee Tak Kim and Prof. Jung Ki Park and their joint team from the Department of Chemical and Biomolecular Engineering at KAIST (President: Sung-Mo Kang) said they have developed a technology that can extend the lifetime of lithium air batteries by three times. The team introduced an organic-inorganic hybrid protective layer consisting of a gel polymer capable of conducting lithium ions and alumina inorganic particles on the surface of the lithium metal negative electrode. The protective layer interferes with the reaction between lithium and the redox mediator, thereby suppressing the loss of the mediator and the growth of the surface lithium dendrite. As a result, they succeeded in extending the lifecycle by about three times through continuing the effect of the mediators. In addition, the protective layer lowers the high reactivity of the cathode as well as the lithium anode, resulting in a synergistic effect that also improves stability. The result of this research, which was supported by the National Research Foundation of Korea's General researcher Project and the Climate Change Response Technology Development Project, was published in an online issue (Feb 3, 2016) of Advanced Materials, a prominent international academic journal in the field of materials science. The research was also selected as a Front Inside Cover in recognition of its excellence. Prof. Kim said, "This study provides us clues to overcome the lifetime limitations of lithium air batteries, which are in the spotlight as a next-generation energy storage device." He continued, "This could be a useful strategy for the practical application of lithium air batteries."



▲ Advanced materials
Front Inside Cover Image

DISCOVERY OF THE PRINCIPLE OF GRAPHENE FORMATION BY SOLID PHASE SEPARATION

Graphene is a carbon nanomaterial separated from the surface layer of graphite and is a new material with the most advanced characteristics found to date. It is transparent and thin with the thickness of only 0.34nm, and highly stable, both physically and chemically. Due to these favorable characteristics, graphene has attracted attention as a future-oriented new material with wide-ranging potential for applications such as ultra-high speed semiconductors, flexible/transparent displays, high efficiency solar cells, and secondary batteries. However, since the graphene separated from graphite was too small in size and irregular in shape, it could not be applied directly to real life until now. To address such disadvantages, a large-area graphene film was previously synthesized by a chemical vapor deposition (CVD) method, despite needing a relatively longer production time and high-temperature process. Yet, the technology developed here allows us to synthesize graphene in a shorter time at room temperature, and to selectively synthesize it on a desired substrate, thus widening the scope of applications for graphene.

Choi, Sung Yool

KI for the NanoCentury

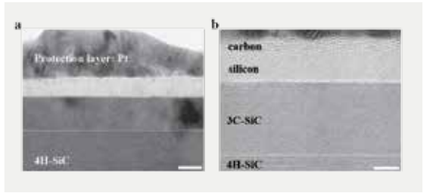
Dept. of Electrical Engineering
Associate Professor

"Easier synthesis of graphene, the dream material, with laser"

The first two-dimensional crystals discovered by mankind

Graphene, also known as the first two-dimensional crystal discovered by mankind, is a thin-film carbon isotope with carbon atoms intertwined in the shape of a hexagonal honeycomb. It was discovered in 2004 and was the subject of a study that won the 2010 Nobel Prize in Physics. Graphene is a thin film one atom thick, that is, 0.34 nm in thickness, which is about 3 billionths of a meter. Although it is extremely thin, it still has high physical and chemical stability. Graphene has been in the spotlight in academia due to its many excellent properties. It is 100 times more conductive than copper and can move electrons more than 100 times faster than silicon.

It is 200 times stronger than steel in intensity, has a high thermal conductivity that is more than twice than diamond, which is known as having the best thermal conductivity. It also has excellent elasticity. Even if it is physically increased or bent by 20%, its various electrical properties do not change at all. Also, since graphene is composed of one layer of atoms, the transmittance of light is as high as 97.7%, which makes it highly transparent. These characteristics make graphene the next big thing that will revolutionize the semiconductor and display industries.

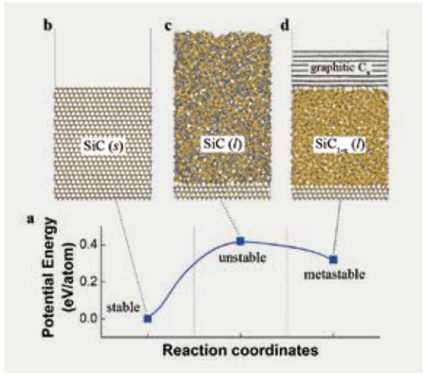


▲ TEM image of 4H-SiC with laser irradiation (A) and high-resolution TEM images of phase separation of SiC (B)

Development of easier and faster synthesis technology

A team of domestic researchers developed a technique that can easily synthesize graphene using a laser. A joint team, led by Prof. Sung-Yool Choi from the Dept. of Electrical Engineering at KAIST and Prof. Keon-Jae Lee from the Dept. of Materials Science and Engineering at KAIST said they discovered the solid phase separation phenomenon of single crystal silicon carbide (SiC) by irradiating ultrashort pulsed lasers for the first time in the world. They used this process to identify the principle of graphene generation. Conventionally, the chemical vapor deposition (CVD) method was mainly used in graphene synthesis.

The CVD method requires a considerable amount of time and a high temperature process in which a gaseous raw material is injected onto a substrate to form a thin film for a raw material on a substrate through chemical reactions in a high temperature environment. Unfortunately, there were a couple of disadvantages with this method: the quality of graphene can deteriorate and the substrate can be damaged during the process due to the process' complexity. Meanwhile, the laser heat treatment method developed by the team is enabling the synthesis of graphene in a short time in room temperature, thus significantly broadening the application of graphene in the future.



▲ Schematic diagram of MD simulations for phase separation process through melting of single-crystal SiC. Simulations demonstrate that atoms are rearranged into the metastable state

In this new method, the researchers irradiated the surface of the single crystal silicon carbide material with laser pulses for a very short period of time, which was only tens of nanoseconds (a nanosecond is one billionth of a second), so that the surface was instantaneously melted and re-solidified. Then, the phase separation was observed in which the silicon carbide surface was separated into an ultra-thin carbon layer and an underlying silicon (Si) layer. They found that the underlying silicon layer evaporated and the carbon layer turned into graphene when the laser pulses were irradiated again. The researchers also confirmed this by molecular dynamics. In particular, the interaction of hetero-structured elements such as silicon carbide with an ultrashort laser is a complex non-equilibrium phenomenon that has not been easy to identify until recently. Yet, the researchers took a picture of the carbon and silicon ultra-thin layers separated instantaneously by laser pulses with a high-resolution electron microscope and found that the light reflectance of semiconductor materials such as silicon in a liquid state was different from the light reflectance in its solid state. Based on such findings, the team succeeded in identifying the phase separation phenomena of silicon carbide.

The laser heat treatment technique used in the study is widely used in the production processes of commercial displays such as Active-Matrix Organic Light-Emitting Diode (AM OLED). This method can be applied to heat-sensitive plastic substrates because the method only instantaneously heats the surface of the material. In addition, the range of applications is expected to be broadened in the field of flexible electronics in the future because this new method enables the synthesis of graphene selectively at a desired position on a substrate. Thanks to its significance, the study was published in a recent issue of Nature Communications, an internationally-renowned academic journal in the fields of natural and applied sciences. Prof. Choi said, "In the future, we will be able to develop new nanomaterials by identifying the interactions of various solid compounds with lasers and utilizing their phase separation phenomena." Prof. Lee also added, "The results of this study is meaningful in that they will contribute to the wider applications of laser technology in 2D nanomaterials such as graphene."

DEVELOPMENT AND COMMERCIALIZATION OF THE 3D HOLOGRAPHY MICROSCOPE

Microscopes that have the 3D holography technique can measure a specimen's shape and internal information and observe the internal cell organelles without cell staining. In the conventional technique, it was necessary to stain the cells with fluorescent materials to effectively acquire three-dimensional images. However, due to this staining process, it was difficult to observe living cells, and, worse yet, this staining process cannot be applied to immune cells or stem cells that need to be injected into the body again. Against this backdrop, the technology introduced here is expected to be used in stem cell research and immunotherapy. The technology can also be applied in a wide range of research of diverse diseases such as infectious diseases, blood related illnesses, and cancers.

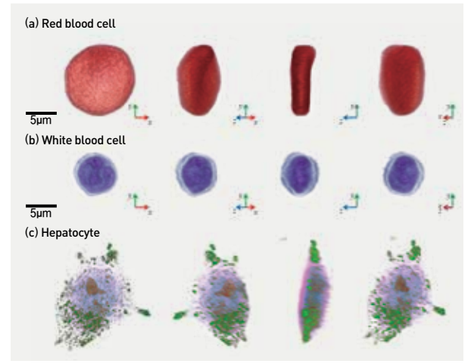
Park, Yongkeun

KI for Health Science and Technology
Dept. of Physics
Associate Professor

"Development of 3D holographic microscope: The opening of another door in diagnostic medicine"

Holographic microscope boosting expectations in its applications

3D holography technology was originally proposed more than 40 years ago, but its technical limitations have constrained its potential for a long time. Holographic microscopes started to be applied in various fields as late as 2000, and it is only recently that the relevant research has been conducted in full scale on the back of the advancement of related technologies. In particular, this technology has been widening its range of applications in line with the development of various new optical technologies in recent years. In the past, the direction of light was controlled by directly turning the mirror. However, the researchers developed and applied new technology known as the Digital Micromirror Device (DMD) to freely control various kinds of light without requiring mechanical parts.



▲ Three-dimensional images of various cells (red blood cells, white blood cells, and hepatocytes) observed using a microscope developed by Tomocube, Inc.

This made the commercialization of holographic microscopes possible. In addition to that, the technique to quickly process 3D image reconstruction using a Graphics Processing Unit (GPU) has also contributed greatly to the practical use of this technology. This research demonstrated the functional development of 3D holographic microscopes and the possibility of using them in medical research. With the basic research and development conducted at KI for Health Science and Technology, Prof. Yongkeun Park and his team established Tomocube Inc. in fall 2015. Tomocube launched prototypes within six months of its founding. Similar to the general microscope, the holographic microscope they developed looks into the body, but the 3D holographic microscope differs from conventional ones in that it uses a laser to look inside the cells.

In the conventional technique, a specimen should be rotated or a rotating mirror is needed to control the incident angle. However, these methods cause measurement defects due to rotation, and sometimes fine correction is needed to address the instability in the optical system. To overcome these limitations, Prof. Park and his team developed a 3D holographic microscope technology using DMD, and have succeeded in recently commercializing the technology. Thanks to their efforts, various industries are expecting robust advancement. In particular, the use of a 3D holographic microscope allows for the observation of cell fluorescence and internal cell organelles without staining the cells. Conventional techniques for observing cells in three-dimensional images such as confocal microscopy and multi-photon microscopy have limitations in that they have to stain cells to do so. In addition, existing techniques for dyeing cells using fluorescent proteins, organic dyes, and quantum dots are not only time-consuming, but also affect the vital phenomenon of the cells in the process of dyeing. The techniques have other limitations as well: the staining method cannot be used in fields such as stem cells and immune cells that need to be injected into the body again. On the other hand, the 3D holography technique, which can produce the result by specifying the refractive index, the optical property originally possessed by the cell, has the merit of solving conventional problems because the dyeing process is not necessary.

Structural studies with reduced limitations and increased expectations

3-dimensional holographic microscopes can measure the living cells for a long time without dyeing them. Plus, various quantitative information such as the cell's mass and concentration can be accurately measured. "This technology can be seen as a new paradigm of microscopic techniques for observing cells," said Prof. Park. He continued, "Tomocube has already started to sell and export the products in the first year, with the investment of SoftBank Ventures Korea and Hanmi Pharmaceuticals. The sales began in overseas markets, including Japan and UK, which are known for having high entry barriers in bio device markets. Our product has already been deployed in a number of advanced research institutes such as MIT, the School of Medicine at the University of Pittsburgh, and the German Cancer Center, and used for various research activities.

▲ Three-dimensional holographic microscope developed by Tomocube, Inc.

Moreover, we are in close cooperation with Seoul National University (SNU) Bundang Hospital, SNU Boramae Medical Center, and Asan Medical Center to find out the potential of our product, not only in studies, but also in the early diagnosis of various diseases. Going forward, we expect that our products will contribute to various fields such as pharmaceutical systems, neurochemistry, immunology, hematology, and cell biology." He also added, "Our study has fared well thanks to the systematic and structured support of Startup KAIST. I hope that high-tech medical device manufacturers and biotechnology companies in Korea continue to grow in the future with the support of highly advanced medical research technologies."

3D RETINA OCT ANGIOGRAPHY SYSTEM

Oh, Wang-Yuhl

KI for Health Science and Technology

Dept. of Mechanical Engineering
Associate Professor

"Providing a new tool for understanding retinal diseases and developing new diagnostic and treatment methods for retinal diseases"

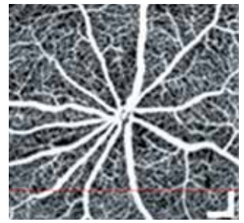
The OCT Angiography system is a useful tool that provides three-dimensional (3D) microvascular images in vivo. The small animal retinal OCT angiography visualizes anomalies in vascular distribution due to various diseases expressed in the retina of small animals. This study demonstrates that the OCT angiography can play a key role in various studies on retinal diseases and developments of new diagnostic and treatment methods for retinal diseases providing efficient visualization of changes in microvasculature as the progression of diseases and the response to the new treatment trials in small animal retinal disease models.

Development of the high-performance 3D microvasculature imaging system

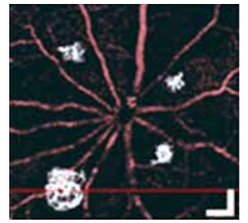
OCT (Optical Coherence Tomography) is an imaging technology capable of high-resolution 3D imaging using light. Today, OCT technology is widely utilized in various medical researches and clinical situations primarily because it provides wide-field high-resolution imaging, which is not availble from the conventional medical imaging devices such as CT, MRI, and ultrasound. In order to accurately diagnose and treat human retinal disease, understanding related diseases should be guaranteed.

It is also essential to have rigorous and repeatable experiments that verify the understanding of the disease, the usefulness and feasibility of the newly developed diagnostic and treatment methods. However, since these experiments cannot be directly performed on the patient, it is essential to develop animal disease models, obtain accurate understanding of the disease, and verify the effective treatment method developed through animal testing. Accordingly, it became necessary to develop a technology to study the 3D retinal microvasculature changes in animal disease models.

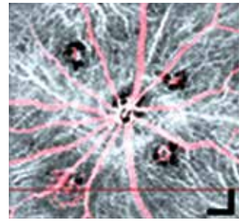
Prof. Oh and his team started the research with the recognition that there was no proper way to confirm these experiments and that previous studies had various limitations. Until recently, image analysis was conducted through histological studies at the expense of large number of small animals. In order to overcome the problems that come with understanding and developing treatment methods for eye diseases, the team developed a 3D imaging system that shows the retinal microvasculature and its changes over time in small animal disease models.



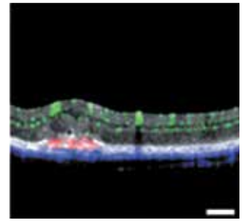
▲ Inner retinal flow



▲ Outer retinal flow



▲ Choroidal flow



▲ Cross section overlay

They also demonstrated the usefulness and effectiveness of the OCT angiography system that they developed by applying this system to small animal retinal disease models. Prof. Oh said, "Since 2012, all researchers engaged in this study have been fully dedicated to develop the system that has practical significance in conducting actual research from its early stage through close collaboration with Prof. Kyu Hyung Park and his team at SNU Bundang Hospital." He added, "This study is the result of persistent efforts by the researchers to develop a system that can provide crucial information through images in small animal retinal disease models confirming the progress and effects of treatment accurately and conveniently."

The researchers hope this study provides new methods and tools in retinal disease researches and development of new diagnostic and treatment methods for retinal diseases

In this study, the collaboration between research teams in KAIST and SNU Bundang Hospital from the early stages made it possible to develop a system that bears practical significance on on-site applications. The join of a post-doctoral researcher who has experience in retinal OCT development also spurred the research. Going forward, it is expected that identifying the cause of retinal disease can be more accurate and detailed in various retinal disease models of animals due to the OCT Angiography system developed by Prof. Oh and his team. This is because their system shows changes in the 3D retinal microvascular structure over time in a non-invasive way. This system is also expected to play an important role in the development of a system that can image medical devices related to eye diseases, including research on the progress of disease treatment and development of new drugs for retinal diseases. This research and the results of the study where the developed system was applied to CNV (choroidal neovascularization) disease in rodents have been recently published in Investigative Ophthalmology & Science (IIOVS), a world-renowned journal in the field of ophthalmology.

MICROSTRUCTURAL DENSIFICATION AND CO_2 SEQUESTRATION BY THE CARBONATION CURING OF BELITE CEMENT

Lee, H.K.

Saudi Aramco KAIST CO_2 Management Center

Dept. of Civil and Environmental Engineering
Professor

"Enhanced performance of concrete and CO_2 sequestration - killing two birds with one stone"

The mechanical properties and performance of cement-based construction materials can be vastly improved by using carbon dioxide (CO_2) in the curing process- carbonation curing- which is also a viable means of thermodynamically stable isolation of CO_2 over an extended period of time. A number of relevant technologies have already become commercialized in a few developed countries, and its interest is yet constantly growing. As the environmental regulations for CO_2 emissions in Korea are gradually taking shape, studies of CO_2 sequestration and utilization in cementitious materials will serve as a shortcut to building a more environmentally friendly and sustainable society.

Stable isolation of CO_2 in belite-rich cement

Concrete is the most common construction material that is produced and consumed by the largest amount across the world. Cement is the main element and the only artificially produced material used in manufacturing concrete. However, during the production of cement, a large amount of carbon dioxide is emitted, which is 5% to 8% of the total amount emitted from the industry as a whole.

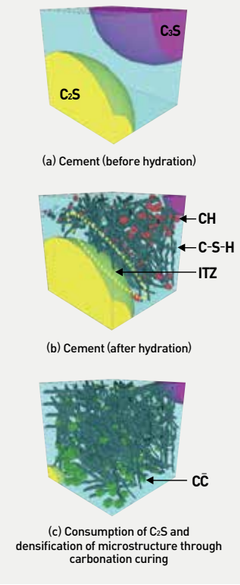
Since CO_2 is a well-known culprit of global warming, studies concerning various means of reducing CO_2 emissions or to capture (store) and utilize the emitted CO_2 have been actively conducted. Over the past several decades, the cement industry has been keen to reduce CO_2 emissions from the cement manufacturing process. In particular, the concrete industry has also been engaged in serious efforts to reduce the CO_2 generated in the concrete manufacturing process by recycling industrial by-products, expanding the use of blended cement, and developing cement-free binders. Even more active attempts have been made recently; one of those is isolating captured CO_2 through carbonation curing of concrete.

Against this backdrop, Prof. H.K. Lee and his team successfully developed technology that utilizes captured CO_2 in the curing process of concrete, thereby increasing the strength and durability of concrete and providing means of stable isolation of CO_2.

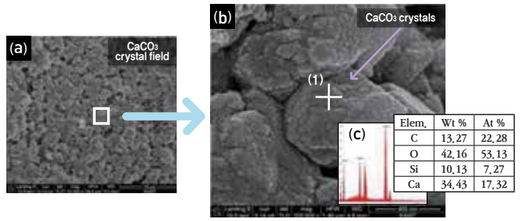
The team first came up with the idea from the fact that hydrated cement paste, which makes up concrete, absorbs CO_2 in the atmosphere by a chemical reaction called carbonation. Then, the team carried out studies on the carbonation reaction of dicalcium silicate (belite, $2CaO{\cdot}SIO_2$), which has a low hydraulic reactivity, in the clinker minerals of cement with the support of the Saudi Aramco-KAIST CO_2 Management Center.

Through the research, Prof. Lee and his team found the mechanism where CO_2 is provided in the curing process of concrete to carbonate belite phase, leading to the microstructural densification and improving the strength and durability of concrete.

In addition, they also found that 16.9% of CO_2 relative to the weight of the cement used can be sequestrated inside concrete by using belite-rich cement. This result has attracted great interest in the academic community. Last April, this study was published in Cement and Concrete Research, a prestigious journal in the field of construction materials.



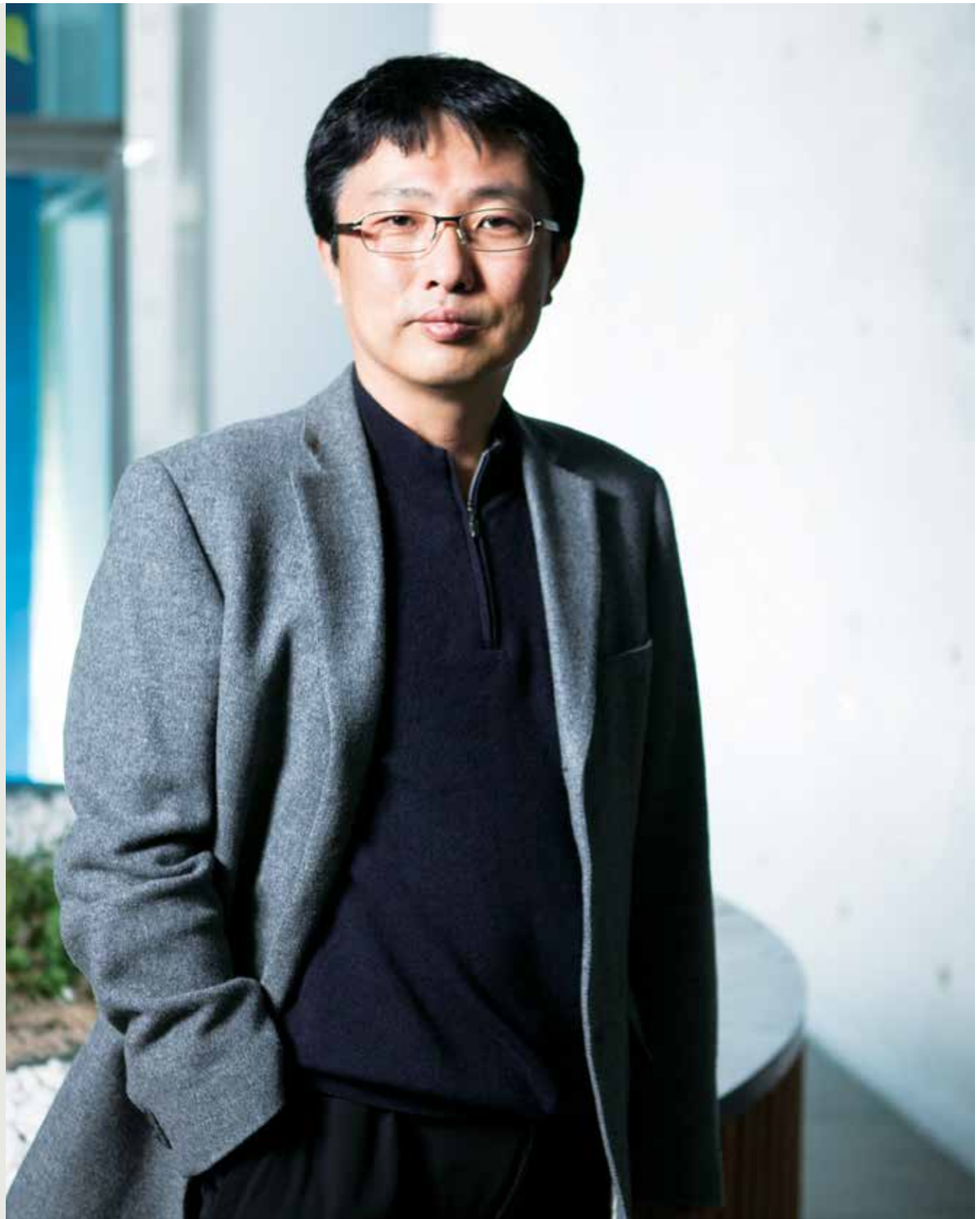
▲ Densification of microstructure and fixing of carbon dioxide through carbonation curing



▲ CO_2 fixed as calcium carbonate due to carbonation reactions of cement

This study has great significance in that cement-concrete, which has not been exactly recognized as an eco-friendly material, has been suggested as a medium that can isolate a large amount of CO_2. The team plans to apply this technology to industrialization through joint research with the Saudi Aramco-KAIST CO_2 Management Center.

STUDY ON THE PRODUCTION OF HIGH VALUE-ADDED RAW MATERIAL CHEMICALS THROUGH A CARBON DIOXIDE CONVERSION CATALYST



Han, Sang Woo

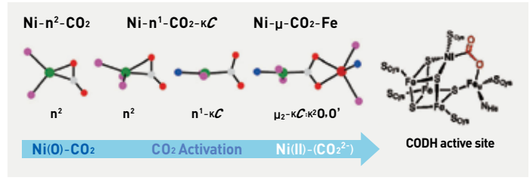
Saudi Aramco KAIST CO_2 Management Center

Dept. of Chemistry
Professor

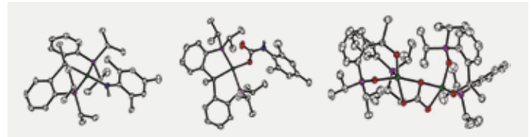
In 2016, Prof. Sang-Woo Han and his team at the Saudi Aramco-KAIST CO_2 Management Center accomplished three major achievements. First, they successfully simulated the method of activation of carbon dioxide with the dinuclear metal system utilized by the CODH enzyme. Second, they synthesized nickel metal compounds using a newly-developed pincer-type ligand, SiP2. Third, they also surprised academia by presenting a new principle of applying biocatalysts to homogeneous catalytic reactions. The results of their research were published in 「Chemical Science」, an internationally-eminent science journal. For Prof. Han and his team, the year 2016 was very rewarding and fruitful.

Validity of the CODH reaction mechanism finally identified

The first achievement of Prof. Han's team was modeling the binding reaction of nickel and CO_2, the electron transfer reaction, and the reaction mechanism for the conversion to CO, all of which take place at the activated site of the CODH/ACS enzyme. In this study, the team successfully synthesized the dinuclear complexes Ni-CO_2-Ni and Ni-CO_2-Fe, as well as the mononuclear complex Ni-CO_2 species, and analyzed their characteristics. In particular, they succeeded in modeling the enzyme active site by using a pincer-type PNP ligand system, and identified the reaction mechanism of CO_2 binding to one nickel atom and a two-electron transfer for the first time in the world.



▲ Stepwise modeling of the 2-electron reduction process of carbon dioxide starting from a single nickel center to a nickel-iron heterobimetallic center found in the CODH enzyme active site.



▲ Study on synthesis of a nickel amide species using a pincer nickel scaffold and its reactivity toward carbon dioxide.

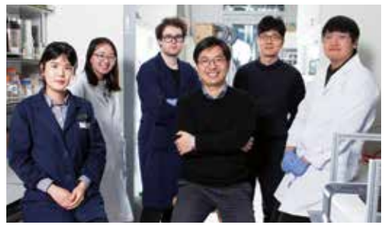
Furthermore, the team introduced ferrous metals to synthesize the (PNP) Ni-CO_2-Fe (PNP) species, a new species not known to date. Also, they confirmed that the C-O bond dissociation occurred due to the reaction between an acid and the nickel-CO_2 chemical species, resulting in a conversion to the nickel carbonyl compound {(PNP) Ni-CO}$^{+}$, which well represents the importance of metal-carbon bonds in the conversion of CO_2 to CO. This study is of great significance, in that CO_2 activation using the dinuclear metal system utilized by the CODH enzyme was successfully modeled and that the validity of the CODH mechanism has finally been identified.
In recognition of its excellence, the result of this study was introduced in Chemical Science in January 2017. It is expected that this study will provide key information in identifying the ultimate role of metals such as iron and nickel in the future.

Nickel-amide species synthesized using SiP2 ligand

Another big achievement of the team is that they synthesized nickel metal compounds and quaternary nickel amide species by using a SiP2 ligand and studied their reaction characteristics. In this study, it was observed that the new type of metal-ligand cooperation, which was also suggested initially by the team through a study on the PPP system, operated similarly in the SiP2 system as well. The most remarkable achievement is the identification of the mechanism where (MeSiP2) Ni-NHTrip, which is a nickel-amide species, reversibly substitutes Si-C bonds and Ni-N bonds to generate new Si-N and Ni-C bonds. This substitution reaction did not occur in a different nickel-amide compound, (MeSiP2) Ni-NHMes, where the successful production of carbamate was observed, by reaction with carbon dioxide. They also found that Ni-CONHPh can be synthesized by the carbonylation of nickel-amide. Because of this, the material will be undergoing a vigorous study for its potential to act as an important intermediate in the production of urea and isocyanate. Due to its excellent results, this study will be published in the special edition of "Inorganic Chemistry – The Next Generation" of Inorganica Chimica Acta in 2017.

Applying heterogeneous catalysts to homogeneous catalytic reactions

Metal nano particles used as heterogeneous catalysts are basically neutral in zero-valent metal states, so the catalytic reactions reported thus far tended to be limited to catalytic reactions that use low cost metals. In contrast, the transition metal compounds used in homogeneous catalysts can possess various oxidation states and therefore can be used for various reactions. Because of this merit, studies on the application of heterogeneous catalysts to homogeneous catalytic reactions have attracted a plethora of attention recently. Against this backdrop, the team synthesized a new core-shell nano catalyst by oxidizing the surface of rhodium nano particles. They then used this catalyst in reactions to synthesize the cyclic carbonate by combining carbon dioxide with epoxide, which has been shown to generally react with Lewis acid homogeneous catalysts.



Various X-ray spectroscopic methods such as XPS, EXAPS, and XANES have been actively used in the research process for analyzing solid surfaces. The results showed that the surface of the nanoparticles was oxidized to Rh (III) and the number Rh-Br and Rh-O bonds increased. In addition, the oxidized rhodium nano particles showed a higher reactivity than conventional rhodium salts, and also showed a high recovery rate in five recycling reactions, which is characteristic of heterogeneous catalysts. The TEM image illustrates that the catalyst's structure is maintained well in the recycling reaction. The results of this study are of great academic significance in terms of proposing a new principle of applying heterogeneous catalysts to homogeneous catalytic reactions, and it is expected that various technologies applying the principle will be developed in the future.

Research Achievements

KI for the BioCentury

Human Microbiome Control

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Cho, Byung Kwan	Construction of a minimal genome as a chassis for synthetic biology (Essays in biochemistry, 2016. 11)
2	Paper	Cho, Byung Kwan	Genome-wide transcriptome analysis revealed organelle specific responses to temperature variations in algae (Scientific reports, 2016. 11)
3	Paper	Cho, Byung Kwan	Analysis of the core genome and pan-genome of autotrophic acetogenic bacteria (Front. Microbiol., 2016. 09)
4	Paper	Cho, Byung Kwan	Effect of ethephon as an ethylene-releasing compound on the metabolic profile of chlorella vulgaris (Journal of Agricultural and Food Chemistry, 2016. 05)
5	Paper	Cho, Byung Kwan	Effects of the timing of a culture temperature reduction on the comprehensive metabolite profiles of chlorella vulgaris (Journal of applied phycology, 2016. 02)
6	Paper	Cho, Byung Kwan	The Dynamic Transcriptional and Translational Landscape of the Model Antibiotic Producer Streptomyces coelicolor A3(2) (Nature communication, 2016. 06)
7	Paper	Cho, Byung Kwan	Functional elucidation of the non-coding RNAs of Kluyveromyces marxianus in the exponential growth phase (BMC Genomics, 2016. 02)
8	Paper	Cho, Byung Kwan	Targeted gene deletion using DNA-free RNA-guided Cas9 nuclease accelerates adaptation of CHO cells to suspension culture (ACS Synthetic Biology, 2016. 02)
9	Paper	Cho, Byung Kwan	DNA-assisted Exfoliation of Tungsten Dichalcogenides and Their Antibacterial Effect (ACS Applied Materials & Interfaces, 2016. 01)
10	Paper	Cho, Byung Kwan	Minimal Genome: Worthwhile or Worthless Efforts toward Being Smaller? (Biotechnology Journal, 2016. 02)
11	Paper	Jeong, Ki Jun	Enhanced Secretion of recombinant proteins via signal recognition particle(SRP)-dependent secretion pathway by deletion of rrsE in Eshcherichia coli (Biotechnology & Bioengineering, 2016. 10)
12	Paper	Jeong, Ki Jun	Modular Optimization of Hemicellulose-utilizing Pathway in Corynebacterium glutamicum for Consolidated Bioprocessing of Hemicellulosic Biomass (ACS Synthetic Biology, 2016. 04)
13	Paper	Jeong, Ki Jun	Development of a new platform for secretory production of recombinant proteins in Corynebacterium glutamicum (Biotechnology & Bioengineering, Cover Article, 2016. 01)
14	Paper	Kim, Sun Chang	Connecting two proteins using a fusion alpha helix stabilized by a chemical cross linker (Nature Communications, 2016. 05)
15	Paper	Kim, Sun Chang	Stepwise phosphorylation of p65 promotes NF-kappa B activation and NK cell responses during target cell recognition (Nature Communications, 2016. 05)
16	Paper	Kim, Sun Chang	The dynamic transcriptional and translational landscape of the model antibiotic producer Streptomyces coelicolor A3(2) (Nature Communications, 2016. 06)
17	Paper	Kim, Sun Chang	Exosome-Mediated Activation of Toll-Like Receptor 3 in Stellate Cells Stimulates Interleukin-17 Production by gamma delta T Cells in Liver Fibrosis (Hepatology, 2016. 08)
18	Paper	Kim, Sun Chang	PARP1 enhances lung adenocarcinoma metastasis by novel mechanisms independent of DNA repair (Oncogene, 2016. 09)
19	Paper	Kim, Sun Chang	PIF1 Regulates Plastid Development by Repressing Photosynthetic Genes in the Endodermis (Molecular Plant, 2016. 10)
20	Patent	Jeong, Ki Jun	A novel promoter and use thereof (Patent registration, 1016730800000, 2016. 10)
21	Patent	Jeong, Ki Jun	A novel expression cassette for secretion of protein (Patent registration, 1016716260000, 2016. 10)

Human Microbiome Control

		Chief Researcher	Research Achievements (Representative Papers / Patents)
22	Patent	Kim, Sun Chang	A Fusion Polypeptide Having Advanced Lipase Activity and Process for Preparing the Same (Patent registration, JP, 2014523877, 2016. 05)
23	Patent	Kim, Sun Chang	A Fusion Polypeptide Having Advanced Lipase Activity and Process for Preparing the Same (Patent registration, CN, 201280029248.X, 2016. 09)

Cancer Metastasis Control

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Cho, Byung Kwan	Analysis of the mouse gut microbiome using full-length 16S rRNA amplicon sequencing (Scientific reports, 2016. 06)
2	Paper	Choi, Chul Hee	Prolonged silencing of diacylglycerol acytransferase-1 induces a dedifferentiated phenotype in human liver cells (Journal of Cellular and Molecular Medicine, 2016. 01)
3	Paper	Choi, Chul Hee	Ginsenoside 20(S)-protopanaxadiol suppresses viability of human glioblastoma cells via down-regulation of cell adhesion proteins and cell cycle arrest (Anticancer Research, 2016. 03)
4	Paper	Choi, Chul Hee	PARP1 enhances lung adenocarcinoma metastasis by novel mechanisms independent of DNA repair (Oncogene, 2016. 09)
5	Paper	Choi, Chul Hee	Combined inhibition of vascular endothelial growth factor receptor signaling with temozolomide enhances cytotoxicity against human glioblastoma cells via downregulation of Neuropilin-1 (Journal of Neuro-Oncology, 2016. 05)
6	Paper	Choi, Chul Hee	SoxF transcription factors are positive feedback regulators for VEGF signaling (Circulation Research, 2016. 09)
7	Paper	Choi, Jung Kyoon	Chromatin structure-based prediction of recurrent noncoding mutations in cancer (Nature Genetics, 2016. 10)
8	Paper	Choi, Jung Kyoon	Histone variant H3F3A promotes lung cancer cell migration through intronic regulation (Nature Communications, 2016. 10)
9	Paper	Choi, Jung Kyoon	Selected heterozygosity at cis-regulatory sequences increases the expression homogeneity of a cell population in humans (Genome Biology, 2016. 07)
10	Paper	Heo, Won Do	Optogenetic oligomerization of Rab GTPases regulates intracellular membrane trafficking (Nature Chemical Biology, 2016. 04)
11	Paper	Heo, Won Do	Optogenetic toolkit reveals the role of Ca^{2+} sparklets in coordinated cell migration (PNAS, 2016. 05)
12	Paper	Heo, Won Do	PLEKHG3 enhances polarized cell migration by activating actin filaments at the cell front (PNAS, 2016. 09)
13	Paper	Jeong, Won Il	Exosome-Mediated Activation of Toll-Like Receptor 3 in Stellate Cells Stimulates Interleukin-17 Production by gamma delta T Cells in Liver Fibrosis (Hepatology, 2016. 08)
14	Paper	Jeong, Won Il	Protective effects of ginsenoside F2 on 12-O-tetradecanoylphorbol-13-acetate-induced skin inflammation in mice (Biochemical and Biophysical Research Communications, 2016. 09)
15	Paper	Jeong, Won Il	Dual Notch signaling in proinflammatory macrophage activation. (Hepatology, 2016. 04)
16	Paper	Jeong, Won Il	Novel insight into a platelet-derived growth factor-C/Smad3 axis in liver fibrosis. Focus on "Role of Smad3 in platelet-derived growth factor-C-induced liver fibrosis" (Am J Physiol Cell Physiol, 2016. 03)
17	Paper	Jeong, Won Il	Hepatic non-parenchymal cells: Master regulators of alcoholic liver disease? (World Journal of Gastroenterology, 2016. 01)

Cancer Metastasis Control

		Chief Researcher	Research Achievements (Representative Papers / Patents)
18	Paper	Jon, Sang Yong	Bioengineered Yeast-derived Vacuoles with Enhanced Tissue Penetrating Ability for Targeted Cancer Therapy (Proc Natl Acad Sci USA, 2016. 01)
19	Paper	Jon, Sang Yong	Mono-arginine Cholesterol-based Small Lipid Nanoparticles as a Systemic siRNA Delivery Platform for Effective Cancer Therapy (THERANOSTICS, 2016. 01)
20	Paper	Jon, Sang Yong	Photo decomposable organic nanoparticles for combined tumor optical imaging and multiple Phototherapies (THERANOSTICS, 2016. 10)
21	Paper	Jon, Sang Yong	Enhanced Fluorescence Turn-on Imaging of Hypochlorous Acid in Living Immune and Cancer Cells (Chemistry-a european journal, 2016. 07)
22	Paper	Jon, Sang Yong	Bilirubin Nanoparticles as a Nanomedicine for Anti-inflammation Therapy (Angewandte chemie-international edition, 2016. 06)
23	Paper	Jon, Sang Yong	Bioreducible branched poly(modified nona-arginine) cell-penetrating peptide as a novel gene delivery platform (Journal of Controlled Release, 2016. 05)
24	Paper	Jon, Sang Yong	Multi-stimul-responsive bilirubin nanoparticles for anticancer therapy (Angewandte chemie-international edition, 2016. 08)
25	Paper	Jon, Sang Yong	Self-assembled nanoparticles comprising aptide-SN38 conjugates for used in targeted cancer therapy (Nanotechnology, 2016. 11)
26	Paper	Jon, Sang Yong	A drug-delivery strategy for overcoming drug resistance in breast cancer through targeting of oncofetal fibronectin (Nanomedicine, 2016. 10)
27	Paper	Jon, Sang Yong	Polymer Thin Films with Tunable Acetylcholine-Like Functionality Enable Long-Term Culture of Primary Hippocampal Neurons (ACS Nano, 2016. 10)
28	Paper	Jon, Sang Yong	Substituent Effects in BODIPY in Live Cell Imaging (Chem Asian J., 2016. 11)
29	Paper	Kim, Mi Young	GALNT14 promotes lung-specific breast cancer metastasis by modulating self-renewal and interaction with the lung microenvironment (Nature Communications, 2016. 12)
30	Paper	Kim, Mi Young	PARP1 enhances lung adenocarcinoma metastasis by novel mechanisms independent of DNA repair (Oncogene, 2016. 09)
31	Paper	Kim, Mi Young	H3K27 Demethylase JMJD3 Employs the NF-kappa B and BMP Signaling Pathways to Modulate the Tumor Microenvironment and Promote Melanoma Progression and Metastasis (Cancer Research, 2016. 01)
32	Paper	Song, Ji Joon	Single-molecule fluorescence measurements reveal the reaction mechanisms of the core RISC, composed of human Argonaute 2 and a guide RNA. (BMB Rep, 2015. 12)
33	Paper	Song, Ji Joon	Molecular Architecture of Yeast Chromatin Assembly Factor 1. (Sci Rep, 2016. 05)
34	Patent	Choi, Chul Hee	Photosensitizer encapsulated sub-12 nm size polymeric micelle for diagnosis and treatment of brain tumor (Patent registration, US, 9,393,308, 2016. 07)
35	Patent	Choi, Chul Hee	Technology to deliver the genome editing tool by using the CRISPR-CAS family (Patent application, 10-2016-0132616, 2016. 10)
36	Patent	Choi, Chul Hee	Process for preparing exosome loading super-repressor-IkB protein, and pharmaceutical composition for use in preventing or treating inflammatory diseases containing the same as an active ingredient (Patent application, 10-2016-0126335, 2016. 09)
37	Patent	Choi, Chul Hee	Process for preparing exosome loading cre recombinase, and pharmaceutical composition for use in generating conditional knock-out alleles containing the same as an active ingredient (Patent application, 10-2016-0126921), 2016. 09)
38	Patent	Choi, Chul Hee	Process for preparing exosome loading Bcl-2-associated X protein, and pharmaceutical composition for use in preventing or treating cancer containing the same as an active ingredient (Patent application, 1. 10-2016-0126961, 2016. 09)

Cancer Metastasis Control

		Chief Researcher	Research Achievements (Representative Papers / Patents)
39	Patent	Choi, Chul Hee	Evaluation of drug-targetable genes by defining modes of abnormality in gene expression (Patent application, 10-2016-0005101, 2016. 01)
40	Patent	Jeong, Won Il	Use of Ginsenoside F2 for Prevention and Treatment of Hepatocellular Carcinoma (Patent application, 10-2016-0099978, 2016. 08)
41	Patent	Jeong, Won Il	Protective Effects of Ginsenoside F2 on Alcohol-Mediated Steatohepatitis (Patent registration, 10-1621356-0000, 2016. 05)
42	Patent	Jon, Sang Yong	Bilirubin nanopartlcles, uses thereof and preparation methods thereof (Patent application, EP, 14875349.4, 2016. 05)
43	Patent	Jon, Sang Yong	Bilirubin nanopartlcles, uses thereof and preparation methods thereof (Patent application, US, 15104040, 2016. 06)
44	Patent	Jon, Sang Yong	Bilirubin nanopartlcles, uses thereof and preparation methods thereof (Patent registration, 10-1681299-0000, 2016. 11)
45	Patent	Jon, Sang Yong	Photo-decomposible organic nanoparticles for combined imaging and multiple phototherapies (Patent registration, 10-2016-0004810, 2016. 01)

Brain Cognitive Function Control

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Han, Jin Hee	Selective Control of Fear Expression by Optogenetic Manipulation of Infralimbic Cortex after Extinction (Neuropsychopharmacology, 2016. 04)
2	Paper	Song, Ji Joon	Huntingtin's spherical solenoid structure enables polyglutamine tract-dependent modulation of its structure and function (Elife, 2016. 05)

Others

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Choi, Chul Hee	H3K27 Demethylase JMJD3 Employs the NF-kB and BMP Signaling Pathways to Modulate the Tumor Microenvironment and Promote Melanoma Progression and Metastasis (Cancer Research, 2016. 01)
2	Paper	Choi, Chul Hee	Protopanaxatirol type ginsenoside Re promotes cyclic growth of hair follicles via inhibiting transforming growth factor signaling cascades (Biochemical and Biophysical Research Communications, 2016. 02)
3	Paper	Choi, Chul Hee	Principal component analysis of dynamic fluorescence images for diagnosis of diabetic vasculopathy (Journal of Biomedical Optics, 2016. 04)
4	Paper	Choi, Chul Hee	Exosome engineering for efficient intracellular delivery of soluble proteins using optically reversible protein-protein interaction module (Nature Communications, 2016. 07)
5	Paper	Choi, Chul Hee	Three-dimensional label-free imaging and quantification of lipid droplets in live hepatocytes (Scientific Reports, 2016. 11)
6	Paper	Heo, Won Do	Tracking protein-protein interaction and localization in living cells using a high-affinity molecular binder (Biochem Biophys Res Commun, 2016. 02)
7	Patent	Choi, Chul Hee	Automatic feature detection device and method using multi-variablization of images for classification of images (Patent registration, 10-1598873, 2016. 02)
8	Patent	Choi, Chul Hee	Process for preparing exosome loading Peroxiredoxin I or II protein, and pharmaceutical composition for use in antioxidant containing the same as an active ingredient (Patent application, 10-2016-0127486, 2016. 10)
9	Patent	Choi, Chul Hee	Process for preparing exosome loading target protein and method for loading target protein to cytosol by using exosome prepared thereby (Patent application, PCT/KR2016/004750, 2016. 05)

KI for IT Convergence

5G Mobile Communications

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Cho, Dong Ho	Autonomous Peer Discovery Scheme for D2D Communications based on Spatial Correlation of Wireless Channel (IEICE Trans. on Communications, 2016)
2	Paper	Cho, Dong Ho	Resource Allocation for Vehicle-to-Infrastructure Communication Using Directional Transmission (IEEE Trans. on ITS, 2016)
3	Paper	Cho, Dong Ho	Proportional Fair Energy-efficient Resource Allocation in Energy-Harvesting-based Wireless Networks (IEEE Systems Journal, 2016)
4	Paper	Cho, Dong Ho	Proportional Fair Resource Allocation in Energy Harvesting based Wireless Networks (IEEE Systems Journal, 2016)
5	Paper	Cho, Dong Ho	Resource Allocation Scheme for Multihop Cellular Networks Using Directional Transmission (Wireless Personal Communications, 2016)
6	Paper	Gil, Gye Tae	Channel Estimation via Orthogonal Matching Pursuit for Hybrid MIMO Systems in Millimeter Wave Communications (IEEE Trans. Commun, 2016)
7	Paper	Lee, Ju Yong	Spatial Multiplexing of OFDM Signals with QPSK Modulation over ESPAR (IEEE Transactions on Vehicular Technology, 2016)
8	Paper	Hong, Song Cheol	A Fully Integrated RF CMOS Front-End IC for Connectivity Applications (IEEE Transactions on Circuits and Systems II: Express Briefs, 2016)
9	Paper	Hong, Song Cheol	A Multi-Band CMOS Power Amplifier Using Reconfigurable Adaptive Power Cell Technique (IEEE Microwave and Wireless Components Letters , 2016)
10	Paper	Hong, Song Cheol	A Quasi-Doherty SOI CMOS Power Amplifier With Folded Combining Transformer (IEEE Transactions on Microwave Theory and Techniques, 2016)
11	Paper	Hong, Song Cheol	A Triple-Power-Mode Digital Polar CMOS RF Power Amplifier With LO Duty Cycle Control (IEEE Microwave and Wireless Components Letters, 2016)
12	Paper	Hong, Song Cheol	An Integrated Dual-Mode CMOS Power Amplifier with Linearizing Body Network (IEEE Transactions on Circuits and Systems II: Express Briefs, 2016)
13	Patent	Cho, Dong Ho	Antenna beamforming apparatus by using anisotropic radome (Patent registration, 1604386, 2016)
14	Patent	Cho, Dong Ho	Method for Cooperative Communication based on Beam Division Multiple Access, and an Apparatus Performing the Same (Patent application, 2016-0020581, 2016)
15	Patent	Cho, Dong Ho	Apparatus and Method for Controlling Uplink Data Retransmission (Patent application, 2016-0121462, 2016)
16	Patent	Cho, Dong Ho	Method for Feedback of Channel Information and Allocation of an Resource using Antenna Grouping, and Apparatuses Performing the Same (Patent application, 2016-0021926, 2016)
17	Patent	Cho, Dong Ho	Method of Supporting Mobility of an Access Point in Ultra Wide Area Wireless Backhaul Network, and Apparatus Performing the Same (Patent application, 2016-0010878, 2016)
18	Patent	Cho, Dong Ho	Method of Determining Hybrid Hand-Over, and an Apparatus Performing the Same (Patent application, 2016-0019303, 2016)
19	Patent	Cho, Dong Ho	Apparatus and Method for Scheduling for Antenna System (Patent application, PCT/KR2016/001044, 2016)
20	Patent	Cho, Dong Ho	Beam Sector Determining Method for User Equipment in BDMA System And Mobility Providing Method for User Equipment in BDMA System (Patent application, PCT/KR2016/001689, 2016)
21	Patent	Cho, Dong Ho	Method for Cooperative Communication based on Beam Division Multiple Access, and an Apparatus Performing the Same (Patent application, PCT/KR2016/001723, 2016)

5G Mobile Communications

		Chief Researcher	Research Achievements (Representative Papers / Patents)
22	Patent	Cho, Dong Ho	Random Access Method in BDMA System and Random Access Method in Pattern/Polarization BDMA System (Patent application, PCT/KR2016/001697, 2016)
23	Patent	Cho, Dong Ho, Gil, Gye Tae	Pattern/Polarization Antenna Apparatus (Patent application, PCT/KR2016/001694, 2016)
24	Patent	Cho, Dong Ho, Lee, Ju Yong	3-stage beamforming architecture for ultra wide area wireless backhaul network (Patent application, 2016-0011292, 2016)
25	Patent	Cho, Dong Ho, Lee, Ju Yong, Gil, Gye Tae	Beamforming method using pattern/polarization antenna (Patent registration, 10-1597148, 2016)
26	Patent	Cho, Dong Ho, Lee, Ju Yong, Gil, Gye Tae	Ofdm symbol transmiting using espar antenna in beamspace mimo system (Patent registration, 10-1645996, 2016)
27	Patent	Cho, Dong Ho, Lee, Ju Yong, Gil, Gye Tae	Resource reuse method for communication system based on bdma (Patent application, 10-2016-0033246, 2016)
28	Patent	Cho, Dong Ho, Lee, Ju Yong, Gil, Gye Tae	Line-of-sight mimo system based on multiple pattern/polarization antennas (Patent application, 10-2016-0030811, 2016)
29	Patent	Cho, Dong Ho, Lee, Ju Yong, Gil, Gye Tae	Method for pattern/polarization beam division multiple access based on massive antennas, and an apparatus performing the same (Patent application, 10-2016-0033376, 2016)
30	Patent	Cho, Dong Ho, Lee, Ju Yong, Gil, Gye Tae	Pattern/polarization antenna (Patent application, 10-2016-0019390, 2016)
31	Patent	Cho, Dong Ho, Lee, Ju Yong, Gil, Gye Tae	Resource reuse method for communication system based on bdma (Patent application, PCT/KR2016/005460, 2016)
32	Patent	Cho, Dong Ho, Lee, Ju Yong, Gil, Gye Tae	Method for Pattern/Polarization Beam Division Multiple Access based on Massive Antennas, and an Apparatus Performing the Same (Patent application, PCT/KR2016/005459, 2016)
33	Patent	Cho, Dong Ho, Lee, Ju Yong, Gil, Gye Tae	Pattern/Polarization Antenna and Beamforming Method (Patent application, 15110921, 2016)
34	Patent	Gil, Gye Tae	Method for channel estimation and feedback in massive MIMO systems (Patent registration, 1669857, 2016)
35	Patent	Gil, Gye Tae	Design of a uniform circular array with array of subarray architecture in LOS channel (Patent application, 2016-0044341, 2016)
36	Patent	Gil, Gye Tae	Method and apparatus for pilot beam design for millimeter wave transmission systems (Patent application, 2016-0004400, 2016)
37	Patent	Lee, Ju Yong	A planar type antenna apparatus for beamspace MIMO system (Patent registration, 10-1657871-0000, 2016)
38	Patent	Lee, Ju Yong	Transmission apparatus and transmission method thereof in MIMO system (Patent application, 10-2016-0021126, 2016)
39	Patent	Lee, Ju Yong	Transmission apparatus performing selective beamforming using multiple Stream transmission circuit and transmission method thereof (Patent application, 10-2016-0021690, 2016)
40	Patent	Lee, Ju Yong	RF device for minimization of return loss (Patent application, 10-2016-0017460, 2016)
41	Patent	Lee, Ju Yong	Method and apparatus for selecting beam direction in long distance wireless backhaul system (Patent application, 10-2016-0051648, 2016)
42	Patent	Lee, Ju Yong	Transmission apparatus performing selective beamforming using multiple Stream transmission circuit and transmission method thereof (Patent application, PCT/KR2016/001798, 2016)

5G Mobile Communications

		Chief Researcher	Research Achievements (Representative Papers / Patents)
43	Patent	Hong, Song Cheol	Transceiver using resonant coupling and nonlinear effect by plasma wave (Patent registration, 10-1661907-0000, 2016)
44	Patent	Hong, Song Cheol	6 Port RF Modulator and Management Method of the Same (Patent application, 10-2016-0010546, 2016)
45	Patent	Hong, Song Cheol	High frequency modulator using switching resonance frequency (Patent application, 10-2016-0124612, 2016)
46	Patent	Hong, Song Cheol	Resonance apparatus and apparatus for transmitting power Wirelessly using the same (Patent application, 10-2016-0077495, 2016)
47	Patent	Hong, Song Cheol	Architecture of CMOS cascode main amplifier and auxiliary amplifier (Patent application, 10-2016-0047631, 2016)
48	Patent	Hong, Song Cheol	Doherty power amplifier (Patent application, 201610085627, 2016)
49	Patent	Hong, Song Cheol	Power amplifier (Patent application, 14993505, 2016)
50	Patent	Hong, Song Cheol	Power amplifier (Patent application, 14993640, 2016)

IoT/WoT

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Kim, Dae Young	Intra-MARIO: A Fast Mobility Management Protocol for 6LoWPAN (IEEE Transactions on Mobile Computing, 2016)
2	Paper	Choi, Jun Kyun	Serving a video into an image carousel: system design and implementation (Springer Cluster Computing, 2016)
3	Paper	Choi, Jun Kyun	A Study on the Network Resource Openness with Software Networking toward the Development of theWeb Technology (Journal of Software Networking, 2016)
4	Paper	Choi, Jun Kyun	Contribution based Energy Trading Mechanism in Micro-Grids for Future Smart Grid : A Game Theoretic Approach (IEEE Transactions on Industrial Electronics , 2016)
5	Paper	Choi, Jun Kyun	Novel Early Wake-up Decision Algorithm for ONUs in TDM-PONs with Sleep Mode (Journal of Optical Communications and Networking, 2016)
6	Paper	Choi, Jun Kyun	Power Efficient Rate Allocation of Wireless Access Networks with Sleep Operation Management for Multi-homing Services (Journal of Communications and Networks, 2016)
7	Paper	Choi, Jun Kyun	Quality of experience provisioned mobile streaming protocol for the hyper-connected Internet of Things devices over the heterogeneous wireless access networks (International Journal of Distributed Sensor Networks, 2016)
8	Paper	Choi, Jun Kyun	Strengthening trust in the future social-cyber-physical infrastructure: an ITU-T perspective (IEEE Communications Magazine, 2016)
9	Paper	Choi, Jun Kyun	A Distributed Power Allocation Scheme for Base Stations Powered by Retailers with Heterogeneous Renewable Energy Sources (ETRI Journal, 2016)
10	Paper	Choi, Jun Kyun	A Study on Trustworthy Cyber-Physical ID/Location Mapping on IoT and NFV (Journal of Software Networking, 2016)
11	Paper	Jung, Sung Kwan	A Study on the IoT Instance Hosting in Edge Cloud and NFV (Journal of Software Networking, 2016)

IoT/WoT

		Chief Researcher	Research Achievements (Representative Papers / Patents)
12	Paper	Jung, Sung Kwan	Development and architecture of video-to-images to enhance user experience for video content consumption (Journal of KIISE, 2016)
13	Paper	Jung, Sung Kwan	Classification model of types of crime based on random-forest algorithms and monitoring interface design factors for real-time crime prediction (KIISE Transactions on Computing Practices, 2016)
14	Patent	Kim, Dae Young	Publish/Subscription Model for GS1 Architecture using GPC, System and Method Implementing the Same (Patent application, 10-2016-0081892, 2016)
15	Patent	Kim, Dae Young	Internet of things device with architecture defining property including GS1 code information and service Providing Method Using The Same (Patent application, 10-2016-0100557, 2016)
16	Patent	Kim, Dae Young	The video system using GS1 code, operating method and service providing method (Patent application, 10-2016-0135515, 2016)
17	Patent	Kim, Dae Young	Beacon apparatus using GS1 code, operating method thereof and service providing method using the same (Patent application, 10-2016-0050668, 2016)
18	Patent	Kim, Dae Young	Graph-based information system and method for identification event and master data (Patent application, 10-2016-0056945, 2016)
19	Patent	Kim, Dae Young	Beacon apparatus using GS1 code, operating method thereof and service providing method using the same (Patent application, 15293031, 2016)
20	Patent	Choi, Jun Kyun	Method and system for manager configuration of intelligent communication (Patent registration, 10-1598044-0000, 2016)
21	Patent	Choi, Jun Kyun	Sevice method and system for managing transaction using application property (Patent registration, 10-1605967-0000, 2016)
22	Patent	Choi, Jun Kyun	Method and system for supportin dynamic instance hosting service of virtual object (Patent registration, 10-1605968-0000, 2016)
23	Patent	Choi, Jun Kyun	Method and system for browsing virtual object (Patent registration, 10-1630954-0000, 2016)
24	Patent	Choi, Jun Kyun	Method and system for displaying learning contents based on learning result (Patent registration, 10-1633543-0000, 2016)
25	Patent	Choi, Jun Kyun	Method and system architecture for providing multi-Independent browser based digital signage (Patent registration, 10-1641833-0000, 2016)
26	Patent	Choi, Jun Kyun	Method and system for controlleing query response (Patent registration, 10-1644702-0000, 2016)
27	Patent	Choi, Jun Kyun	Method and system for energy efficient bandwidth allocation for relay in millimeter-wave mobile systems (Patent registration, 10-1645129-0000, 2016)
28	Patent	Choi, Jun Kyun	Bio-inspired algorithm based P2P content caching method for wireless mesh networks and system thereof (Patent registration, 10-1653092-0000, 2016)
29	Patent	Choi, Jun Kyun	System and method for providing multi screen using relative position between the plurality of screen (Patent registration, 10-1653922-0000, 2016)
30	Patent	Choi, Jun Kyun	Method and system for controlling device based internet of things (Patent registration, 10-1662396-0000, 2016)
31	Patent	Choi, Jun Kyun	System and method for processing data in environment of internet of things (Patent registration, 10-1665861-0000, 2016)
32	Patent	Choi, Jun Kyun	Service method and system using instance interface of virtualization object in internet of things environment (Patent registration, 2840813, 2016)

IoT/WoT

		Chief Researcher	Research Achievements (Representative Papers / Patents)
33	Patent	Choi, Jun Kyun	Method for invoking application in screen lock environment (Patent registration, 9256749, 2016)
34	Patent	Choi, Jun Kyun	Method and apparatus for moving web object based on intent (Patent registration, 9442687, 2016)
35	Patent	Choi, Jun Kyun	Method and system for correcting play areas using slope information of user terminal during 360 degree content playback (Patent application, 10-2016-0087641, 2016)
36	Patent	Choi, Jun Kyun	Method and System Apparatus for Internet of Things Service management (Patent application, 10-2016-0056795, 2016)
37	Patent	Choi, Jun Kyun	Method and system to controlling the point automatically of spherical content (Patent application, 10-2016-0049807, 2016)
38	Patent	Choi, Jun Kyun	Method and system for processing in bound call of the messenger subscriber (Patent application, 10-2016-0080230, 2016)
39	Patent	Choi, Jun Kyun	Method and system for determing delivery point using unmanned aerial vehicle (Patent application, 10-2016-0057607, 2016)
40	Patent	Choi, Jun Kyun	method and system for determing delivery point using unmanned aerial vehicle (Patent application, 10-2016-0081524, 2016)
41	Patent	Choi, Jun Kyun	Multi-media File Format Including Meta Information for Providing User Request and Environment Customize Contents (Patent application, 10-2016-0009946, 2016)
42	Patent	Choi, Jun Kyun	Method and apparatus to operating energy-efficient home video cache (Patent application, 10-2016-0027444, 2016)
43	Patent	Choi, Jun Kyun	Method and system to controlling view angle of spherical content (Patent application, 10-2016-0087623, 2016)
44	Patent	Choi, Jun Kyun	Method and system for correcting play areas using slope information of user terminal during 360 degree content playback (Patent application, PCT/KR2016/010909, 2016)
45	Patent	Choi, Jun Kyun	Bio-inspired Algorithm based P2P Content Caching Method for Wireless Mesh Networks and System thereof (Patent application, 15003740, 2016)
46	Patent	Choi, Jun Kyun	Multi-media file structure and system including meta information for providing user request and environment customize contents (Patent application, PCT/KR2016/010909, 2016)
47	Patent	Choi, Jun Kyun	Method and system for providing video content based on image (Patent application, 15149729, 2016)
48	Patent	Choi, Jun Kyun	Method and apparatus for user centric cache allocation in infrastructure wireless mesh networks (Patent application, 15288177, 2016)

Integrated Sensors

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Cho, Gyuseong	A Design of a Valid Signal Selecting and Position Decoding ASIC for PET Using Silicon Photomultipliers (JINST, 2016)
2	Paper	Cho, Gyuseong	Optimization of a guard ring structure in Geiger-mode avalanche photodiodes fabricated at National Nanofab Center (JINST, 2016)
3	Paper	Cho, Gyuseong	Design of a Linear Detector Array Unit for High Energy X-ray Helical Computed Tomography and Linear Scanner (Journal of Radiation Industry, 2016)

Integrated Sensors

		Chief Researcher	Research Achievements (Representative Papers / Patents)
4	Paper	Cho, Gyuseong	Calculation of Concrete Shielding Wall Thickness for 450 kVp X-ray Tube with MCNP Simulation and Result Comparison with Half Value Layer Method Calculation (Journal of Radiation Industry, 2016)
5	Paper	Yoo, Hyung Joun	Three-Electrode Metal-Oxide Gas Sensor System (IEEE Sensors J., 2016)
6	Paper	Yoo, Hyung Joun	Method of operating three-electrode gas sensor (Science and Technology of Sensors, 2016)
7	Paper	Park, Inkyu	A room temperature hydrogen sulfide gas sensor based on electrospun polyaniline–polyethylene oxide nanofibers directly written on flexible substrates (RSC Advances, 2016)
8	Paper	Park, Inkyu	Highly Sensitive, Flexible and Wearable Pressure Sensor Based on a Giant Piezocapacitive Effect of Three-Dimensional Microporous Elastomeric Dielectric Layer (ACS Applied Materials & Interfaces, 2016)
9	Paper	Park, Inkyu	Temperature measurement of Joule heated silicon micro/nanowires using selectively decorated quantum dots (Nanoscale, 2016)
10	Paper	Park, Inkyu	Extremely Robust and Patternable Electrodes for Copy-Paper-Based Electronics (ACS Applied Materials & Interfaces, 2016)
11	Paper	Park, Inkyu	High-Performance, Solution-Processed, Embedded Multiscale Metallic Transparent Conductors (ACS Applied Materials & Interfaces, 2016)
12	Paper	Park, Inkyu	Stretchable, skin-mountable, and wearable strain sensors and their potential applications: A review (Advanced Functional Materials, 2016)
13	Paper	Park, Inkyu	Polymeric biomaterials for medical implants and devices (ACS Biomaterials Science and Engineering, 2016)
14	Paper	Park, Inkyu	Recent Trends of Light-enhanced Metal Oxide Gas Sensors: Review (Journal of Sensor Science and Technology, 2016)
15	Paper	Park, Jongwook	Comparison of the Power Consumption between the Ceramic and Wire Bonding Packaging Methods for Solid- State Electrochemical Carbon dioxide sensors (Journal of Sensor Science and Technology, 2016)
16	Paper	Hong, Songcheol	A 254 GHz CMOS Transmitter With VCO-Q Modulation (IEEE Microwave and Wireless Components Letters, 2016)
17	Paper	Hong, Songcheol	A 79-GHz Adaptive-Gain and Low-Noise UWB Radar Receiver Front-End in 65-nm CMOS (IEEE Transactions on Microwave Theory and Techniques, 2016)
18	Paper	Hong, Songcheol	Highly efficient W-band 2.5 GHz bandwidth pulse generator with –1 dBm output power in 65 nm CMOS (Electronics Letters, 2016)
19	Paper	Hong, Songcheol	K-Band Single-Path Dual-Mode CMOS Transmitter for FMCW/UWB Radar (IEEE Microwave and Wireless Components Letters, 2016)
20	Patent	Cho, Gyuseong	A radiation counting readout circuit having dual signal-procecessing paths and the radiation counting method using the same (Patent registration, 10-2014-0086586, 2016)
21	Patent	Cho, Gyuseong	Method and system to increase spatial resolution using the charge sharing at the medical imaging sensor (Patent application, 10-2016-0075078, 2016)
22	Patent	Cho, Gyuseong	Method of generating an image based on a difference of filter per pixel, and apparatuses performing the same (Patent application, 10-201-0081806, 2016)
23	Patent	Cho, Gyuseong	The circuit of the detector for positron emission tomography with selecting effective signals and reducing channels (Patent application, 10-2016-0046978, 2016)
24	Patent	Cho, Gyuseong	The module of silicon photomultipliers with outputs to both ends (Patent application, 10-2016-0035439, 2016)

Integrated Sensors

		Chief Researcher	Research Achievements (Representative Papers / Patents)
25	Patent	Yoo, Hyung Joun	Coupling shielded inductor for high inductive isolation (Patent application, 10-2016-0068260, 2016)
26	Patent	Yoo, Hyung Joun	Impedance magnitude measurement circuit using time-offset-based self-sampling schemes and impedance magnitude and phase measurement device using the same (Patent application, 10-2016-0131773, 2016)
27	Patent	Park, Inkyu	Capacitive type pressure sensor with porous dielectric layer (Patent application, 14990838, 2016)
28	Patent	Park, Jongwook	Hydrogen sensor element for measuring concentration of hydrogen gas dissolved in liquid and method for measuring concentration of hydrogen gas using same (Patent application, 15021609, 2016)
29	Patent	Park, Jongwook	Hydrogen sensor element for measuring concentration of hydrogen gas dissolved in liquid and method for measuring concentration of hydrogen gas using same (Patnet application, 2016-542633, 2016)
30	Patent	Park, Jongwook	Hydrogen sensor element for measuring concentration of hydrogen gas dissolved in liquid and method for measuring concentration of hydrogen gas using same (Patent application, 201480062090.5, 2016)
31	Patent	Park, Jongwook	Hydrogen sensor element for measuring concentration of hydrogen gas dissolved in liquid and method for measuring concentration of hydrogen gas using same (Patent application, 14844519.0, 2016)
32	Patent	Choi, Jun Kyun	Play areas correction method using the slope information of the user terminal during vr playback (Patent application, 10-2016-0059320, 2016)
33	Patent	Hong, Songcheol	Harmonic oscillator using transmission line transformer (Patent registration, 10-1599726-0000, 2016)
34	Patent	Hong, Songcheol	High-frequency pulse beam-forming radar (Patent registration, 10-1614815-0000, 2016)
35	Patent	Hong, Songcheol	Pulsed Doppler Radar and Operating Method of the Same (Patent application, 10-2016-0011302, 2016)

Others

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Yoo, Hyung Joun	A Coupling Shielded Inductor for High Isolation Between PA and LC-Based DCO (IEEE EDL, 2016)
2	Patent	Cho, Dong Ho	Apparatus and method for providing electric power and thrust force to a wireless charging lim type maglev hybrid vehicle (Patent registration, 1606152, 2016)
3	Patent	Cho, Dong Ho	Apparatus and method for detecting pedestrian using edge projections (Patent registration, 1644190, 2016)
4	Patent	Cho, Dong Ho	Pickup with core slit for wireless power transmission system weight reduction (Patent registration, 1657570, 2016)
5	Patent	Cho, Dong Ho	Transmission Line for Capacitively Coil (Patent registration, 9350171, 2016)
6	Patent	Cho, Dong Ho	System and Method for Controlling Group Driving (Patent registration, I1517995, 2016)
7	Patent	Cho, Dong Ho	Apparatus for Protecting Over Voltage (Patent application, 2016-0008866, 2016)
8	Patent	Cho, Dong Ho	Wireless Power Transfer System (Patent application, 2016-0020637, 2016)

Others

		Chief Researcher	Research Achievements (Representative Papers / Patents)
9	Patent	Cho, Dong Ho	Apparatus for Detecting Change of Load Impedance Wireless Power Transmission System (Patent application, 2016-0056585, 2016)
10	Patent	Cho, Dong Ho	Wireless Power Transfer System for every electric vehicle on the Road (Patent application, 2016-0071342, 2016)
11	Patent	Cho, Dong Ho	Power Feeding and Pick-up Apparatus Having Human Safety (Patent application, 2016-0078246, 2016)
12	Patent	Cho, Dong Ho	Apparatus for Detection Change of Impedance (Patent application, 2016-0014397, 2016)
13	Patent	Cho, Dong Ho	Method of Adaptive Fast Wireless Charging System (Patent application, 2016-0058898, 2016)
14	Patent	Cho, Dong Ho	Localization System with using an Equipment for Wireless Power Transfer (Patent application, 2016-0061937, 2016)
15	Patent	Cho, Dong Ho	Apparatus and Method for Power Feeding and Pick-up Measurable Optimum Charging Position (Patent application, 2016-0136053, 2016)
16	Patent	Cho, Dong Ho	System of Wireless Power Transfer for Drones to Transport a Goods (Patent application, 2016-0087711, 2016)
17	Patent	Cho, Dong Ho	Wireless Power Charging System Strong to Deviation (Patent application, 2016-0136057, 2016)

KI for Robotics

RTOS for Humanoid Robots

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Oh, Jun Ho	Humanoid Posture Selection for Reaching Motion and a Cooperative Balancing Controller (Journal of Intelligent Robotic Systems, 2016. 03)
2	Paper	Oh, Jun Ho	Robot system of DRC-HUBO+ and Control Strategy of Team KAIST in DARPA Robotics Challenge Finals (Journal of Field Robotics, 2016. 09)

Mobile Intelligence for Vehicular Robots

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Kim, A Young	Bundle Adjustment and 3D Reconstruction Method for Underwater Sonar Image (Journal of korea Robotics Society, 2016. 06)
2	Paper	Kim, A Young	Comparative Study of Sonar Image Processing for Underwater Navigation (Journal of Advanced Research in Ocean Engineering, 2016. 06)
3	Paper	Kim, A Young	Accurate Mobile Urban Mapping via Digital Map-based SLAM (SENSORS, 2016. 08)
4	Paper	Kim, Jin Whan	Predictive evaluation of ship collision risk using the concept of probability flow (IEEE Journal, 2016. 11)
5	Paper	Kim, Jin Whan	Fast underwater image mosaicing through submapping (Journal of Intelligent, 2016. 05)
6	Paper	Kim, Jin Whan	Development of an Unmanned Surface Vehicle System for the 2014 Maritime RobotX Challenge (Journal of Field Robotics, 2016. 06)
7	Paper	Kim, Jin Whan	A Robust Loop-Closure Method for Visual SLAM in Unstructured Seafloor Environments (Autonomous Robots, 2016. 08)
8	Paper	Kim, Jin Whan	Online underwater optical mapping for trajectories with gaps (Intelligent Service, 2016. 07)
9	Paper	Kim, Jin Whan	Path Optimization for Marine Vehicles in Ocean Currents using Reinforcement Learning (Journal of Marine Science and Technology, 2016. 06)
10	Paper	Kim, Jin Whan	Mobile Robot Navigation using Grid Line Patterns via Probabilistic Measurement Modeling (Intelligent Service Robotics, 2016. 04)
11	Paper	Kim, Jin Whan	An Explicit Data Assimilation Scheme for a Nonlinear Wave Prediction Model Based on a Pseudo-Spectral Method (IEEE Journal of Oceanic, 2016. 01)
12	Paper	Kim, Jin Whan	Dynamic Positioning Control of a Twin-hull Unmanned Surface Ship (Journal of korea Robotics Society, 2016. 12)
13	Paper	Kim, Jin Whan	Model-Based Pose Estimation for High-Precise Underwater Navigation Using Monocular Vision (Journal of korea Robotics Society, 2016. 12)
14	Paper	Kim, Jin Whan	Development of a Hover-capable AUV System for In-water Visual Inspection via Image Mosaicking (Journal of Advanced Research in Ocean Engineering, 2016. 03)
15	Paper	Shim, Hyun Chul	Toward autonomous aircraft piloting by a humanoid robot: Hardware and control algorithm design (Intelligent Robot & Systems, 2016. 10)
16	Paper	Shim, Hyun Chul	EureCar Turbo: a Self-Driving Car that can Handle Adverse Weather Conditions (Intelligent Robot & Systems, 2016. 10)

Mobile Intelligence for Vehicular Robots

		Chief Researcher	Research Achievements (Representative Papers / Patents)
17	Paper	Shim, Hyun Chul	Landing Control on a Mobile Platform for Multi-copters using an Omnidirectional Image Sensor (Journal of Intelligent & Robotic Systems, 2016. 03)
18	Paper	Shim, Hyun Chul	Fault Tolerant Control of Hexacopter for Actuator Faults using Time Delay Control Method (International Journal of Aeronautical and Space Sciences, 2016. 03)

AI for Cooperative Robots

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Kwon, Dong Soo	Multidimensional evaluation and analysis of motion segmentation for inertial measurement unit applications (Multimedia Tools and Applications, 2016. 09)
2	Paper	Kwon, Dong Soo	Mechanical and psychophysical performance evaluation of a haptic actuator based on magnetorheological fluids (Journal of intelligent material systems and structures, 2016. 08)
3	Paper	Kwon, Dong Soo	Development and Evaluation of an Impact Vibration Actuator using an Unstable Mass for Mobile Devices (International Journal of Control, Automation and Systems, 2016. 07)
4	Paper	Kim, Jong Hwan	Behavior Hierarchy-Based Affordance Map for Recognition of Human Intention and Its Application to Human-Robot Interaction (IEEE Transactions on Human-Machine Systems, 2016. 10)
5	Paper	Kim, Jong Hwan	Evolutionary Fuzzy Integral-based Gaze Control with Preference of Human Gaze (IEEE Transactions on Cognitive and Developmental Systems, 2016. 09)
6	Paper	Kim, Jong Hwan	Effective Background Model-Based RGB-D Dense Visual Odometry in a Dynamic Environment (IEEE Transactions on Robotics, 2016. 12)
7	Paper	Kim, Jong Hwan	Interactive Human Intention Reading by Learning Hierarchical Behavior Knowledge Network for Human-Robot Interaction (ETRI Journal, 2016. 12)

KI for the NanoCentury

NT for Climate Change

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Byon, Hye Ryung	High energy efficiency and stability for photoassisted aqueous lithium-iodine redox batteries (ACS Energy Letters, 2016. 09)
2	Paper	Byon, Hye Ryung	Structurally tuning Li2O2 by controlling the surface properties of carbon electrodes: Implications for Li-O2 batteries (Chemistry of Materials, 2016. 10)
3	Paper	Jung, Hee Tae	A combined graphene and periodic Au nanograte structure: fundamentals and application as a flexible transparent conducting film in a flexible organic photovoltaic cell (Carbon, 2016. 07)
4	Paper	Jung, Hee Tae	Enhanced Stability of Laminated Graphene Oxide Membranes for Nanofiltration via Interstitial Amide Bonding (ACS Applied Materials & Interfaces, 2016. 09)
5	Paper	Jung, Hee Tae	Enhanced Water Permeation Based on Nanoporous Multilayer Graphene Membrane: The Role of Pore Size and Density (Journal of Materials Chemistry A, 2016. 11)
6	Paper	Jung, Yousung	Defect-Controled Formation of Triclinic Na2CoP2O7 for 4V Sodium-Ion Batteries (Angewandte Chemie-International Edition, 2016. 06)
7	Paper	Jung, Yousung	Single-Atom Catalysts for CO_2 Electroreduction with Significant Activity and Selectivity Improvements (Chemical Science, 2016. 09)
8	Paper	Jung, Yousung	Selective Nitrogen Capture by Porous Hybrid Materials Containing Accessible Transition Metal Ion Sites (Nature Materials, 2016. 12)
9	Paper	Kim, Hee Tak	Silver nanowire networks embedded in cure-controlled optical adhesive film for transparent and highly conductive electrode (Journal of Material Chemistry C, 2016. 09)

NT for Healthcare

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Chung, Hyun Jung	A Magneto-DNA Nanoparticle System for the Rapid and Sensitive Diagnosis of Enteric Fever (Scientific Reports, 2016. 09)
2	Paper	Jeon, Seokwoo	Bio-Inspired, Highly Stretchable and Conductive Dry Adhesives based on 1D-2D Hybrid Carbon Nanocomposites for All-in-One ECG electrodes (ACS Nano, 2016. 04)
3	Paper	Jung, Hee Tae	Superior Chemical Sensing Performance of Black Phosphorus: Comparison with MoS2 and Graphene (Advanced Materials. 2016. 06)
4	Paper	Jung, Hee Tae	High-Resolution p-type Metal Oxide Semiconductor Nanowire Array as an Ultrasensitive Sensor for Volatile Organic Compounds (Nano Letters, 2016.06)

NT for Advanced Opto-Electronics

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Jeon, Seokwoo	Intrinsic Photoluminescence Emission from Subdomained Graphene Quantum Dots (Advanced Materials, 2016. 05)
2	Paper	Jung, Hee Tae	Fabrication of graphite grids via stencil lithography for highly sensitive motion sensors (Carbon, 2016. 01)
3	Paper	Jung, Hee Tae	Hydrous amorphous RuO2 nanoparticles supported on reduced graphene oxide for non-aqueous Li-O2 batteries (RSC Advances, 2016. 02)
4	Paper	Jung, Hee Tae	Macroscopic alignment of chromonic liquid Q1 Q2 crystals using patterned substrates (Physical Chemistry Chemical Physics, 2016. 03)

NT for Advanced Opto-Electronics

		Chief Researcher	Research Achievements (Representative Papers / Patents)
5	Paper	Jung, Hee Tae	A three-dimensional metal grid mesh as a practical alternative to ITO (Nanoscale, 2016. 06)
6	Paper	Jung, Hee Tae	Complex High Aspect Ratio Metal Nanostructures by Secondary Sputtering Phenomenon Combined with Block Copolymer Self-Assembly (Advanced Materials, 2016. 08)
7	Paper	Jung, Hee Tae	Controlling Smectic Liquid Crystal Defect Patterns by Physical Stamping-Assisted Domain Separation and Their Use as Templates for Quantum Dot Cluster Arrays (Langmuir, 2016. 11)
8	Paper	Kim, Sang Ouk	Dopant-specific unzipping of carbon nanotubes for intact crystalline graphene nanostructures (Nature Communications, 2016. 01)
9	Paper	Kim, Sang Ouk	Laser Writing Block Copolymer Self-Assembly on Graphene Light Absorbing Layer (ACS Nano, 2016. 03)
10	Paper	Kim, Sang Ouk	Laser Crystallization of Organic-Inorganic Hybrid Perovskite Solar Cells (ACS Nano, 2016. 08)
11	Paper	Kim, Sang Ouk	Highly tunable refractive index visible-light metasurface from block copolymer self-assembly (Nature Communications, 2016. 09)
12	Paper	Lee, Keon Jae	Optogenetic Mapping of Functional Connectivity in Freely Moving Mice via Insertable Wrapping Electrode Array Beneath the Skull (ACS Nano, 2016. 01)
13	Paper	Lee, Keon Jae	Laser Writing Block Copolymer Self-Assembly on Graphene Light-Absorbing Layer (ACS Nano, 2016. 02)
14	Paper	Lee, Keon Jae	Skin-Like Oxide Thin-Film Transistors for Transparent Displays (Advanced Functional Materials, 2016. 07)
15	Paper	Lee, Keon Jae	Laser-induced phase separation of silicon carbide (Nature Communications, 2016. 11)
16	Paper	Lee, Keon Jae	Flash-Induced Self-Limited Plasmonic Welding of Silver Nanowire Network for Transparent Flexible Energy Harvester (Advanced Materials, 2016. 11)
17	Paper	Seo, Myungeun	Heteroarm core cross-linked star polymers via RAFT copolymerization of styrene and bismaleimide (RSC Advances, 2016. 06)
18	Paper	Yoo, Seunghyup	Synergetic electrode architecture for efficient graphene-based flexible organic light-emitting diodes (Nature Communications, 2016. 06)
19	Patent	Jeon, Seokwoo	3-Dimensional metal combination structure and methods of manufacturing the same (Patent registration, 10-1691969-0000, 2016. 12)
20	Patent	Kim, Sang Ouk	Pattern having a large grain, and method for preparing the same (Patent application, 10-2016-0147246, 2016. 11)
21	Patent	Kim, Sang Ouk	Formation method of nano scale patterning and intergrated device for electronic apparatus manufacturing thereof (Patent registration, 10-1674972-0000, 2016. 11)
22	Patent	Kim, Sang Ouk	Manufacturing method of graphene using doped carbon materials (Patent application, 10-2016-0149475, 2016. 11)
23	Patent	Kim, Sang Ouk	Metamaterial having a high refractive index, and method for preparing the same (Patent application, 10-2016-0151633, 2016. 11)
24	Patent	Lee, Keon Jae	Method for manufacturing thin film using light (Patent application, 10-2016-0032786, 2016. 03)
25	Patent	Lee, Keon Jae	Wearable thin-film electronic device and Method for manufacturing the same (Patent registration 10-1629468-0000, 2016. 05)

NT for Advanced Opto-Electronics

		Chief Researcher	Research Achievements (Representative Papers / Patents)
26	Patent	Lee, Keon Jae	Method for preparing graphene using solid carbon source (Patent application, 10-2015-0080684, 2016. 06)
27	Patent	Lee, Keon Jae	Pattern having a large grain, and method for preparing the same (Patent application, 10-2016-0148810, 2016. 11)
28	Patent	Lee, Keon Jae	Method for Manufacturing Silicene Using Phase Separation of Binary Compound and Silicene Manufactured by the Same Method (Patent registration, 10-1685149-0000, 2016. 12)

Others

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Choi, Sung Yool	Multilayer Graphene with a Rippled Structure as a Spacer for Improving Plasmonic Coupling (Advanced Functional Materials, 2016. 07)
2	Paper	Choi, Sung Yool	Conductive Graphitic Channel in Graphene Oxide-Based Memristive Devices (Advanced Functional Materials, 2016. 11)
3	Paper	Choi, Sung Yool	Laser-induced phase separation of silicon carbide (Nature Communications, 2016. 11)
4	Paper	Yoon, Dong Ki	Controlling Gaussian and mean curvatures at microscale by sublimation and condensation of smectic liquid crystals (Nature Communications, 2016. 01)
5	Paper	Yoon, Dong Ki	Highly polarized fluorescent illumination using liquid crystal phase (ACS Applied Materials & Interfaces, 2016. 01)
6	Paper	Yoon, Dong Ki	Linkage-length dependent structuring behaviour of bent-core molecules in helical nanostructures (Soft Matter, 2016. 02)
7	Paper	Yoon, Dong Ki	Chiral nematic self-assembly of minimally surface damaged chitin nanofibils and its laod bearing functions (Scientific Reports, 2016. 03)
8	Paper	Yoon, Dong Ki	Fabrication of disordered porous structures by solvent-assisted reorganisation of liquid crystal materials (Liquid Crystals, 2016. 04)
9	Paper	Yoon, Dong Ki	Fast Fabrication of Sub-200-nm Nanogrooves using Liquid Crystal Material (ACS Applied Materials & Interfaces, 2016. 04)
10	Paper	Yoon, Dong Ki	Molecular orientation of liquid crystals on topographic nanopatterns (ACS Applied Materials & Interfaces, 2016. 06)
11	Paper	Yoon, Dong Ki	Airflow-aligned helical nanofilament (B4) phase in topographic confinement (Scientific Reports, 2016, 07)
12	Paper	Yoon, Dong Ki	Liquid crystal phases in confined geometries (Liquid Crystals, 2016. 07)
13	Paper	Yoon, Dong Ki	Direct observation of liquid crystal phases under nanoconfinement: A grazing incidence X-ray diffraction study (Liquid Crystals, 2016. 09)
14	Paper	Yoon, Dong Ki	Orientation Control of Smectic Liquid Crystals via a Combination Method of Topographic Patterning and Applying In-Plane Electric Field for Linearly Polarized Illuminator (ACS Applied Materials & Interfaces, 2016. 09)
15	Paper	Yoon, Dong Ki	Digital DNA detection based on compact optofluidic laser with ultra-low sample consumption (Lab on a Chip, 2016. 11)
16	Paper	Yoon, Dong Ki	Control of Periodic Zigzag Structures of DNA by a Simple Shearing Method (Advanced Materials, 2016. 11)

Others

		Chief Researcher	Research Achievements (Representative Papers / Patents)
17	Paper	Yoon, Dong Ki	Switchable photonic crystals using one-dimensional confined liquid crystals for photonic device application (ACS Applied Materials & Interfaces, 2016. 12)
18	Patent	Yoon, Dong Ki	Method of Preparing Coating Layer of Lyotropic Chromonic Liquid Crystal for Multi-Domain Liquid Crystal Alignment (Patent application. 10-2016-0033332, 2016. 03)
19	Patent	Yoon, Dong Ki	Method of Fabricating Liquid Crystal Layer and Nanoparticle Clusters (Patent application, 10-2016-0068711, 2016. 06)
20	Patent	Yoon, Dong Ki	Method of Dichroic Polarizing Light-emitting Film Using Ferroelectric Liquid Crystal Molecule Have Luminescence Properties and Liquid Crystal Display Comprising the Same (Patent application, 10-2016-0115457, 2016. 09)
21	Patent	Yoon, Dong Ki	Alignment Method of Liquid Crystal and Method of Preparing Liquid Crystal Cell (Patent application, 10-2016-0143510, 2016. 10)
22	Patent	Yoon, Dong Ki	Method for fabricating nanoparticle clusters (Patent application, 10-2016-0141159, 2016. 10)
23	Patent	Yoon, Dong Ki	Method for preparing DNA template for nano-structure fabrication (Patent registration, 10-1683777-0000, 2016. 12)
24	Patent	Yoon, Dong Ki	Photo-luminescence liquid crystal compound (Patent application, 10-2016-0182198, 2016. 12)

KI for Health Science and Technology

Biophotonics

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Kim, Pilhan	Amelioration of sepsis by TIE2 activation-induced vascular protection (Science translational medicine, 2016. 04)
2	Paper	Kim, Pilhan	Live Images of Donor Dendritic Cells Trafficking via CX_3CR_1 Pathway (Frontiers in immunology, 2016. 10)
3	Paper	Kim, Pilhan	Holographic intravital microscopy for 2-D and 3-D imaging intact circulating blood cells in microcapillaries of live mice (Scientific reports, 2016. 09)
4	Paper	Kim, Pilhan	Imaging Laser-Induced Choroidal Neovascularization in the Rodent Retina Using Optical Coherence Tomography Angiography (Investigative ophthalmology & visual science, 2016. 07)
5	Paper	Kim, Pilhan	In Vivo Fluorescence Retinal Imaging Following AAV2-Mediated Gene Delivery in the Rat Retina (Investigative ophthalmology & visual science, 2016. 06)
6	Paper	Kim, Pilhan	Secreted Tryptophanyl-tRNA Synthetase as a Primary Defense System against Infection (Nature Microbiology, 2016. 10)
7	Paper	Oh, Wang Yuhl	Imaging Laser-Induced Choroidal Neovascularization in the Rodent Retina Using Optical Coherence Tomography AngiographyImaging Rodent Choroidal Neovascularization With OCTA (Investigative Ophthalmology& Visual Science, 2016. 07)
8	Paper	Oh, Wang Yuhl	Characterization of lipid-rich plaques using spectroscopic optical coherence tomography (Journal of Biomedical Optics ,2016. 07)
9	Paper	Oh, Wang Yuhl	Single cardiac cycle three-dimensional intracoronary optical coherence tomography (Biomedical Optics Express, 2016. 12)
10	Paper	Oh, Wang Yuhl	Intracoronary dual-modal optical coherence tomography-near-infrared fluorescence structural-molecular imaging with a clinical dose of indocyanine green for the assessment of high-risk plaques and stent-associated inflammation in a beating coronary artery (European Heart Journal, 2016. 01)
11	Paper	Oh, Wang Yuhl	Intravascular optical imaging of high-risk plaques in vivo by targeting macrophage mannose receptors (Scientific Reports, 2016. 03)
12	Paper	Oh, Wang Yuhl	ECG-Triggered, Single Cardiac Cycle, High-Speed, 3D, Intracoronary OCT (JACC: Cardiovascular Imaging, 2016. 05)
13	Paper	Park, Yongkeun	Exploiting the speckle-correlation scattering matrix for a compact reference-free holographic image sensor (Nature Communications, 2016. 10)
14	Paper	Park, Yongkeun	In vivo deep tissue imaging using wavefront shaping optical coherence tomography (Journal of biomedical optics, 2016. 10)
15	Paper	Park, Yongkeun	Holographic intravital microscopy for 2-D and 3-D imaging intact circulating blood cells in microcapillaries (Scientific Reports, 2016. 09)
16	Paper	Park, Yongkeun	Cellular normoxic biophysical markers of hydroxyurea treatment in sickle cell disease (PNAS, 2016. 10)
17	Paper	Park, Yongkeun	Optical characterization of red blood cells from individuals with sickle cell trait and disease in Tanzania using quantitative phase imaging (SCIENTIFIC REPORTS, 2016. 08)
18	Paper	Park, Yongkeun	Label-free optical quantification of structural alterations in Alzheimer's disease (Scientific reports, 2016. 08)
19	Paper	Park, Yongkeun	White-light quantitative phase imaging unit (Optics express, 2016. 05)
20	Paper	Park, Yongkeun	Optical diffraction tomography using a digital micromirror device for stable measurement of 4-D refractive index (proc. SPIE, 2016. 03)
21	Paper	Park, Yongkeun	Study of erythrocyte membrane fluctuation using light scattering analysis (proc. SPIE, 2016. 03)

Biophotonics

		Chief Researcher	Research Achievements (Representative Papers / Patents)
22	Paper	Park, Yongkeun	Hyperspectral optical diffraction tomography (OPTICS EXPRESS, 2016. 02)
23	Patent	Kim, Pilhan	Confocal microscopy and method of processing image using the same (Patent application, PCT/KR2016/010818, 2016. 09)
24	Patent	Kim, Pilhan	Window apparatus for in vivo microscopic imaging of mammary tissue and method for obtaining image using the same (Patent application, PCT/KR2016/009719, 2016. 08)
25	Patent	Kim, Pilhan	Lung window apparatus based on micro-suction for in vivo microscopic imaging of lung tissue and method for obtaining image using the same (Patent application, PCT/KR2016/009720, 2016. 08)
26	Patent	Kim, Pilhan	Apparatus and methods for in vivo microscopic imaging of pancreatic tissue (Patent application, 10-2016-0065091, 2016. 05)
27	Patent	Kim, Pilhan	Apparatus and method of processing image of targeting material for circulating cells (Patent application, 10-2016-0044138, 2016. 04)

Neuroimaging and Neuromodulation

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Jeong, Bumseok	Neural correlates of text-based emoticons: a preliminary fMRI study (Brain and Behavior, 2016. 04)
2	Paper	Jeong, Bumseok	The Effects of Equine-assisted Activities and Therapy on Resting-state Brain Function in Attention-deficit/Hyperactivity Disorder: A Pilot Study (Clinical Psychopharmacology and Neuroscience, 2016. 11)
3	Paper	Jeong, Bumseok	Insights from an expressive writing intervention on Facebook to help alleviate depressive symptoms (Computers in Human Behavior, 2016. 04)
4	Paper	Jeong, Bumseok	Rhythmical Photic Stimulation at Alpha Frequencies Produces Antidepressant-Like Effects in a Mouse Model of Depression (PLOS ONE, 2016. 02)
5	Paper	Jeong, Yong	Sparse SPM: Group Sparse-dictionary learning in SPM framework for resting-state functional connectivity MRI analysis (NEUROIMAGE, 2016. 01)
6	Paper	Jeong, Yong	Rhythmical Photic Stimulation at Alpha Frequencies Produces Antidepressant-Like Effects in a Mouse Model of Depression (PLOS ONE, 2016. 01)
7	Paper	Jeong, Yong	Glucose Metabolic Brain Networks in Early-Onset vs. Late-Onset Alzheimer's Disease (Frontiers in aging neuroscience, 2016. 06)
8	Paper	Jeong, Yong	Label-free optical quantification of structural alterations in Alzheimer's disease (Scientific reports, 2016. 08)
9	Paper	Jeong, Yong	Modality-specific spectral dynamics in response to visual and tactile sequential shape information processing tasks: An MEG study using multivariate pattern classification analysis (BRAIN RESEARCH, 2016. 08)
10	Paper	Jeong, Yong	In vivo deep tissue imaging using wavefront shaping optical coherence tomography (Journal of biomedical optics, 2016. 10)
11	Paper	Jeong, Yong	Default mode network functional connectivity in the early and late mild cognitive impairment: results from the Alzheimer's Disease Neuroimaging Initiative (Alzheimer disease & associated disorders, 2016. 10)
12	Paper	Jeong, Yong	Collaborative effects of wavefront shaping and optical clearing agent in optical coherence tomography (Journal of Biomedical Optics, 2016. 10)
13	Paper	Jeong, Yong	Degree-based statistic and center persistency for brain connectivity analysis. Hum Brain Mapp (Human brain mapping, 2016. 09)

Therapeutic Bioengineering

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Park, Ji Ho	Cellular Engineering with Membrane Fusogenic Liposomes to Produce Functionalized Extracellular Vesicles (ACS Applied Materials & Interfaces, 2016. 03)
2	Paper	Park, Ji Ho	Electro-Optical Neural Platform Integrated with Nanoplasmonic Inhibition Interface (ACS Nano, 2016. 03)
3	Paper	Park, Ji Ho	Magnetophoretic sorting of single cell-containing microdroplets (Micromachines, 2016. 03)
4	Paper	Park, Ji Ho	Cell-free production and streamlined assay of cytosol-penetrating antibodies (Biotechnology and Bioengineering, 2016. 04)
5	Paper	Park, Ji Ho	Exosome engineering for efficient intracellular delivery of soluble proteins using optically reversible protein-protein interaction module (Nature Communications, 2016. 07)
6	Paper	Park, Ji Ho	Intraoperative pulmonary neoplasm identification using near-infrared fluorescence imaging (Eur. J. Cardio-Thoracic Surg., 2016. 05)
7	Paper	Park, Ji Ho	Macrophage-Targeted Indocyanine Green-Neomannosyl Human Serum Albumin for Intraoperative Sentinel Lymph Node Mapping in Porcine Esophagus (Ann. Thorax. Surg., 2016. 06)
8	Paper	Park, Ji Ho	Zein-alginate based oral drug delivery systems: protection and release of therapeutic proteins (Int. J. Pharm., 2016. 10)
9	Paper	Park, Ji Ho	Liposomal delivery systems for intestinal lymphatic drug transport (Biomaterials Res., 2016. 11)
10	Paper	Park, Ji Ho	Effective Retinal Penetration of Lipophilic and Lipid-Conjugated Hydrophilic Agents Delivered by Engineered Liposomes (Mol. Pharm., 2016. 12)
11	Patent	Park, Ji Ho	Composition for Phototherapy of Cancer Comprising Complex of Liposome, Indocyanine Green And Anti-cancer drug (Patent registration, 10-1630397-0000, 2016. 06)
12	Patent	Park, Ji Ho	Composition for Phototherapy of Cancer Comprising Complex of Liposome And Indocyanine Green (Patent registration, 10-1686145-0000, 2016. 12)

Saudi Aramco-KAIST CO_2 Management Center

Development of CO_2 capture and conversion process

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Kim, Jihan	Understanding the Mechanisms of CO_2 Adsorption Enhancement in Pure Silica Zeolites Under Humid Conditions (The Journal of Physical Chemistry C, 120,23500, 2016. 09)
2	Paper	Kim, Jihan	Towards accurate porosity descriptors based on guest-host interactions (Journal of Molecular Graphics and Modelling, 66, 91, 2016. 05)
3	Paper	Kim, Jihan	Probing gas adsorption in MOFs using an efficient ab initio widom insertion Monte Carlo method (Journal of Computational Chemistry, 37, 2808, 2016.10)
4	Paper	Lee, Jay H.	Process systems engineering issues & applications towards reducing carbon dioxide emissions through conversion technologies (Chemical Engineering Research and Design, 116, pp. 27-47, 2016)
5	Paper	Lee, Jay H.	A methodology for the sustainable design and implementation of CO_2 utilization processes (Computers and Chemical Engineering, 91, pp. 407-421, 2016)
6	Paper	Lee, Jay H.	A Methodological Framework for the Development of Feasible CO_2 Conversion Processes (International Journal of Greenhouse Gas Control, 47, pp. 250–265, 2016)
7	Paper	Lee, Jay H.	Evaluation of Adsorbents for CO_2 Capture with New Performance Indicators (Computers and Chemical Engineering, in press, 2016)
8	Paper	Lee, Jay H.	Optimal Design for Flexible Operation of the Post-combustion CO_2 Capture Plant with Uncertain Economic Factors (Computers and Chemical Engineering, 84, 199-207, 2016)
9	Patent	Han, Jong In	Method of separation and concentration of carbon dioxide from mixture gas (Patent application, 10-2016-0070153, 2016. 06)

CO_2 reduction by enhancing energy efficiency

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Lee, Jeong Ik	Study on CO_2 – water printed circuit heat exchanger performance operating under various CO_2 phases for S-CO_2 power cycle application (Applied Thermal Engineering, Research paper, 2017. 01)
2	Patent	Lee, Jeong Ik	Generation system using supercritical carbon dioxide and method of driving the same by temperature differential of heat source (Patenet registration, 10-1691908, 2016. 12)

CO_2 conversion technology

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Jung, Yousung	Selective Nitrogen Capture by Porous Hybrid Materials Containing Accessible Transition Metal Ion Sites (Nature Materials, 2016. 12)
2	Paper	Jung, Yousung	Single-Atom Catalysts for CO_2 Electroreduction with Significant Activity and Selectivity Improvements (Chemical Science, 2016. 09)
3	Paper	Jung, Yousung	Defect-Controled Formation of Triclinic $Na_2CoP_2O_7$ for 4V Sodium-Ion Batteries (Angewandte Chemie-International Edition, 2016. 06)
4	Paper	Lee, H.K.	Review on recent advances in CO_2 utilization and sequestration technologies in cement-based materials (Construction and Building Materials, 2016. 11)
5	Paper	Lee, H.K.	An NMR spectroscopic investigation of aluminosilicate gel in alkali-activated fly ash in a CO_2-rich environment (Materials, 2016. 04)

CO_2 conversion technology

		Chief Researcher	Research Achievements (Representative Papers / Patents)
6	Paper	Lee, H.K.	Microstructural densification and CO_2 uptake promoted by the carbonation curing of belite-rich Portland cement (Cement and Concrete Research, 2016. 04)
7	Paper	Lee, H.K.	Strength development of alkali-activated fly ash exposed to carbon dioxide-rich environment at early age (Journal of the Korean Ceramic Society, 2016. 01)
8	Patent	Han, Sang Woo	Polyoxometalate catalyst, preparing method thereof, and preparing method of cyclic carbonates using the same (Patent application, 10-2016-0035805, 2016. 03)

Solar energy-based CO_2 conversion

		Chief Researcher	Research Achievements (Representative Papers / Patents)
1	Paper	Lee, Doh Chang	Low-coordinated surface atoms of CuPt alloy cocatalysts on TiO_2 for enhanced photocatalytic conversion of CO_2 (Nanoscale, 2016. 04)
2	Paper	Lee, Doh Chang	Bi_2O_3 as a Promoter for Cu/TiO_2 Photocatalysts for the Selective Conversion of Carbon Dioxide into Methane (ChemCatChem, 2016. 05)
3	Paper	Song, Hyunjoon	Enhanced Visible Light Activity of Single-Crystalline WO_3 Microplates for Photoelectrochemical Water Oxidation (J. Phys. Chem. C, 120, 9192-9199, 2016)
4	Paper	Song, Hyunjoon	Metal–semiconductor double shell hollow nanocubes for highly stable hydrogen generation photocatalysts (J. Mater. Chem. A, 4, 13414-13418, 2016)
5	Patent	Song, Hyunjoon	Reduction method of carbon dioxide using zinc based catalyst particle having core-shell structure and apparatus therefor (Patent application, 10-2016-0074534, 2016. 06)
6	Patent	Song, Hyunjoon	Zinc based catalyst particle having core-shell structure and methanation method of carbon dioxide using the same (Patent application, PCT/KR2016/008496, 2016. 08)
7	Patent	Song, Hyunjoon	Zinc based catalyst particle having core-shell structure and methanation of carbon dioxide using the same (Patent registration, 10-1688111-0000, 2016. 12)

Faculty Information

KI for the BioCentury

Human Microbiome Control

Name	Education	Research Interests	Website	
Kim, Sun Chang Dept. of Biological Sciences, Professor	Univ. of Wisconsin, Food Microbiology, Molecular Genetics, Ph.D. 1985	Synthetic Biology, Genome Engineering, Antimicrobial Peptides(AMPs)	http://bs.kaist.ac.kr/~mbtlab	Director
Cho, Byung-Kwan Dept. of Biological Sciences, Associate Professor	Seoul Nat'l Univ., Biochemical Engineering & Biotechnology, Ph.D. 2003	Synthetic Biology, Genome and Transcriptome Engineering, Electrobiosynthesis	http://cholab.or.kr	
Jeong, Ki Jun Dept. of Chemical & Biomolecular Engineering, Associate Professor	KAIST, Chemical & Biomolecular Engineering, Ph.D. 2001	Protein Engineering, Antibody Engineering, Protein Display and HTS	http://proteineng.kaist.ac.kr	
Kim, Joon Graduate School of Medical Science & Engineering, Associate Professor	Univ. of California at Irvine, Anatomy and Neurobiology, Ph.D. 2006	Molecular Genetics, Cell Biology, Neuroembryology	https://sites.google.com/a/kaist.edu/biochem-molbiol-lab	
Kim, Hail Graduate School of Medical Science & Engineering, Associate Professor	Yonsei Univ., Biochemistry and Molecular Biology, M.D./Ph.D. 2002	Diabetology, Beta Cell Biology, Serotonin Biology	http://mdrl.kaist.ac.kr	
Lee, Sang Yup Dept. of Chemical & Biomolecular Engineering, Professor	Northwestern Univ., Chemical Engineering, Ph.D. 1991	Metabolic Engineering, Biochemical Engineering, DNA chip	http://mbel.kaist.ac.kr	
Park, Hee Sung Dept. of Chemistry, Associate Professor	KAIST, Chemical Engineering, Ph. D. 2000	Biochemistry, Chemical Biology	https://sites.google.com/site/hsparkmsbl	
Park, Hyun Gyu Dept. of Chemical & Biomolecular Engineering, Professor	KAIST, Chemical Engineering, Ph. D. 1996	Nucleic Acid Bioengineering, Biochips & Biosensor, Electrochemical Diagnosis	http://bcbd.kaist.ac.kr	
Cho, Suhyung KI for the BioCentury, Research Professor	Seoul Nat'l Univ., Biochemical Engineering and Biotechnology, Ph.D. 2005	Transcription Processing, Regulation, RNA Synthetic Biology, Regulatory Genomics	http://biocentury.kaist.ac.kr	
Lee, Jun Hyoung KI for the BioCentury, Research Professor	KAIST, Molecular Biotechnology, Ph.D. 2010	Synthetic Biology	http://biocentury.kaist.ac.kr	

Cancer Metastasis Control

Name	Education	Research Interests	Website	
Han, Yong Man Dept. of Biological Sciences, Professor	KAIST, Molecular Biology, Ph.D. 1993	Differentiation of Embryonic Stem Cells, Induced Pluripotent Stem Cells	http://stemcell.kaist.ac.kr	
Heo, Won Do Dept. of Biological Sciences, Associate Professor	Gyeongsang Nat'l Univ., Biochemistry, Ph.D. 1999	Bio-Imaging, Cell Signaling, Neuroscience	https://sites.google.com/site/heolab	
Jeong, Won-il Graduate School of Medical Science & Engineering, Associate Professor	Kyungpook Nat'l Univ., College of Veterinary Medicine, D.V.M./Ph.D. 2004	Pathology, Cell Engineering	http://web.kaist.ac.kr/~llr	
Jon, Sangyong Dept. of Biological Sciences, Professor	KAIST, Chemistry, Ph.D. 1999	Targeted Therapy, Drug Delivery System, Nanoparticle Based Vaccine	http://www.bionanolab.co.kr	
Kim, Ho Min Graduate School of Medical Science & Engineering, Associate Professor	KAIST, Biological Sciences, Ph.D. 2005	Molecular Structure Biology, X-ray Crystallography, Electron Microscope	http://gsmse.kaist.ac.kr	

Cancer Metastasis Control

Name	Education	Research Interests	Website	
Kim, Jaehoon Dept. of Biological Sciences, Assistant Professor	Rockefeller Univ., Biochemistry and Molecular Biology, Ph.D. 2007	Biochemistry, Molecular Biology	http://molneuro.kaist.ac.kr/contents	
Kim, Mi Young Dept. of Biological Sciences, Assistant Professor	Cornell Univ., Molecular Biology and Genetics, Ph.D. 2004	Metastasis, Epigenetics, Stem Cell	https://sites.google.com/site/bglabkorea	
Kim, Seyun Dept. of Biological Sciences, Assistant Professor	Johns Hopkins Univ of Medicine, Dept. of Biological Chemistry, Ph.D. 2007	Metabolism Signaling Network	http://pbil.kaist.ac.kr	
Lee, Gyun Min Dept. of Biological Sciences, Professor	Univ. of Michigan, Chemical Engineering, Ph.D. 1990	Cell Engineering, Proteomics, Cell Therapy	http://bs.kaist.ac.kr/~acelab	
Lee, Jie Oh Dept. of Chemistry, Professor	Harvard Univ., Biochemistry, Ph.D. 1995	Structural Immunochemistry	http://cafe.naver.com/advbio.cafe	
Oh, Byung-Ha Dept. of Biological Sciences, Professor	Univ. of Wisconsin-Madison Biophysics, Ph.D. 1989	Chronosome Codensation, Infection and Immunity	http://struct.kaist.ac.kr	
Song, Ji-Joon Dept. of Biological Sciences, Associate Professor	Watson School of Biological Sciences, Cold Spring Harbor Laboratory, Structural Biology, Ph.D. 2005	Histone Methyltransferases, Chromatin Assembly, Nucleosome Recognition, Neurodegenerative Disease	https://sites.google.com/site/songkaist	
Cho, Carol KI for the BioCentury, Research Professor	Univ. of California, San Francisco, Biochemistry, Ph.D. 2011	Biochemistry, Biological sciences	http://biocentury.kaist.ac.kr	

Brain Cognitive Function Control

Name	Education	Research Interests	Website	
Choi, Chulhee Dept. of Bio and Brain Engineering, Professor	Yonsei Univ., Microbiology/Immunology, M.D./Ph.D. 1999	Neurobiology, Molecular and Cellular Biology, Computational Cell Biology, Neuroimmunology, Tumor Immunology	http://ccbio.kaist.ac.kr	
Choi, Jung Kyoon Dept. of Bio and Brain Engineering, Associate Professor	KAIST, Biology, Ph.D. 2004	Omics, Genome/Epigenome Engineering	http://omics.kaist.ac.kr	
Han, Jin Hee Dept. of Biological Sciences, Associate Professor	Seoul Nat'l Univ., Neurosciece, Ph.D. 2004	Neurobiology, Neural Circuit, Synaptic Physiology, Animal Behavior	https://sites.google.com/site/neuralcircuitandbehaviorlab	
Jung, Min Whan Dept. of Biological Sciences, Professor	Univ. of California, Irvine, Psychobiology, Ph.D. 1990	Decision Making, Episodic Memory, Interval Timing	https://sites.google.com/site/systemsneurolaboratory	
Kim, Daesoo Dept. of Biological Sciences, Associate Professor	POSTECH, Life Science, Ph.D. 1998	Behavioral Neuroscience, Movement Disorders	https://sites.google.com/site/mcikaist	
Kim, Eunjoon Dept. of Biological Sciences, Professor	Michigan State Univ., Pharmacology and Toxicology, Ph.D. 1994	Neuroscience, Molecule Neuroscience	https://sites.google.com/site/seyunkimlab	
Kim, Jin Woo Dept. of Biological Sciences, Associate Professor	KAIST, Biological Sciences, Ph.D. 1999	Developmental Neurobiology, Neuro-regeneration, Retinal Degeneration	https://sites.google.com/site/kaistjhkim	

Brain Cognitive Function Control

Name	Education	Research Interests	Website	
Lee, Seung-Hee Dept. of Biological Sciences, Assistant Professor	Seoul Nat'l Univ., School of Biological Sciences, Ph.D. 2007	Neurobiology, Neurophysiology, Neuromodulatory systems	https://sites.google.com/site/leelab2013	
Park, Chankyu Dept. of Biological Sciences, Professor	Washington State Univ., Microbiology, Ph.D 1985	Molecular Physiology	https://sites.google.com/site/ckparkhome	
Chae, Sujin KI for the BioCentury, Research Professor	Seoul Nat'l Univ., Biomedical Biochemistry, Ph.D. 2009	Behavioral Epigenetics	http://biocentury.kaist.ac.kr	
Kang, Kyung Hwa KI for the BioCentury, Research Professor	Chung-ang Univ., Molecular Cell Biology, Ph.D. 2000	Moelcular Mechanism	http://biocentury.kaist.ac.kr	

KI for IT Convergence

5G Mobile Communications

Name	Education	Research Interests	Website	
Hong, Songcheol School of Electrical Engineering, Professor	Univ. of Michigan, Electrical Engineering, Ph.D. 1989	Integrated High frequency sensor, 5G communication	http://weis.kaist.ac.kr	Director
Cho, Dong Ho School of Electrical Engineering, Professor	KAIST, Electrical Engineering, Ph.D. 1985	5G mobile communication, Wireless power transfer, System biology	http://umls.kaist.ac.kr	
Kang, Joonhyuk School of Electrical Engineering, Associate Professor	Univ. of Texas at Austin, Telecommunication and Information System Engineering, Ph.D. 2002	The digital communication techniques for advanced wireless communication systems	http://artlab.kaist.ac.kr	
Lee, Yong-Hoon School of Electrical Engineering, Professor	Univ.of Pennsylvania, Electrical Engineering, Ph.D. 1984	Communication Signal Processing	http://kalman.kaist.ac.kr	
Park, Dong-Jo School of Electrical Engineering, Professor	Univ. of California, Los Angeles, Communication, Ph.D. 1984	Wireless communications signal processing, adaptive signal processing, optimization techniques, image processing and target tracking	http://armi.kaist.ac.kr	
Sung, Dan-Keun School of Electrical Engineering, Professor	Univ. of Texas at Austin, Electronic & Computer Engineering, Ph.D. 1986	Communication system, 5G, SmartGrid, M2M, Heterogeneous Network (HetNet)	http://cnr.kaist.ac.kr	
Lee, Ju Yong KI for IT Convergence, Research Associate Professor	KAIST, Electrical Engineering, Ph.D. 2003	5-th Generation Wireless Communication	http://itc.kaist.ac.kr	
Gil, Gye-Tae KI for IT Convergence, Research Associate Professor	KAIST, Electrical Engineering, Ph.D. 2004	Communication signal processing, Advanced Multi-user MIMO technology, Adaptive filter design	http://itc.kaist.ac.kr	

IoT/WoT

Name	Education	Research Interests	Website	
Choi, Jun Kyun School of Electrical Engineering, Professor	KAIST, Electrical Engineering, Ph.D. 1988	Energy-saving network, Internet of Things, Knowledge engineering	http://mnlab.kaist.ac.kr	
Kim, Dae-Shik School of Electrical Engineering, Professor	Max-Planck-Institute for Brain Research, Brain Systems Research, Ph.D. 1994	Systems neuro science, Neuro robotics, Brain decodes	http://brain.kaist.ac.kr	
Kim, Daeyoung School of Computing, Professor	Univ. of Florida, Computer Engineering, Ph.D. 2001	Realtime and Embedded Systems, Internet of Things	http://www.resl.kaist.ac.kr	
Kim, Heeyoung Dept. of Industrial&Systems Engineering, Assistant Professor	Georgia Institute of Technology, Industrial Engineering, Ph.D. 2011	Statistics and data mining	http://istat.kaist.ac.kr	
Kim, Yongdae School of Electrical Engineering, Professor	Univ. of Southern California, Computer Science, Ph.D. 2002	Network and Distributed System Security, Applied Cryptography	http://syssec.kaist.ac.kr/~yongdaek	
Lee, Doheon Dept. of Bio and Brain Engineering, Professor	KAIST, Computer Science, Ph.D. 1995	Bio/Medical Informatics, Neuroinformatics, Systems Biology	http://biosoft.kaist.ac.kr	
Lim, Youn-Kyung Dept. of Industrial Design, Associate Professor	Illinois Institute of Technology, Design, Ph.D. 2003	Human-Computer Interaction, Ubiquitous Computing, Experience-centered Design	http://cixd.kaist.ac.kr	
Woo, Woontack Graduate School of Culture Technology, Professor	Univ. of Southern California, EE-systems, Ph.D. 1998	3D Vision, Context-aware Interaction, Augmented Human	http://uvrlab.org	
Yi, Mun-Yong Dept. of Industrial&Systems Engineering, Professor	Univ. of Maryland, Information Systems, Ph.D. 1998	Business Intelligence, Human-Computer Interaction, Intelligent Agent, Knowledge Engineering and Management, Semantic Information Retrieval	http://kslab.kaist.ac.kr	
Jung, Sungkwan KI for IT Convergence, Research Associate Professor	KAIST, Electrical Engineering, Ph.D. 2007	IoT/M2M, Web, UI	http://itc.kaist.ac.kr	

Integrated Sensors

Name	Education	Research Interests	Website	
Hong, Songcheol School of Electrical Engineering, Professor	Univ. of Michigan, Electrical Engineering, Ph.D. 1989	Integrated High frequency sensor, 5G communication	http://weis.kaist.ac.kr	Director
Cho, Gyuseong Dept. of Nuclear&Quamtum Engineering, Professor	Univ. of Califorinia Berkeley, Nuclear Engineering, Ph.D. 1992	Radiation image sensor, Medical diagnosis equipment, Radiation detector	https://radiation.kaist.ac.kr	
Cho, Seungryong Dept. of Nuclear&Quantum Engineering, Associate Professor	The Univ. of Chicago, Medical Physics, Ph.D. 2009	Medical imaging, Radiation therapy	http://mirlab.kaist.ac.kr	
Jun Tani School of Electrical Engineering, Professor	Sophia Univ., Electrical Engineering, Ph.D. 1995	Neuro-robotics, Complex systems, Cognitive science	http://neurorobot.kaist.ac.kr	

Integrated Sensors

Name	Education	Research Interests	Website	
Lee, Soo-Young School of Electrical Engineering, Professor	Polytechnic Univ. of New York, Electro Physics, Ph.D. 1984	Artificial Brain, Machine Intelligence, Cognitive Information Processing	http://cnsl.kaist.ac.kr	
Park, Chong-Ook Dept. of Materials Science Engineering, Professor	Ohio State Univ., Materials Science, Ph.D. 1985	Chemical sensors	http://mse.kaist.ac.kr/~copark	
Park, Inkyu Dept. of Mechanical Engineering, Associate Professor	Univ. of California at Berkeley, Mechanical Engineering, Ph.D. 2007	Micro/nano sensors for Healthcare/ Environment monitoring, Multiscale Manufacturing, Reliability Evaluation and Innovation in Micro/Nanoscale	http://mintlab1.kaist.ac.kr	
Park, Sung-Hong Dept. of Bio and Brain Engineering, Assistant Professor	Univ. of Pittsburgh, Bioengineering, Ph.D. 2009	Magnetic Resonance Imaging, Neuroimaging, Bio-signal processing	http://mri.kaist.ac.kr	
Yoo, Hyung-Joun School of Electrical Engineering, Professor	KAIST, Physics, Ph.D. 1994	Sensor communications, RF systems for mobile communications	http://codes.kaist.ac.kr	
Chang, Ho-Jong KI for IT Convergence, Research Assistant Professor	Chungnam Nat'l Univ., Electronics Engineering, Ph.D. 2014	Medical Device Biosignal Measurement	http://itc.kaist.ac.kr	
Lee, Byung-Cheon KI for IT Convergence, Research Associate Professor	Chung-ang University, Pharmacy, Ph.D. 1998	Primo vascular system	http://itc.kaist.ac.kr	
Yoo, Sang-Sun KI for IT Convergence, Research Assistant Professor	KAIST, Electrical Engineering, Ph.D. 2012	Sensor communications, RF systems for mobile communications	http://codes.kaist.ac.kr	

KI for Robotics

RTOS for Humanoid Robots

Name	Education	Research Interests	Website	
Oh, Jun Ho Dept. of Mechanical Engineering, Professor	Univ. of California, Berkeley, Mechanical Engineering, Ph.D. 1985	Control System for Humanoid, Telescope Mount System, Sensor & Measurement	http://hubolab.kaist.ac.kr	Director

Mobile Intelligence for Vehicular Robots

Name	Education	Research Interests	Website	
Chang, Naehyuck School of Electrical Engineering, Professor	Seoul Nat'l Univ. , Electrical Engineering, Ph.D. 1996	Low-power and low-energy design, Operation of electric vehicles	http://www.cad4x.kaist.ac.kr	
Kim, A Young Civil&Environmental Engineering, Assistant Professor	Univ. of Michigan, Mechanical Engineering, Ph.D. 2012	SLAM, Navigation, Perception	http://irap.kaist.ac.kr	

Mobile Intelligence for Vehicular Robots

Name	Education	Research Interests	Website	
Kim, Jin Whan Dept. of Mechanical Engineering, Associate Professor	Stanford Univ. , Aeronautics and Astronautics (with Ph.D. minor in Electrical Engineering), Ph.D. 2007	Vehicle intelligence, Vehicle dynamics and control, Marine robotics	http://morin.kaist.ac.kr	
Shim, Hyun chul Dept. of Aerospace Engineering, Associate Professor	Univ. of California, Berkeley, Mechanical Engineering, Ph.D. 2000	Robotics, Unmanned system	http://unmanned.kaist.ac.kr	
Kim, Jun Mo School of Electrical Engineering, Assistant Professor	Massachusetts Institute of Technology, Electrical Engineering, Ph.D. 2005	Machine learning, Deep learning, Computer vision	http://siit.kaist.ac.kr	
Myung, Hyun Civil&Environmental Engineering, Associate Professor	KAIST, Electrical Engineering, Ph.D. 1998	Robot navigation, Artificial intelligence, Inspection robot	http://urobot.kaist.ac.kr	

AI for Cooperative Robots

Name	Education	Research Interests	Website	
Jo, Sung Ho School of Computing, Associate Professor	MIT, Electrical Engineering & Computer Science, Ph.D. 2006	Intelligent robot, Neuro computing	http://isnl.kaist.ac.kr	
Kwon, Dong Soo Dept. of Mechanical Engineering, Professor	Georgia Institute of Technology, Mechanical Engineering, Ph.D. 1991	Human-Robot Interaction, Haptics, Medical Robotics	http://robot.kaist.ac.kr	
Kim, Jong Hwan School of Electrical Engineering, Professor	Seoul Nat'l Univ., Electrical Engineering, Ph.D. 1987	Intelligence Super Agent, Intelligent Interactive Technology	http://rit.kaist.ac.kr	

KI for the NanoCentury

NT for Climate Change

Name	Education	Research Interests	Website	
Jung, Hee Tae Dept. of Chemical & Biomolecular Engineering, Professor	Case Western Reserve Univ., Macromolecular Science & Engineering, Ph.D. 1998	Molecular Self-Assembly, Soft-building Blocks, Organic Opto-electronic Devices: Display, Energy Devices & Sensor	http://ooem.kaist.ac.kr	Director
Byon, Hye Ryung Dept. of Chemistry, Assistant Professor	POSTECH, Chemistry, Ph.D. 2008	Li-O_2 Batteries, Li-S Batteries, Redox Flow Batteries	http://www.emdl.kaist.ac.kr	
Cho, Eun Ae Dept. of Materials Science and Engineering, Associate Professor	KAIST, Materials Science and Engineering, Ph.D. 2002	Fuel Cell, Battery, Electrolysis	http://ecsm.kaist.ac.kr	
Choi, Jang Wook Graduate School of EEWS, Associate Professor	Caltech, Chemistry and Chemical Engineering, Ph.D. 2007	Rechargeable Battery, Supercapacitor, Materials Chemistry	http://nest.kaist.ac.kr	

NT for Climate Change

Name	Education	Research Interests	Website
Choi, Minkee Dept. of Chemical & Biomolecular Engineering, Associate Professor	KAIST, Chemistry, Ph.D. 2007	Nanotechnology for Energy & Environment, Catalyst Design by Nanotechnology, Lignocellulose-Based Energy and Chemical Source	http://egcl.kaist.ac.kr
Choi, Siyoung Dept. of Chemical & Biomolecular Engineering, Associate Professor	UCSB, Chemical Engineering, Ph.D. 2011	Transport Science (Rheology and Mass Transfer), Fluids in Porous Media, Lipid Bilayers Membranes	https://mpcomplexfluids.wordpress.com
Chung, Sung Yoon Graduate School of EEWS, Associate Professor	KAIST, Materials Science & Engineering, Ph.D. 2001	Materials Physics and Defects Chemistry for Energy Storage and Conversion, Atomic-Level Visualization with TEM/STEM, In-Situ Observation of Phase Transitions & Evolution	https://sites.google.com/site/atomicscaledefects
Coskun, Ali Graduate School of EEWS, Associate Professor	METU, Organic Chemistry, Ph.D. 2007	CO_2 Capture & Separation in Porous Polymers, H_2 Storage in Porous Graphenes, Supramolecular Gels	http://alicoskun.kaist.ac.kr
Han, Myung Joon Dept. of Physics, Associate Professor	Seoul Nat'l Univ., Physics, Ph.D. 2007	Condensed Matter Theory	https://sites.google.com/site/myungjoonhan
Han, Sang Woo Dept. of Chemistry, Professor	Seoul Nat'l Univ., Chemistry, Ph.D. 2000	Noble Metal Nanocrystals and Their Designed Assembly	http://ntl.kaist.ac.kr
Han, Seung Min Jane Graduate School of EEWS, Associate Professor	Stanford Univ., Materials Science and Engineering, Ph.D. 2006	Mechanical Properties of Nano-Structured Energy Materials	http://mpnano.kaist.ac.kr
Hong, Soon Hyung Dept. of Materials Science and Engineering, Professor	Northwestern Univ., Materials Science & Engineering, Ph.D. 1984	Design, Processes & Properties of Composite Materials	http://composite.kaist.ac.kr
Jang, Dong Chan Dept. of Nuclear and Quantum Engineering, Assistant Professor	Univ. of Michigan, Materials Science & Engineering, Ph.D. 2006	Nanomechanics and Radiation Materials Science	http://sth528.wix.com/nanomechalab
Jung, Woo Chul Dept. of Materials Science & Engineering, Assistant Professor	MIT, Materials Science & Engineering, Ph.D. 2010	Solar Fuels, Fuel Cells, Electro-catalysis	http://seml.kaist.ac.kr
Jung, Yousung Graduate School of EEWS, Associate Professor	UC Berkeley, Chemistry, Ph.D. 2005	Advanced Materials High-Throughput Computational Design	http://qchem.kaist.ac.kr
Kang, Jeung Ku Graduate School of EEWS, Professor	Stanford Univ., Materials Science & Engineering, Ph.D. 2002	Artificial Photosynthesis for Regeneration of Sustainable Fuel from CO_2 and H_2O, Energy Storage, New multiscale Simulation Method	http://nanosf.kaist.ac.kr
Kim, Bumjoon Dept. of Chemical & Biomolecular Engineering, Associate Professor	University of California, Chemical Engineering, Ph.D. 2006	Organic Solar Cells, Polymer/Inorganic Hybrid Materials, Polymer Nanomaterials	http://pnel.kaist.ac.kr
Kim, Do Kyung Dept. of Materials Science & Engineering, Professor	KAIST, Materials Science & Engineering, Ph.D. 1987	Nano Ceramics for Energy and Structural Applications	http://mse2.kaist.ac.kr/~ncrl
Kim, Hee-Tak Dept. of Chemical & Biomolecular Engineering, Associate Professor	KAIST, Chemical Engineering, Ph.D. 1999	Fuel Cells, Lithium Batteries & Redox Flow Batteries, Nano Fabrications	http://eed.kaist.ac.kr
Kim, Il-Doo Dept. of Materials Science & Engineering, Associate Professor	KAIST, Materials Science & Engineering, Ph.D. 2002	Inorganic Nanomaterials for Energy and Nanoelectronics	http://advnano.kaist.ac.kr

NT for Climate Change

Name	Education	Research Interests	Website
Kim, Ji Han Dept. of Chemical & Biomolecular Engineering, Assistant Professor	Univ. of Illiniois, Electrical & Computer Engineering, Ph.D. 2009.	Carbon Capture, Methane/Hydrogen Storage, Materials Genome Project	http://molsim.kaist.ac.kr
Kim, Yong-Hoon Graduate School of EEWS, Associate Professor	Univ. of Illiniois, Physics, Ph.D. 2000	Nanostructures, Nanosurfaces, Nanointerfaces	http://nanofun.kaist.ac.kr/yhklab
Lee, Doh Chang Dept. of Chemical & Biomolecular Engineering, Associate Professor	The Univ. of Texas at Austin, Chemical Engineering, Ph.D. 2007	Quantum Dots, Photocatalysis, QLED	http://dclee.kaist.ac.kr
Lee, Jae Woo Dept. of Chemical & Biomolecular Engineering, Professor	Carnegie Mellon Univ., Chemical Engineering, Ph.D. 2000	CO_2 Conversion to Energy Materials, Energy Efficient Designs, Clathrate Hydrates	http://efdl.kaist.ac.kr
Lee, Jay Hyung Dept. of Chemical & Biomolecular Engineering, Professor	California Institute of Technology, Chemical Engineering, Ph.D. 1991	Model Predictive Control, Approximate Dynamic Programming for Stochastic MDPs, Real-Time Optimization	http://lense.kaist.ac.kr
Lee, Jung-Yong Graduate School of EEWS, Associate Professor	Stanford Univ., Electrical Engineering, Ph.D. 2009	Renewable Energy, Nanomaterials	http://adec.kaist.ac.kr
Oh, Ji Hun Graduate School of EEWS, Assistant Professor	MIT, Materials Science & Engineering, Ph.D. 2010	Nanomaterials, Solar Energy Conversion	http://les.kaist.ac.kr
Park, Inkyu Dept. of Mechanical Engineering, Associate Professor	California Univ., Mechanical Engineering, Ph.D. 2007	High Performance Bio/Chemical & Physical Sensors based on Functional Nanostructures, Micro/Nanomanufacturing Processes and Systems, Mechanics & Reliability of Micro/nanoscale Structures and Systems	http://mintlab1.kaist.ac.kr
Park, Jeong Young Graduate School of EEWS, Associate Professor	Seoul Nat'l Univ., Physics, Ph.D. 1999	Metal-semiconductor Nanodiode, Nanotribology, Mechanics, and Molecular Electronics with SPM, Fabrication and Characterization of Nanoscale Hybrid Systems	http://scale.kaist.ac.kr
Ryu, Ho Jin Dept. of Nuclear and Quantum Engineering, Associate Professor	KAIST, Materials Science & Engineering, Ph.D. 2000	Nuclear Fuel Development and Fuel Cycle Materials Research	https://sites.google.com/site/fuelcyclematerials
Shin, Byungha Dept. of Materials Science & Engineering, Assistant Professor	Harvard Univ., Applied Physics, Ph.D. 2007	Inorganic Thin Film Solar Cells, Organic-inorganic Hybrid Photovoltaic Materials, Electronic Materials	http://energymatlab.kaist.ac.kr
Song, Hyunjoon Dept. of Chemistry, Professor	KAIST, Chemistry, Ph.D. 2000	Surface Plasmon Monitoring, Photoactive Energy Catalysts, Electroactive Materials	http://small.kaist.ac.kr
Jeong, Hyung Mo KI for the Nanocentury, Research Professor	KAIST, Materials Science & Engineering, Ph.D. 2014	Development of Energy Storage & Conversion Systems	http://nanocentury.kaist.ac.kr

NT for Healthcare

Name	Education	Research Interests	Website
Chung, Hyun Jung Graduate School of Nanoscience & Technology, Assistant Professor	KAIST, Bioengineering, Ph.D. 2010	Nanobiomedicine	https://sites.google.com/site/nanobiomedlab

NT for Healthcare

Name	Education	Research Interests	Website
Kim, Bongsoo Dept. of Chemistry, Professor	California Univ., Chemistry, Ph.D. 1990	Advanced Plasmonic Materials, Medical Nanobio Technology Employing Noble Metal Nanowire, Self-Assembled Monolayer(SAM) using 2-Dimensional Gold Nanostructure	http://nanowire.kaist.ac.kr
Kim, Hak Sung Dept. of Biological Sciences, Professor	Université de Technologie de Compiègne, Biochemical Engineering, Ph.D. 1985	Molecular Evolution, Biomolecular Recognition	http://bel.kaist.ac.kr
Kim, Pilnam Dept. of Bio and Brain Engineering, Assistant Professor	Seoul Nat'l Univ., Mechanical Engineering, Ph.D. 2009	Space of the Dynamics of Organism Architectures and Biological Patterns.	http://pilnam.kaist.ac.kr
Kim, Yeu Chun Dept. of Chemical & Biomolecular Engineering, Assistant Professor	Georgia Institute of Technology, Chemical & Biomolecular Engineering, Ph.D. 2007	Drug and Vaccine Delivery, Cell-penetrating Peptide, Cancer Therapy	http://bmnd.kaist.ac.kr
Kim, Yong Woon Graduate School of Nanoscience & Technology, Assistant Professor	POSTECH, Physics, Ph.D. 2002	Theoretical Biophysics, Soft Matter Theory, Nonequilibrium Phenomena	-
Kim, Yong-Hyun Graduate School of Nanoscience & Technology, Associate Professor	KAIST, Physics, Ph.D. 2003	Quantum Nano-bio Materials Science/simulation, First-principles Electronic Structure and Molecular Dynamics Calculations for Nano-bio and Energy Materials	http://qnmsg.kaist.ac.kr
Lee, Haeshin Dept. of Chemistry, Associate Professor	Northwestern Univ., Biomedical Engineering, Ph.D. 2008	Generalized Strategy for Functionalization of any Material Surfaces Inspired by Mussel Adhesion Adhesive Anti-bacterial, Anti-fungal Compounds Nanoparticle Synthesis Protein Therapeutics Development of Synthetic Gecko Adhesives Biointerphases	http://sticky.kaist.ac.kr
Lee, Sang Yup Dept. of Chemical & Biomolecular Engineering, Distinguished Professor	Northwestern Univ., Chemical Engineering, Ph.D. 1991	Metabolic Engineering, Systems Biotechnology, Synthetic Biology	http://mbel.kaist.ac.kr
Lee, Wonhee Graduate School of Nanoscience & Technology, Assistant Professor	California Institute of Technology, Applied Physics, Ph.D. 2008	Development of Microfluidic Calorimeters and Applications for Cell Biology, High-throughput Self-assembly of Nano-, Microparticles using Inertial Microfluidics	http://mfbsl.kaist.ac.kr
Nam, Yoon Sung Dept. of Materials Science & Engineering, Associate Professor	MIT, Biological Engineering, Ph.D. 2010	Peptide-based Nanomaterials, Nucleic acid-based Nanomaterials, Solar Fuel Cells	http://nabi.kaist.ac.kr
Nam, Yoonkey Dept. of Bio and Brain Engineering, Associate Professor	Univ. of Illiniois, Electrical Engineering, Ph.D. 2005	Neural Microsystems and Instrumentation, Neural Interfacing, Neuron-on-a-chip	http://neuros.kaist.ac.kr
Park, Chan Beum Dept. of Materials Science & Engineering, Professor	POSTECH, Biochemical Engineering, Ph.D. 1999	Biomaterials for Energy and Medicine	http://biomaterials.kaist.ac.kr
Park, Je-Kyun Dept. of Bio and Brain Engineering, Professor	KAIST, Biotechnology, Ph.D. 1992	Nanobiotechnology, Integrative Bioengineering, Microfluidics, Lab-on-a-chip	http://nanobio.kaist.ac.kr
Park, Ji Ho Dept. of Bio and Brain Engineering, Associate Professor	California Univ., Materials Science, Ph.D. 2009	Biomaterials, Cancer Nanotechnology	http://openwetware.org/wiki/Park_Lab
Park, Su-Hyung Graduate School of Medical Science & Engineering, Assistant Professor	POSTECH, Biological Sciences Ph.D. 2008	Infectious Disease, Viral Immunology, Vaccine	-
Shin, Jennifer H. Dept. of Mechanical Engineering, Associate Professor	MIT, Mechanical Engineering, Ph.D. 2004	Cell Mechanics, Cellular Mechanobiology, Microfluidics, Biological Locomotio	http://softbm.kaist.ac.kr

NT for Healthcare

Name	Education	Research Interests	Website
Sohn, Jong-Woo Dept. of Biological Sciences, Assistant Professor)	Seoul Nat'l University College of Medicine, Physiology, Ph.D. 2008	Central Serotonin System, Autonomic Neuroscience	https://sites.google.com/site/sohnlab2014

NT for Advanced Opto-Electronics

Name	Education	Research Interests	Website
Bae, Byeong-Soo Dept. of Materials Science & Engineering, Professor	Univ. of Arizona, Materials Sci. & Engineering, Ph.D. 1993	Optical and Display Materials, Sol-Gel Technology	http://www.sol-gel.net
Cho, Byung Jin Dept. of Electrical Engineering, Professor	KAIST, Electrical Engineering, Ph.D. 1991	Nano IC Technology	https://need.kaist.ac.kr
Cho, Sungjae Dept. of Physics, Assistant Professor	Univ. of Maryland at College Park, Physics, Ph.D. 2011	Quantum Transport in Topological Materials, Quantum Phase Transitions in Thin Films, Spin Transport	http://qtak.kaist.ac.kr
Cho, Yong-Hoon Dept. of Physics, Professor	Seoul Nat'l Univ., Physics, Ph.D. 1997	Semiconductor Physics	http://qnp.kaist.ac.kr
Choi, Hyoung Soon Dept. of Physics, Associate Professor	Northwestern Univ., Physics, Ph.D. 2007	Experimental Condensed Matter Physics at Low Temperatures	-
Choi, Sung-Min Dept. of Nuclear & Quantum Engineering, Professor	MIT, Nuclear Engineering, Ph.D. 1998	Neutron Scattering Studies of Nano-Materials and Superconductivity Nuclear Magnetic Resonance Imaging and Spectroscopy	http://egcl.kaist.ac.kr
Choi, Sung-Yool Dept. of Electrical Engineering, Associate Professor	KAIST, Chemistry, Ph.D. 1998	Graphene & 2D Materials and Applications, Flexible/Wearable/Soft Electronics	http://mndl.kaist.ac.kr
Im, Sung Gap Dept. of Chemical & Biomolecular Engineering, Associate Professor	MIT, Chemical Engineering, Ph.D. 2009	Chemical Vapor Deposition of Electrically Conducting Polymers and Functional Polymers, New Concept Organic Electronic Devices and Energy Devices: Flexible and Disposable, Microfluidic Device Fabrication by Applying Various Substrate Materials	http://ftfl.kaist.ac.kr
Jeon, Duk Young Dept. of Materials Science & Engineering, Professor	Lehigh Univ., Physics, Ph.D. 1988	Semiconductor Physics, Display Materials	http://display.kaist.ac.kr
Jeon, Seokwoo Dept. of Materials Science & Engineering, Associate Professor	Univ. of Illiniois, Materials Science & Engineering, Ph.D. 2006	Flexible Nanoelectronics, Advanced Photonic Materials	http://fdml.kaist.ac.kr
Jung, Yeon Sik Dept. of Materials Science & Engineering, Associate Professor	MIT, Materials Science & Engineering, Ph.D. 2009	Self-assembly, Nanofabrication, Memory Devices, Energy Capture and Storage Materials	http://funnano.kaist.ac.kr
Kim, Chun-Gon Dept. of Aerospace Engineering, Professor	KAIST, Aeronautical Engineering, Ph.D. 1987	Smart Composites, Stealth Structures	http://smartech.kaist.ac.kr
Kim, Sang Ouk Dept. of Materials Science & Engineering, Professor	KAIST, Chemical Engineering, Ph.D. 2000	Soft Nanomaterials, Carbon Nanotubes & Graphene, Energy & Catalysis	http://snml.kaist.ac.kr

NT for Advanced Opto-Electronics

Name	Education	Research Interests	Website
Kim, Sang Youl Dept. of Chemistry, Professor	Rensselaer Polytechnic Institute, Chemistry, Ph.D. 1989	New Polymerization Reactions and Methods, Polymeric Materials with controlled Architecture, Design & Synthesis of Functional Macromolecules	http://macro.kaist.ac.kr
Kim, Shin-Hyun Dept. of Chemical & Biomolecular Engineering, Associate Professor	KAIST, Chemical & Biomolecular Engineering, Ph.D. 2009	Functional Microparticles, Soft Microcapsules, Soft Photonic Materials	http://isml.kaist.ac.kr
Kim, Taek-Soo Dept. of Mechanical Engineering, Associate Professor	Stanford Univ., Mechanical Engineering, Ph.D. 2010	Graphene, Microelectronics, Fuel Cells, Solar Cells, Flexible Electronics, Thin Films	http://aptf.kaist.ac.kr
Lee, Hansuek Graduate School of Nanoscience & Technology, Assistant Professor	Seoul Nat'l Univ., Electrical Engineering, Ph.D. 2008	Light Matter Interactions and Opto-mechanics in Nano-Structures and their Applications	https://sites.google.com/site/hleelab
Lee, Hee Chul Dept. of Electrical Engineering, Professor	Tokyo Institute of Technology, Electronic Engineering, Ph.D. 1989	Semiconductors, Infrared Detectors, Ferroelectric RAM, High Dielectric Thin Film	http://irislab.kaist.ac.kr
Lee, Hyuck Mo Dept. of Materials Science & Engineering, Professor	MIT, Metallurgy, Ph.D. 1989	Alloy Phase Equilibria, Application of Nanomaterials	http://triangle.kaist.ac.kr
Lee, Jeong Yong Dept. of Materials Science & Engineering, Professor	Univ. of California, Materials Science & Engineering, Ph.D. 1986	Electron Microscopy	http://hrtem.kaist.ac.kr
Lee, Jhinhwan Dept. of Physics, Assistant Professor	Seoul Nat'l Univ., Physics, Ph.D. 2002	Scanning Probe Microscopies Strongly Correlated Electron Systems Nanoscale and Low Dimensional Electron Systems	http://ltspm.kaist.ac.kr
Lee, Keon Jae Dept. of Materials Science & Engineering, Associate Professor	Illinois Univ., Materials Science & Engineering, Ph.D. 2006	Self-powered Flexible Energy, Flexible Large Scale Integration, Flexible Opto-electronics, Laser Material Interaction	http://fand.kaist.ac.kr
Oh, Il Kwon Dept. of Mechanical Engineering, Professor	KAIST, Mechanical Engineering, Ph.D. 2001	Actuators, Transducers & Artificial muscles, Graphene & Nano-Engineering	http://sdss.kaist.ac.kr
Park, Byong Guk Dept. of Materials Science & Engineering, Associate Professor	KAIST, Materials Science & Engineering, Ph.D. 2003	Magnetic Materials, Spintronic Devices, Magnetic Memory (MRAM)	http://nanospin.kaist.ac.kr
Park, O Ok Dept. of Chemical & Biomolecular Engineering, Professor	Stanford Univ., Chemical Engineering, Ph.D. 1985	Optoelectronic Devices, Colloidal Crystals & Soft Lithography, Metal Nanocrystals	http://stereo.kaist.ac.kr
Ryu, Seunghwa Dept. of Mechanical Engineering, Associate Professor	Stanford Univ., Physics, Ph.D. 2011	Mechanics and Materials Science at Nanoscale, Development of Multiscale Simulation Methods, Interaction of Chemistry and Mechanics	https://sites.google.com/site/seunghwalab
Seo, Min-Kyo Dept. of Physics, Associate Professor	KAIST, Physics, Ph.D. 2009	Surface Plasmon based Sub-wavelength Optics, Electrically Activated Surface Plasmonic Devices, Optical Antennas for Near-field Optics	http://swol.kaist.ac.kr
Seo, Myungeun Graduate School of Nanoscience & Technology, Associate Professor	KAIST, Chemistry, Ph.D. 2008	Polymer Synthesis	http://nanopsg.kaist.ac.kr
Shin, Jonghwa Dept. of Materials Science & Engineering, Assistant Professor	Stanford Univ., Electrical Engineering, Ph.D. 2008	Nanophotonics, Metamaterials, Energy and Information Devices	http://apmd.kaist.ac.kr

NT for Advanced Opto-Electronics

Name	Education	Research Interests	Website	
Yang, Chan-Ho Dept. of Physics, Associate Professor	POSTECH, Physics, Ph.D. 2005	Complex Oxide Heterostructures and Multiferroics	http://oxide.kaist.ac.kr	
Yoo, Seunghyup Dept. of Electrical Engineering, Professor	Univ. of Arizona, Optical Sciences, Ph.D. 2005	OLEDs for Display and Lighting, OPVs for Energy Havesting, OTFTs for Integrated Printed Electronics, Vapor Jet Printing for Low-cost Printed Electronics	http://ioel.kaist.ac.kr	
Yoon, Dong Ki Graduate School of Nanoscience & Technology, Associate Professor	KAIST, Chemical & Biomolecular Engineering, Ph.D. 2007	Novel Bio-vehicles and Organic Nanodevices including Photovoltaics, OLED, etc. Soft Nanomaterials; Liquid Crystals, Supramolecules, Polymers, Particles, etc.	http://yoon.kaist.ac.kr	
Yu, Kyoungsik Dept. of Electrical Engineering, Associate Professor	Stanford Univ., Electrical Engineering, Ph.D. 2004	Nanophotonics, Optoelelctronics, MEMS	http://yu.kaist.ac.kr	
Kim, Yong Joo KI for the Nanocentury, KI Fellow	MIT, Materials Scienceand Engineering, Ph.D. 2013	Macromolecule Theory, Self-assembly	http://nanocentury.kaist.ac.kr	

KI for Health Science and Technology

Neuroimaging and Neuromodulation

Name	Education	Research Interests	Website	
Jeong, Yong Dept. of Bio & Brain Engineering, Associate Professor	Yonsei Univ., Neurophysiology, Ph.D. 1997	Brain Science, Clinical Neuroscience, Neuroimaging	http://ibrain.kaist.ac.kr	Director
Bae, Hyeon-Min School of Electrical Engineering, Associate Professor	University of Illinois at Urbana-Champaign, Electrical enginnering Ph.D. 2004	Circuit design, Communication, Biomedical engineering	http://nais.kaist.ac.kr	
Cho, Seungryong Dept. of Nuclear & Quantum Engineering, Associate Professor	The Univ. of Chicago, Medical Physics, Ph.D. 2009	X-ray Computed Tomography Reconstruction, Low-dose Imaging, X-ray Non-destructive Testing	http://mirlab.kaist.ac.kr	
Park, Chul Soon School of Electrical Engineering, Professor	KAIST, Materials Science and Engineering, Ph.D. 1985	Milli-meter Wave(mmWave) Wireless Communication System, Milli-meter Wave(mmWave) Chip to Chip communication System, STNO (Spin Transfer Torque Oscillator) Wireless Communication	http://microlab.kaist.ac.kr	
Jeong, Bum Seok Graduate School of Medical Science & Engineering, Associate Professor	Ulsan Univ. College of Medicine, Psychiatry, Ph.D. 2002	Emotional experience and Brain development, Computational Modeling of Emotional Feeling, Emotional Behavior on Social network	https://sites.google.com/site/kaistclinicalneuroscience lab	
Jo, Sungho School of Computing, Associate Professor	MIT, Electrical Engineering and Computer Science, Ph.D. 2006	Robotic Intelligence, Neuro-hybrid Intelligence, Neuro-inspired Intelligence	http://isnl.kaist.ac.kr	

Neuroimaging and Neuromodulation

Name	Education	Research Interests	Website	
Kim, Daesoo Dept. of Biological Sciences, Associate Professor	POSTECH, Biological science, Ph.D. 1998	Molecular Biology, Neuroscience, Genetics	https://sites.google.com/site/bglabkorea	
Kim, Junmo School of Electrical Engineering, Assistant Professor	MIT, Electrical Engineering and Computer Science, Ph.D. 2005	Statistical Signal Processing, Image Processing & Computer Vision, Information Theory	http://siit.kaist.ac.kr	
Lee, Hyunjoo Jenny School of Electrical Engineering, Assistant Professor	Stanford Univ., Electrical Engineering, Ph.D. 2012	Flexible Biomedical Devices for Understanding Fundamental Science, Non-invasive Brain Stimulation for Therapeutics, Highly Sensitive Chem/Bio Sensors for Early Detection of Neurodegenerative Diseases	https://sites.google.com/site/kaistbmm	
Lee, Sang Wan Dept. of Bio and Brain Engineering, Assistant Professor	KAIST, Electrical engineering and computer science(EECS), Ph.D. 2009	Computational Neuroscience, brain-inspired Artificial Intelligence	http://aibrain.kaist.ac.kr	
Lee, Sue Hyun Dept. of Bio and Brain Engineering, Assistant Professor	Seoul Nat'l Univ., Biological Sciences, Ph.D. 2008	Cognitive Neuroscience, Neuroimaging, Brain Stimulation	http://memory.kaist.ac.kr	
Park, Jinah School of Computing, Associate Professor	Univ. of Pennsylvania, Computer and Information Science, Ph.D. 1996	Deformable Model, Medical Imaging, Virtual Reality	http://cgv.kaist.ac.kr	
Park, Sung-Hong Dept. of Bio and Brain Engineering, Assistant Professor	Univ. of Pittsburgh, USA Radiology, Ph.D. 2009	MRI Anatomical / Functional Imaging, MRI Physiological / Metabolic Imaging, Intraoperative MRI Imaging	http://mri.kaist.ac.kr	
Paik, Se Bum Dept. of Bio and Brain Engineering, Assistant Professor	Univ. of California at Berkeley, Physics, Ph.D. 2009	Computational Neuroscience, Visual Information Processing, Neural Network Modeling	http://vs.kaist.ac.kr	
Ye, Jong Chul Dept. of Bio and Brain Engineering, Professor	Purdue Univ., Electrical Engineering, Ph.D. 1999	Inverse Problems, Medical Imaging (MRI, CT, Optics, Ultrasounds, DOT, etc.), Deep Neural Network	http://bispl.weebly.com	

Biophonics

Name	Education	Research Interests	Website	
Choi, Chulhee Dept. of Bio and Brain Engineering, Professor	Yonsei Univ. College of Medicine, Microbiology, Ph.D. 1999	Cell Signaling, Biomedical Imaging, Biophotonics	http://ccbio.kaist.ac.kr	
Jeong, Ki-Hun Dept. of Bio and Brain Engineering, Associate Professor	Univ. of Californica, Berkely, USA, Mechanical engineering, Ph.D. 2005	MEMS and Nanophotonics for Clinical Endoscopy, Biologically Inspired Photonics, Nanobioplasmonics	http://biophotonics.kaist.ac.kr	
Kim, Pilhan Graduate School of Nanoscience & Technology, Assistant Professor	Seoul National Univ., Electrical Engineering, Ph.D. 2005	Bioimaging, Confocal Microscopy, Two-photon Microscopy	http://ivmvl.kaist.ac.kr	
Oh, Wang Yuhl Dept. of Mechanical Engineering, Associate Professor	KAIST, Physics Ph.D. 1997	Optics, Fiber, Laser	http://bpil.kaist.ac.kr	
Park, Yongkeun Dept. of Physics, Associate Professor	MIT, Havard-MIT Division of Health Sciences and Technology, Medical Engineering and Medical Physics, Ph.D. 2010	Biomedical Optics, Biophotonics, Biophysics	https://bmol.kaist.ac.kr	

Therapeutic Bioengineering

Name	Education	Research Interests	Website	
Chung, Hyun Jung Graduate School of Nanoscience & Technology, Assistant Professor	KAIST, Biological Sciences, Ph.D. 2010	Nanomedicine, Molecular Diagnostics, Drug Delivery	http://nanomedicine.kaist.ac.kr	
Kim, Pilnam Dept. of Bio and Brain Engineering, Assistant Professor	Seoul National Univ., Mechanical Engineering, Ph.D. 2009	Tissue Engineering, Human Disease Models, Bio-inspired Microsystem	http://www.pilnam.kaist.ac.kr	
Lee, Wonhee Graduate School of Nanoscience & Technology, Assistant Professor	California Institute of Technology, Applied Physics, Ph.D. 2008	Biochip, Microfluidics, MEMS	-	
Nam, Yoonkey Dept. of Bio and Brain Engineering, Associate Professor	Univ. of Illinois, Electrical Engineering, Ph.D. 2005	Neural Microsystems and Instrumentation, Neuron-on-a-chip, Neural Cell Patterning	http://neuros.kaist.ac.kr	
Nam, Yoon Sung Dept. of Materials Science & Engineering, Associate Professor	MIT, Biological Engineering, Ph.D. 2010	Colloids for Therapeutics, Biosensing, Photothermal Therapy and Bio-imaging, Biological Self-assembly for Cell-based and DNA-Based Biosensors, Artificial Photosynthesis	http://nabi.kaist.ac.kr	
Park, Je-Kyun Dept. of Bio and Brain Engineering, Professor	KAIST, biotechnology, Ph.D. 1992	Nanotechnology-based Integrative Bioengineering, BioMEMS for Cell & Tissue Engineering, Lab-on-a-chip and Microfluidic Analytical Technologies	http://nanobio.kaist.ac.kr	
Park, Ji Ho Dept. of Bio and Brain Engineering, Associate Professor	Univ. of california, San Diego (UCSD), Materials Science, Ph.D. 2009	Translational Bio-freindly Materials, Systems Nanotechnology, Artificial Targeting Agents	http://openwetware.org/wiki/Park_Lab	

Smart Healthcare

Name	Education	Research Interests	Website
Kim, Daeyoung School of Computing, Professor	Univ. of Florida, Computer Science, Ph.D. 2001	Realtime and Embedded Systems, Internet of Things	http://resl.kaist.ac.kr
Ko, In-Young School of Computing, Associate Professor	Univ. of Southern California (USC), Computer Science, Ph.D. 2003	Services Computing, Web Engineering, Software Engineering	http://bigbear.kaist.ac.kr/~iko
Lee, Jae-Gil Dept. of Industrial & Systems Engineering, Associate Professor	KAIST, Computer Science, Ph.D. 2005	Spatio-Temporal Data Mining Big Data Analysis with Hadoop/MapReduce and Spark Stream Data Mining and Complex Event Processing	http://ie.kaist.ac.kr
Lee, Uichin Dept. of Industrial & Systems Engineering, Associate Professor	Univ. of California, Los Angeles, Computer Science, PhD. 2008	Mobile Health, Social Computing, Ubiquitous Computing	http://ic.kaist.ac.kr

Saudi Aramco-KAIST CO_2 Management Center

Development of CO_2 capture and conversion process

Name	Education	Research Interests	Website	
Lee, Jay H. Dept. of Chemical engineering, Professor	California Institute of Technology, Chemical Engineering, Ph.D. 1991	Model Predictive Control, Approximate Dynamic Programming, Production Scheduling	http://lense.kaist.ac.kr	Director
Han, Jong-In Dept. of Civil and Environmental Engineering, Associate Professor	Univ. of Michigan, Environmental engineering, Ph.D. 2002	Algae-based biodiesel, Pretreatmenf of cellulosic biomass, Electrical conversion of exhaust	http://ebtel.kaist.ac.kr	
Im, Sung Gap Dept. of Chemical and Biomolecular Engineering, Associate Professor	MIT, Chemical engineering, Ph.D. 2009	Membranes, Surface Treatment, Insulating Layer	http://ftfl.kaist.ac.kr	
Kim, Jihan Dept. of Chemical and Biomolecular Engineering, Assistant Professor	Univ. of Illinois at Urbana-Champaign, Electrical Engineering, Ph.D. 2009	Molecular Simulations, Multi-scale Modeling, Materials Design	http://molsim.kaist.ac.kr	

CO_2 reduction by enhancing energy efficiency

Name	Education	Research Interests	Website	
Bae, Choong Sik Dept. of Mechanical Engineering, Professor	Imperial College, Mechanical Engineering, Thermofluids, Ph.D. 1994	Internal Combustion Engine, Combustion, Thermofluids Experiments, Laser diagnostics and instrumentation	http://engine.kaist.ac.kr	
Choi, Jang Wook Graduate School of EEWS, Associate Professor	California Institute of Technology, Chemical Engineering, Ph.D. 2007	Energy Storage, Rechargeable Battery, CO_2 capture	http://nest.kaist.ac.kr	
Jang, Kitae Cho Chun Shik Graduate School for Green Transportation, Assistant Professor	Univ. of California, Berkeley, Civil and Environmental Engineering, Ph.D. 2011	Traffic Operation and Control, Sustainable Transportation, Traffic Safety	tops.kaist.ac.kr	
Lee, Jeong Ik Dept. of Nuclear and Quantum Engineering, Associate Professor	Massachusetts Institute of Technology, Nuclear Science and Engineering, Ph.D. 2007	Nuclear enegy and system engineering, Power conversion and propulsion, Supercritical CO_2 power cycle	http://npnp.kaist.ac.kr	

CO_2 conversion technology

Name	Education	Research Interests	Website	
Han, Sang Woo Dept. of Chemistry, Professor	Seoul National Univ., Physcial Chemistry, Ph.D. 2000	Nnaocatalysts, Solar energy conversion, Plasmonics	http://ntl.kaist.ac.kr	
Jung, Yousung Graduate School of EEWS, Associate Professor	UC Berkeley, Chemistry, Ph.D. 2005	Atomistic materials design for CO_2 capture and conversion, Energy storage materials, Computational methods developments	http://qchem.kaist.ac.kr	
Lee, H.K. Dept. of Civil and Environmental Engineering, Professor	Univ. of California, Los Angeles, Civil and Environment Engineering, Ph.D. 1998	Construction Materials, Structural Analysis	http://samlab.kaist.ac.kr	
Lee, Jae Woo Dept. of Chemical & Biomolecular Engineering, Professor	Carnegie Mellon Univ., Chemical Engineering, Ph.D. 2000	CO_2 Conversion, H_2 Storage, Biomass Conversion	http://efdl.kaist.ac.kr	

Solar energy-based CO_2 conversion

Name	Education	Research Interests	Website
Lee, Doh Chang Dept. of Chemical and Biomolecular Engineering, Associate Professor	Univ. of Texas at Austin, Chemical Engineering, Ph.D. 2007	Photocatalysis, Quantum dot display, Self-assembly	http://dclee.kaist.ac.kr
Song, Hyunjoon Dept. of Chemistry, Professor	KAIST, Inorganic and Organometallic Chemistry, Ph.D. 2000	Plasmon Nanocrystals, Photochemical Catalysts, Electroactive Materials	http://small.kaist.ac.kr

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*Campus Map_*

*Address_*

Operation Team for KAIST Institutes, KAIST,
291 Daehak-ro, Yuseong-gu, Daejeon
E-mail : kiadmin@kaist.ac.kr

*Staff_*

KI	Name	E-mail
KI for the BioCentury	Lee, Jung Hee	ljh80@kaist.ac.kr
KI for IT Convergence	Kim, Ha Lim	hlkim@kaist.ac.kr
KI for Robotics	Park, Yu Na	yunasa@kaist.ac.kr
KI for the NanoCentury	Kim, Nu Ri	kimnuri@kaist.ac.kr
KI for Healht Science and Technology	Kim, Mi Hyun	meihyong@kaist.ac.kr
Saudi Aramco-KAIST CO_2 Management Center	Kim, Jung Yi	jaimiekim@kaist.ac.kr