2020 KAIST INSTITUTES ANNUAL REPORT

KIB

KIITC

CMC

KIR

FIRIC

KINC

CEP

KIHST

KIAI

2020 KAIST INSTITUTES ANNUAL REPORT

KAIST INSTITUTES

http://kis.kaist.ac.kr
291 Daehak-ro, Yuseong-gu, Daejeon, Republic of Korea
T. +82-42-350-2381~9 F. +82-42-350-2080

KAIST INSTITUTES

2020 KAIST INSTITUTES ANNUAL REPORT

KAIST INSTITUTES

History

2020 KAIST INSTITUTES ANNUAL REPORT

2006

August.
Established KAIST Institutes
October.
Established KIB, KIITC, KIDCS
November.
Established KIEE, KINC

2007

January.
Established KIEcoE, KIUSS
December.
Established KIOST

2010

May.
Completion of Hong & Park KI B/D

2012

January.
Closed KIEE, KIEcoE

2013

February.
Closed KIUSS
Established Saudi Aramco-KAIST CO_2 Management Center (CMC)

2014

September.
Established KIDS

2015

June.
Established KI for Convergence Research Innovation Center (I-Space)
December.
Closed KIDS

2016

March.
Changed the name of Institute from KIOST to KIHST
Changed the name of Institute from KIDCS to KIR

2017

April.
Promoted NExFIRE Program
May.
Established KIAI
July.
Established Fourth Industrial Revolution Intelligence Center (FIRIC)

2020

April.
Established Center for Epidemic Preparedness (CEP)
Closed KI for Convergence Research Innovation Center (I-Space)

Contents

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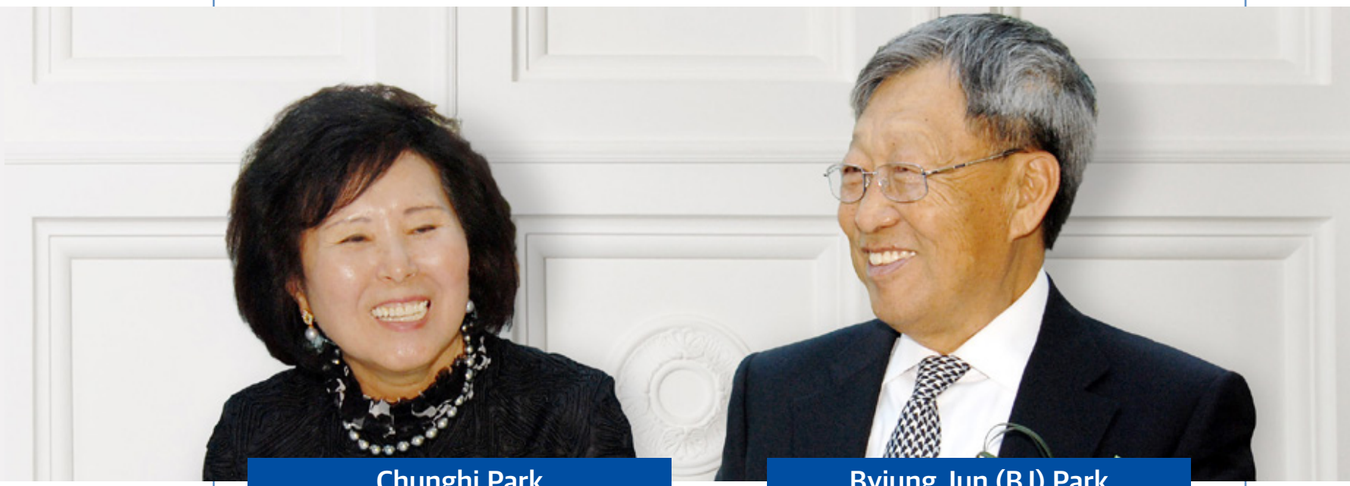
Donations for the Future of KAIST

Dr. Byiung Jun Park and his wife, Ms. Chunghi Park generously donated 10 million dollars in 2007 for the construction of the Chunghi & Byiung Jun Park KI Building in hopes that KAIST would become the greatest university in the world. Based on their wish, the construction of Chunghi & Byiung Jun Park 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.



Chunghi Park

Byiung Jun (BJ) Park

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
- Funding for a student exchange program "Leeds to South Korea" as a part of "Making a World of Difference" at University of Leeds

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.

Greetings

2020 KAIST INSTITUTES ANNUAL REPORT

“KAIST, Striving to Achieve a Brighter Future for Humanity and a Sustainable World”

Founded in 1971, KAIST has grown into a world-class university that the Korean people take pride in within just a half century. Having been acclaimed as “the future of Korea” is a testament to the precious history of KAIST’s 50 years.

As KAIST begins the new journey into its next 50 years, we are at important crossroads disrupted by COVID-19 and the Fourth Industrial Revolution. KAIST will continue to strive to achieve a brighter future for humanity and a sustainable world.

KAIST dreams of becoming a top 10 global university of unparallel distinctness. The KAIST Institutes (KI), established in 2006, delivers creative energy into academics and industries by conducting multi- and interdisciplinary meta-convergence research projects. KI is endeavoring to develop the world’s first outcomes by shifting its focus from research on ‘how’ to solve problems are defined by others to determining ‘what’ to study. Such an effort will drive us one step closer to realizing our dream.

The 2020 KI Annual Report contains major achievements in innovation made in 2020 by the six institutes specializing in bio-convergence, IT convergence, robotics, nano-convergence, health science, and artificial intelligence, as well as the Saudi Aramco-KAIST CO_2 Management Center, the Fourth Industrial Revolution Intelligence Center, and the Center for Epidemic Preparedness. I hope that this report will inspire researchers and motivate students to pursue bigger dreams in science and technology.

I look forward to your continued interest and support for a promising future as the KI pushes new boundaries in science and technology.

Thank you.

President of KAIST

Kwang Hyung Lee

“KAIST Institutes, Advancing Innovative Responses to Global Challenges based on Interdisciplinary Research, Experience, and Know-How in Convergence”

KAIST Institutes (KI) was established in 2006 to maximize KAIST’s outstanding human and intellectual resources through interdisciplinary research. KI has created new value and produced achievements consistent with its founding purpose based on a system of innovation that promotes innovative thinking and projects that blur boundaries across disciplines and organizations.

KI has actively engaged in interdisciplinary research under research institutes spanning six disciplines, namely, bio-convergence, IT convergence, robotics, nano-convergence, health science, and artificial intelligence. Now, it seeks to usher in a new age of meta-convergence, in which convergence enhances further convergence to address the great challenges that humanity faces today, including aging and public health crisis, environment and climate change, and energy depletion. Multi-faceted, complex meta-convergence research will be conducted to drive innovation in technology and create new growth engines.

The COVID-19 pandemic that swept the globe in 2020 has presented new challenges for KI. To prepare against mutations and other new diseases, the Center for Epidemic Preparedness (CEP) was established under KI in April 2020. CEP will allow Korea to respond effectively to both the current and future pandemics by conducting research on infection control strategies and developing the necessary technology and distribution platforms for vaccination.

KI, which has contributed to Korea’s productive research culture, will respond promptly to challenging situations in the ever-changing 21st century. It will exert efforts to foster interdisciplinary research that are in line with government policies and strategies. Ultimately, KI aims to become a world-class interdisciplinary research institute, solving global challenges and securing new growth engines for a better future. Your support and encouragement throughout this journey is highly appreciated.

Thank you.

Dean of KAIST Institutes

Sun-Chang Kim

KAIST Institutes Introduction

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

KI for the BioCentury

Mission

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

Vision

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. We 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

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 aging

Rhee, June-Koo KIITC
Director
rhee.jk@kaist.ac.kr

KI for IT Convergence

Mission

Conduct global-leading multidisciplinary research and industrialization with the aid of information technologies.

Vision

- 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

B5G/6G Mobile Communications and Wireless Power Transfer Technology
- B5G millimeter band/6G terahertz band mobile communication technology
- RF wireless power transfer technology
- High-resolution 4D radar technology

IoT/WoT
- IoT/WoT interworking framework
- IoT data stream analysis and machine learning for situation awareness
- Virtual and Augmented Reality/Augmented Human

Integrated Sensors
- Smart integrated sensors and networks
- Single photon sensor (Quantum sensor)
- Mobile healthcare sensors and systems

Shim, Hyunchul KIR
Director
hcshim@kaist.ac.kr

KI for Robotics

Mission
- Focus on the research toward new type of robots that can operate in real world with a high reliability.
- Perform researches on fundamental technologies and implementations on future unmanned vehicle systems.
- Promote synergetic research through interdisciplinary collaboration among electrical engineering, mechanical engineering, aerospace engineering, civil engineering and computer science.

Vision
- Interdisciplinary research on robotics
- Research on intelligent future unmanned vehicle systems

Core Competence

Fundamental Research on Future Robotics
- Research on high performance perception using machine learning
- A novel framework for robot-human collaboration

Mobile Robot Technologies
- Robot control using deep reinforcement learning
- Coordination of multiple/heterogeneous unmanned agents

Future Mobility Technologies
- Research on next generation mobility systems such as autonomous trams, unmanned surface vehicles, UAMs
- Research on Effective Operation of future mobility systems

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

KI for the NanoCentury

Mission

With an aim to promote and advance the multidisciplinary nature of nanotechnology, we target on becoming a globally leading laboratory in various fields of nanotechnology by creatively overcoming the boundaries of different areas.

Vision

The World-Leading University Hub of Nano Convergence Research
- Creativity through interdisciplinary research
- Fusion research for synergistic effects
- Win-win through cooperation

Core Competence

NT for Climate Change
- Nanotechnology for environmental applications, water, particulate matter, micro plastic
- Nanotechnology for sustainable energy
  Nanotechnology for advanced battery, solar energy
- Efficient nano-processes for CO_2 emission

NT for Healthcare
- Nanotechnology systems for diagnosis of infections
- Nano-sensor technology (Optical Sensor, Flow Sensor, Image/near-infrared sensor, exhaled breath sensor, magnetic sensor etc.)
- **Nano-based membrane technology (Cross-aligned nanofilter based membrane)**

NT for Advanced Opto-Electronics
- Nanotechnology for advanced 3D display
- Nanotechnology for wearable electronics
- Nanotechnology for next-generation semiconductor

NT for Customized Nanomaterials & Nano Devices
- Replacing existing nanomaterials, nano-process and system
- New nano-manufacturing

KAIST Institutes Introduction

KI for Health Science and Technology

Jeong, Yong
Director
yong@kaist.ac.kr

KIHST

Mission

Develop new high-impact technologies through combination of medicine and engineering to lead the future healthcare field.

Vision

- Development of innovative future healthcare technology through interdisciplinary research of medicine and engineering
- Frontier in future healthcare industry and market through synergistic partnership of academia, hospital and industry R&D activity in the field of health science

Core Competence

Neuroimaging & Neuromodulation
- Neuroimaging-based brain network and hemodynamics analysis
- Imaging Biomarker and neuromodulation for neurodegenerative diseases
- Model-based emotion perception
- Milimeter-based non-invasive vagus nerve stimulation

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

Therapeutic Bioengineering
- Biological analysis of tumor microenvironments
- Targeted nanomedicine for cancer therapy
- Cooperative tumor cell membrane targeted photo therapy

Smart Healthcare
- Development of key technology for mobile healthcare system
- Establishment of mobile healthcare ecosystem and its validation
- Digital phenotype for personal physical and mental healthcare service

KI for Artificial Intelligence

Oh, Alice
Director
alice.oh@kaist.ac.kr

KIAI

Mission

By developing innovative AI technologies for the human "Quality-of-Life" improvement, we will contribute to the 4th Industrial Revolution and serve as AI hub and think tank.

Vision

World top class Artificial Intelligence Research Institute via development of artificial intelligence core and domain-specific enabling technologies

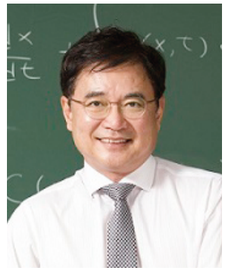
Core Competence

AI Fundamentals
- Brain-inspired cognitive inference computation architecture and learning rule
- Vision/speech based multimodal representation, cognition and interaction
- Natural language processing, understanding, gene ration and conversation
- Understanding and computational model of human internal states (such as intention, emotion, trust, memory, ethics, and personality)
- Human-like situation awareness, judgement and behavior modeling

AI Applications
- Intelligent service agents
- Solutions for natural science and engineering problems
- Medicine and healthcare
- Intelligent robot/drone and autonomous vehicle
- Design of new material and composition
- Management and finance
- Information security
- Environment forecasting system
- etc.

AI Emergings
- Brain-AI Interface
- Smart chip
- Quantum machine learning

Saudi Aramco-KAIST CO_2 Management Center



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

CMC

Mission

Research activities of the center have primarily focused on the process of capturing CO_2 and innovative methods of reducing CO_2 emissions. We also focus on the transformation of CO_2 into valuable chemicals and materials in an economically-feasible manner.

Vision

- Within 10 years of its establishment, we 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, we 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

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

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

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

CO_2 Storage
- Resilient geologic storage of CO_2

Fourth Industrial Revolution Intelligence Center (FIRIC)

Kim, So Young
Director
soyoungkim@kaist.ac.kr

FIRIC

Mission

Monitoring of merging technologies driving the Fourth Industrial Revolution and the research and policy development on the social, economic, and cultural impacts of those technologies

Vision

A global strategic research center for the co-designing of technologies and policies leading the Fourth Industrial Revolution

Core Competence

- Collaborative research with WEF C4IR on three core topics (AI, blockchain, precision medicine)
- Publication of trends of 4IR core technologies report and issue papers
- Operation of a consultative group with research institutes and researchers and launch of a professional network database
- Participation in domestic and international policy discussions and joint meetings

Center for Epidemic Preparedness (CEP)

Shin, Eui-Cheol
Director
ecshin@kaist.ac.kr

CEP

Mission

In order to respond to newly emerging and re-emerging infectious diseases, we research virology and immunology of newly emerging and re-emerging infectious diseases.

Vision

Center for Epidemic Preparedness (CEP) develops technologies for prophylactic vaccines and therapeutics, and establishes platforms for these technologies. We also serve as a hub for convergence research on newly emerging and re-emerging infectious diseases within KAIST.

Core Competence

Study of Host Responses to Newly Emerging Viruses at a Single-Cell Level
- Single-cell RNA sequencing analysis of blood leukocytes from patients with various viral diseases
- Identification of gene signatures specific to each viral disease
- Development of a screening platform for re-purposing of inflammation-modifying agents

Characterization of T Cells Reactive to Newly Emerging Viruses
- Phenotypic and functional characte rization of T cells reactive to newly emerging viruses
- Investigation of roles for T cells in severe and critical viral disease
- Understanding of cross-reactive T cells in uninfected individuals

Development of Prophylactic Vaccines against Newly Emerging Viruses
- Identification of common antigens across a species of each newly emerging virus
- Development of a strategy for utilizing common antigens as vaccine antigens
- Development of vaccines targeting newly emerging viruses in a broad range

KAIST Institutes Statistics

Faculty

As of Dec 2020

Faculty	KIB	KIITC	KIR	KINC	KIHST	KIAI	CMC	CEP	Total
Professor	23	16	7	75	41	30	22	8	222
Research Professor (KI Fellow)	4	3 (1)	-	-	1	-	-	-	8 (1)
Adjunct Professor	-	9	-	-	-	-	-	-	9
Total	27	28	7	75	42	30	22	8	239

Papers - Total (SCI)

Year	KIB	KIITC	KIR	KINC	KIHST	KIAI	CMC	CEP	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)
2017	53 (50)	45 (34)	23 (21)	66 (65)	66 (62)	2 (2)	23 (17)	-	278 (251)
2018	119 (119)	45 (41)	49 (43)	180 (173)	50 (47)	52 (47)	14 (14)	-	509 (484)
2019	114 (111)	36 (27)	50 (44)	180 (179)	66 (63)	51 (48)	10 (10)	-	507 (482)
2020	152 (145)	43 (38)	40 (38)	163 (156)	105 (99)	73 (67)	18 (18)	6 (6)	600 (573)

Patents - Total (International)

Year	KIB		KIITC		KIR		KINC		KIHST		KIAI		CMC		CEP		Total	
	Pending	Registration	Pending	Registration	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	2	-	-	4 (1)	-	-	-	26 (6)	1
2017	7 (2)	9 (6)	75 (19)	69 (12)	6	2	23 (3)	9 (2)	19 (6)	4	3	-	3 (1)	1	-	-	136 (31)	94 (20)
2018	13 (1)	11 (7)	52 (15)	57 (14)	12	7	56 (8)	26 (2)	21 (13)	6	45 (9)	18 (5)	3 (1)	1	-	-	202 (47)	126 (28)
2019	14 (2)	12 (6)	49 (15)	43 (17)	22 (5)	6	62 (16)	27 (3)	23 (6)	5	53 (18)	18 (3)	18 (11)	-	-	-	241 (73)	111 (29)
2020	31 (13)	5	68 (29)	45 (10)	20 (11)	5 (1)	58 (15)	35 (7)	27 (15)	17 (4)	48 (18)	40 (7)	1 (1)	2	1	1	254 (102)	150 (29)

Funding & Project

Unit: KRW Million

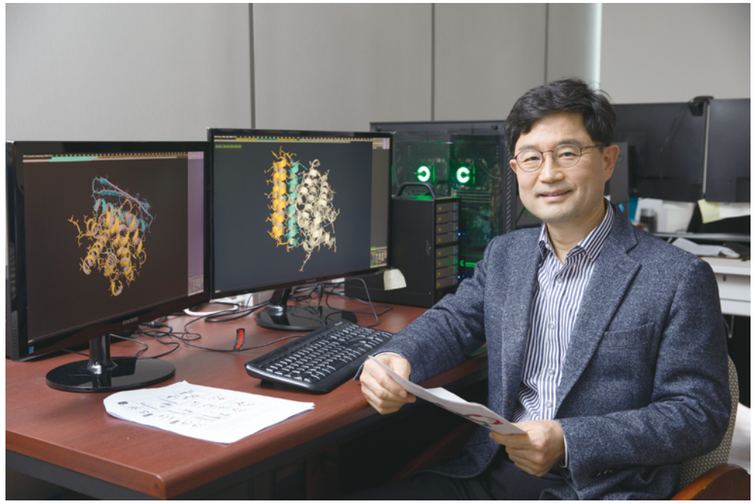
Year	KIB		KIITC		KIR		KINC		KIHST		KIAI		CMC		CEP		Total	
	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects	Fund	Projects
2008	4,012	24	11,787	54	1,380	13	5,479	32	250	1	-	-	-	-	-	-	22,908	124
2009	11,851	49	12,016	63	786	9	17,349	39	782	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	25	-	-	3,030	23	-	-	38,605	201
2017	16,742	25	11,085	64	5,870	35	7,942	48	6,005	31	1,135	2	1,983	17	-	-	50,762	222
2018	17,808	45	10,328	64	17,122	46	12,254	101	4,538	24	12,892	65	2,267	18	-	-	77,209	363
2019	14,954	45	9,729	68	13,906	42	12,939	103	6,933	30	15,048	54	3,426	22	-	-	76,935	364
2020 (USD)	18,260 (16M)	47	9,898 (9M)	60	5,151 (4M)	44	15,133 (14M)	116	5,547 (5M)	29	14,728 (13M)	67	1,973 (1M)	12	1,390 (1M)	4	72,080 (66M)	379

Team reveals protein complex structure through repeated experiments

Legionnaires' disease, first reported in the United States, is an infectious disease that can be fatal. About 200 attendees of a 1976 American Legion convention in Philadelphia were infected, and 28 of them died. In Korea, 30 ICU patients at a general hospital in Seoul contracted the disease in 1984, and among them, 4 died. Outbreaks have been detected every summer, but there is no vaccine available to date.

The team, led by Professor Byung-Ha Oh, became the world's first to reveal the structure of the *Legionella pneumophila* secretion system, which causes Legionnaires' disease, thereby laying a foundation for the development of antibiotics.

Byung-Ha Oh
KI for the BioCentury
Dept. of Biological Sciences,
Professor



Structure of *Legionella pneumophila* secretion system revealed

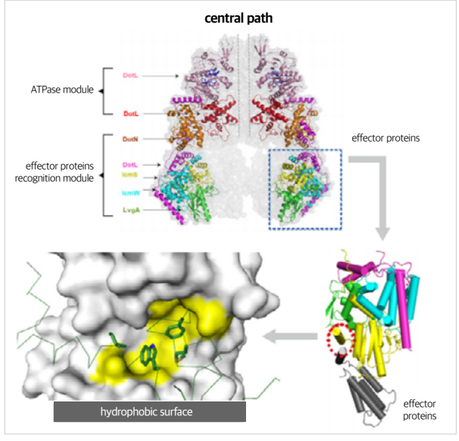
Legionella pneumophila protein complex structure unveils method of recognizing effector proteins

Legionnaires' disease is a Class 3 infectious disease in Korea. While multi-drug resistant strains have not been discovered, the disease-causing ***Legionella pneumophila*** is known as a highly virulent pathogen. New antibiotics are required when a pathogen gains antibiotic resistance. Similar to other pathogens, the protein secretion mechanism of ***Legionella pneumophila*** involves two steps. First, the system recognizes effector proteins from among thousands of bacterial proteins. Next, it secrets them outside of cells. The research team revealed the entire structure of the type VI coupling protein complex, which is responsible for the first step. They found that six different proteins (DotL, DotN, IcmS, IcmW, LvgA, DotM) form the core of the protein complex. By reporting the coupling of the complex to effector proteins, the team identified the part of the protein complex that recognizes and selects effector proteins.

"Basis for development of antibiotics that are not toxic to humans"

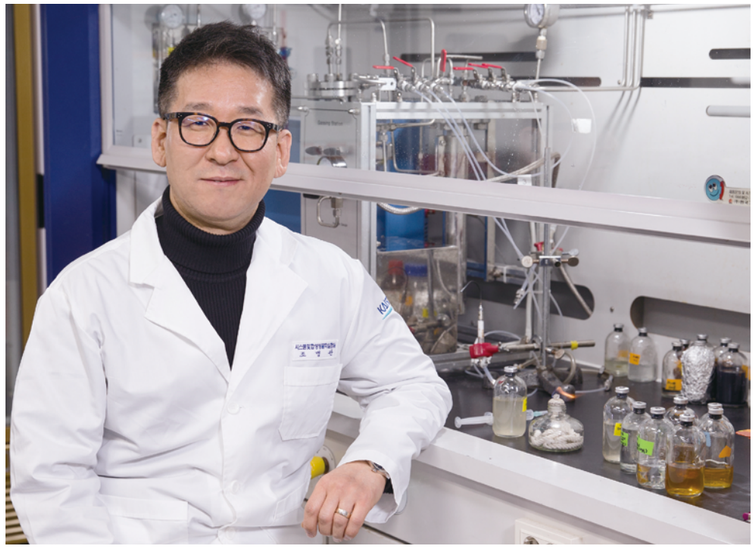
Professor Byung-Ha Oh said, "The bottom of the complex selectively recognizes effector proteins, and the ATPase domain at the top processes the structure into a linear chain, releasing it through the central path. The released chain is transferred to another protein complex, and eventually secreted outside cells."

The team repeated their experiments to ensure high accuracy, and found that the surface of the binding site is concave and comprised of hydrophobic amino acids. Antibiotics effective against ***Legionella pneumophila*** may be developed by finding molecular compounds that bind strongly to the surface of effector proteins. The results are expected to serve as a basis for follow-up studies on the development of antibiotics that are not toxic to humans. The paper was published in the international journal, ***Nature Communications***, in May 2020.



Structure of T4CP complex and coupling structure of effector proteins

Byung-Kwan Cho
KI for the BioCentury
Dept. of Biological Sciences,
Associate Professor



Resourcification of greenhouse gases: C1-fixing pathway discovered

A method of converting gases, a cause of climate change, into valuable biochemical substances has been discovered. Gases emitted from factory chimneys, such as carbon dioxide and methane, are known as primary greenhouse gases. C1 gases having one carbon atom, namely, carbon dioxide (CO_2), carbon monoxide (CO), and methane (CH_4) are being extensively studied as they look promising as a new source of energy, depending on the processing method.

The team, led by Professor Byung-Kwan Cho, identified a new pathway that utilizes C1 gases. The proposed pathway is the most efficient among related pathways known to date, and is expected to be useful in industrial applications that convert C1 gases into biochemical substances.

Converting discarded natural gases into valuable substances

Seventh pathway is most efficient among the C1-fixing pathways

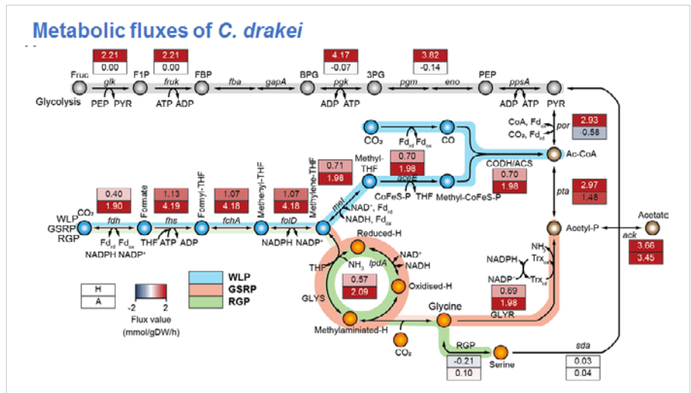
The team, led by Professor Byung-Kwan Cho, discovered a new pathway to convert C1 gases into organic matter. There are six C1-fixing pathways known to date. Before this discovery, the Wood-Ljungdahl pathway in acetogens was found to be the most efficient. Acetogens can thrive in various environments and produce hundreds of billions of kilograms of acetic acid in a year, thus playing a key role in the global carbon cycle. However, they grow at a rate ten times slower than E. coli and other industrial microorganisms, which acts as a limitation during the conversion of C1 gases into valuable biochemical substances.

Using next-generation genome sequencing and genetic analysis, the team established a digital virtual cell model. They predicted the efficiency of C1-fixing pathways, and discovered that a seventh pathway exists. The new pathway was found by coutilizing the Wood-Ljungdahl pathway and glycine synthase pathway to fix C1 compounds, and at the same time, acquire energy needed for cellular growth. The team proved that C1 gas is used in the autotrophic growth of *Clostridium drakei* via gene expression, isotope-based metabolite-tracing, and genome editing. In addition, C1 gas was found to be rapidly utilized when related genes were introduced in other acetogens having slow growth rates.

"New pathway discovered after countless failures"

Professor Byung-Kwan Cho said, "There is a higher demand for this technology than when I started this study seven years ago, and I feel a greater sense of responsibility. By using the new pathway, we can overcome limitations on the synthesis of biochemical substances caused by the slow growth of acetogens." The team plans to build upon this study to create intelligent artificial cells.

The study was published in the online version of the *Proceedings of the National Academy of Sciences of the United States of America* (PNAS) on March 13, 2020.



Prediction of carbon flow for Wood-Ljungdahl pathway (blue) and new glycine synthase pathways (orange and green) through a digital virtual cell model established based on genetic information of C1-fixing *Clostridium drakei*

Woontack Woo
KI for IT Convergence
Graduate School of Culture Technology, Professor

New platform overcomes time and space constraints

A walk from the famous Place de la Concorde to the beautiful Champs-Élysées is one of the top things to do in Paris. In a contact-free era, is it possible to feel the romantic atmosphere in Paris without being there in person? This may soon be realized thanks to domestic technology. Users can travel to the romantic city of Paris in virtual reality; however, making virtual worlds realistic and believable involves significant time and money. Against this backdrop, the team, led by Professor Woontack Woo, developed a platform that utilizes spatial information for anyone to easily create and experience three-dimensional worlds.

Easy-to-use platform for anyone to create virtual worlds

Algorithm and authoring tools for easier VR content production

The team, led by Professor Woontack Woo, developed an algorithm that estimates camera pose based on 360-degree panoramic images and spatial information provided by GIS services. By combining the coordinates of 360-degree images in Google and camera pose estimation, image textures can be mapped onto virtual worlds. The team also developed a scene rendering technique using Smart Panoramic Texture Mapping (SPTM), which stitches two-dimensional images to three-dimensional images, enabling scenes to be generated while walking. Interactive dynamic object generation was achieved using GAN, a deep learning technique. Three-dimensional models were provided for moving objects, such as watches and vehicles, so that they can be moved into three-dimensional worlds. This is a key technique that supports user interactions in the content production environment.

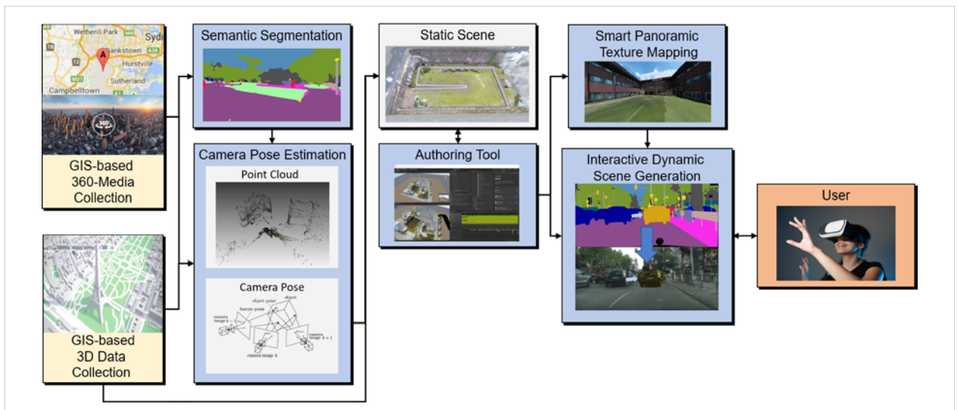
Authoring tools (interaction, navigation) were also developed. The tools support object detection and location tracking for users to interact with objects in the S3D 360VR environment, and integrate property editing and related information to conveniently produce VR content with industrial applications.

"Providing new experiences in augmented reality for the contact-free era"

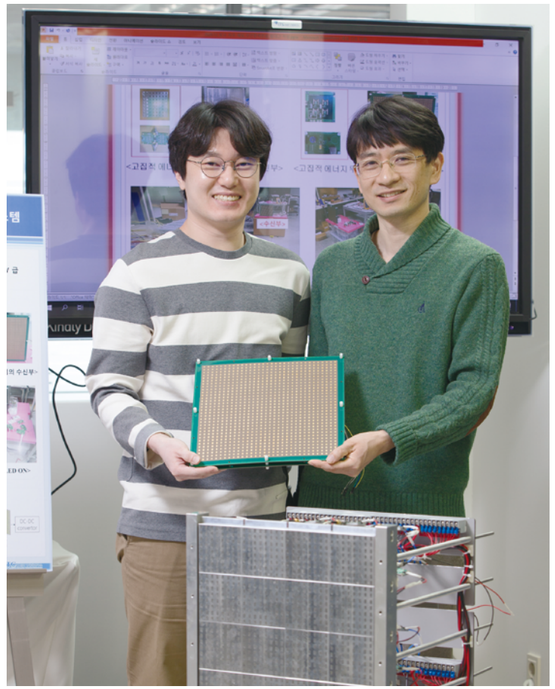
Professor Woontack Woo said, "The future will be a digital twin era, with users sharing their emotions and social relations in virtual reality. Individuals will be users, and at the same time, content producers."

Through further research, the team plans to provide a VR content production platform that allows users to freely interact in virtual space without time and space constraints, using three-dimensional spatial data. The study was conducted under the Information and Communications/Broadcasting R&D Program of the Institute for Information & Communications Technology Planning & Evaluation (IITP) under the Ministry of Science and ICT. The team published a related paper in an international journal, and applied for one PCT patent.

Virtual reality technology development process



Wireless Power Transfer technology for more independent and active movement of intelligent objects



Ju Yong Lee
KI for IT Convergence
Research Professor (KI Fellow)

Wireless Power Transfer (WPT) is a technology that transfers energy without a transmission line by converting electrical energy into a specific frequency electrical signal or light wave in the form of an electromagnetic wave. As a base technology required for the independent, active movement of intelligent objects employed by smart homes, smart factories, autonomous vehicles and artificial intelligence technologies, WPT will become a game changer in the industry including smart devices and IoT. A research team led by Professor Ju Yong Lee has successfully developed a WPT system that allows for the transmission of information and electricity simultaneously using the same resources based on a multiple-antenna system. By establishing an integrated PoC system for charging and wireless power transmission with high transmission/reception efficiency, it is expected to lead to more effective system modularization and improvement of efficiency.

Simultaneous transmission technology for electricity and information, opening an era of a “truly wireless” world

Higher efficiency achieved with development of WPT system for simultaneous transmission of information and power

WPT technology is categorized into magnetic induction/magnetic resonance method, radio frequency (RF) method, infrared light method and ultrasonic wave method. △For the magnetic induction/resonance method, the transmission distance is relatively short and the terminal can be charged only when it is in the correct contact location. △The RF method transmits/receives electromagnetic waves, enabling long-distance transmission. An array antenna is used for higher efficiency, but a bigger size antenna is required at low frequencies. △The infrared method utilizes a laser. △The ultrasonic method converts energy from a transmitter into ultrasonic waves and transmits those, and the received ultrasonic waves are changed back to electrical energy.

Prof. Lee and his team developed a WPT system that allows for the transmission of information and electricity simultaneously using the same multiple-antenna based resources. The initial goal was to achieve 50% efficiency at a distance of 10m, but it was unrealistic when first simulated. They heightened the frequencies, and then the desired energy efficiency was achieved, which led to the development of a prototype. They continued the study to achieve a level of efficiency in which all factors for transmission and reception were satisfied via the use of energy-efficient elements. The team also developed a high-efficiency transmission RF module that supports a waveguide array-based transmit antenna and a power amplifier (PA). The team built an integrated PoC system for wireless power transmission and charging by making a “Rectenna” (Receiving antenna + Rectifier) with high-density receiver and DC-DC converter module; using the system, they achieved 50% efficiency between receiving and transmitting antennas and 70% efficiency at the receiving rectifier, using a 10m transmission/reception distance, and compact-sized transmission (60cmx60cm) and receiving (30cmx30cm) antennas.

“We will develop the optimal technology, keeping in mind any possible harm to human body”

Prof. Lee said, “Wireless power transmission technology must ensure human harmlessness, as well as considerations for efficiency, modularization, and economic feasibility until a prototype is finally commercialzed.” He continued, “For this technology to be successfully commercialized, we must obtain desired results through accurate predictions and simulations in the process of developing source technologies; consistent investment and research is also required.”

RF-based Wireless Power Transfer PoC system

Creating low cost and high performance “Eyes” for autonomous vehicles and drones

Kuk-Jin Yoon
KI for Robotics
Dept. of Mechanical Engineering,
Associate Professor

One of the key aspects of the promising AI industry, represented by autonomous vehicles, drones, robots, etc., is improving the ability to perceive the environment and movements detected around a vehicle. A system should be able to understand the overall 3D structure of its surroundings while recognizing the surrounding objects and its own movement to identify its location based on the surroundings. In line with this, there has been robust research carried out using “Computer Vision,” a technology for identifying the surrounding environment based on video images provided by a vision sensor. Though conventional cameras are the most commonly used vision sensor, they have their technical limitations. To tackle such limitations, Professor Kuk-Jin Yoon and his team have developed a driving environment recognition algorithm using a new type of vision sensor. They have conducted an in-depth study of omni-directional camera-based vision technology and developed an event camera-based technology that can obtain robust vision information under dynamic lighting and movement environments. Many relevant industry corporations have also taken keen interest to their new approach.

Vision technology that can obtain accurate visual information even under dynamic conditions

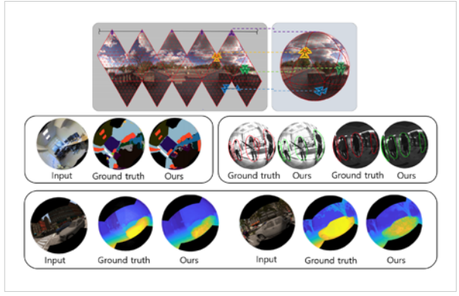
Maximizing the strengths of 360-degree and Neuromorphic cameras

Prof. Yoon and his team have developed an 360-degree omni-directional perception technology for autonomous driving that can perceive all directions. The developed technology can be attached to mobility systems, helping them understand their surrounding 3D environment, including people and cars, as well as identifying possible driving paths. The 360-degree camera has a wider viewing angle than conventional cameras, making it possible for it to acquire more visual information with fewer cameras. However, as the images taken are modeled using images spheres, the images experience some distortion when representing them using rectangular planar images. Against this backdrop, the research team has developed a new expression method using a regular icosahedron, enabling various perception algorithms to be implemented on 360-degree images.

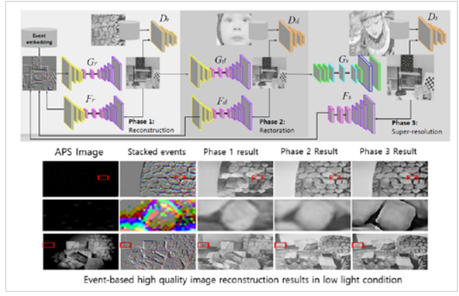
The team has also developed a method of generating high resolution images from neuromorphic cameras called “Event cameras”. The event camera is a sensor that asynchronously detects changes in brightness of individual pixels, enabling low latency and high speed capture. This camera can be used in various applications such as autonomous vehicles and drones as it operates stably even with dynamic changes in lighting. However, the sensor is limited in that its resolution is relatively low and the data type requires new algorithms. To address such limitations, the team has developed an artificial intelligence deep learning technology that uses neural networks to generate high-resolution images from low-resolution event data. The proposed network not only generates high-quality images from event data, but also increases the low-resolution of the event data to high-resolution, ultimately allowing the model to generate high quality, high-resolution images.

A comprehensive visionary recognition technology comparable to the human eye

Prof. Yoon said, “The 360-degree camera has many advantages over existing cameras, but it also has disadvantages. We developed an algorithm that obtains good results and compensates for the shortcomings.” He continued, “Event cameras also have many advantages in dynamic environments, so they can be used in autonomous vehicles, drones, robots, and military operations. We will continue our study to widen the usage of event cameras.” The results of their research were published in IEEE/CVF CVPR, an international conference on computer vision and pattern recognition, as well as in IEEE TPAMI, an international academic journal for pattern analysis and machine intelligence.



Above – A technique of representing 360 degree omni-directional images using regular icosahedrons
Center (left) – Semantic segmentation result on 360 degree images using the proposed method
Center (right) – Object detection results using the proposed method
Below – Results of monocular depth estimation using the proposed method



Above – Deep learning based network that reconstructs high-resolution images using event data
Below – Results of reconstructing high-resolution images from event data in low-lighting environment

Choi, Han-Lim
KI for Robotics
Dept. of Aerospace Engineering,
Associate Professor

More efficient multi-robot operation

Recently, you may have seen thousands of drones flying in the sky, making a spectacular aerial show on a special occasion. This “Drone Show”, like an artwork, is a combination of highly advanced technology, artistic touch, and various other factors in action. What roles then will drones play in the future, other than this kind of clustered flight? Robots, including drones, will play various and rather complicated roles in line with the advancement of related technologies. Accordingly, scientists searching for more efficient ways to operate multi-robot systems should play bigger roles too. Professor Choi, Han-Lim and his team have studied how to make multiple robots (“Multi-robots”) satisfy regulations, constraints, and rules while carrying out complicated missions. They have recently succeeded in developing an algorithm that can more effectively handle missions, routes, and planning of multi-robots.

New algorithm for efficient drone tour design

New algorithms to handle complicated missions

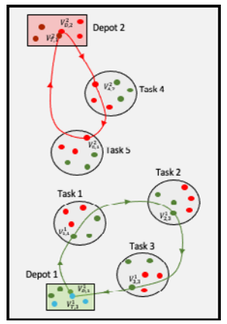
Prof. Choi and his team have developed an algorithm that can effectively handle missions, routes, and planning of multi-robot operations. This algorithm helps define a route for each drone when a large number of drones are active in a vast area for forest fire monitoring or crop management, for example. If the location subject to monitoring or observation is a dense space, the mobility constraints of the robots should be taken into consideration, or missions in such places would be impossible to carry out. As such, mobility constraints must be considered for observation missions of multiple observation locations using UAVs or ground excursion robots with limited turn radius (TR).

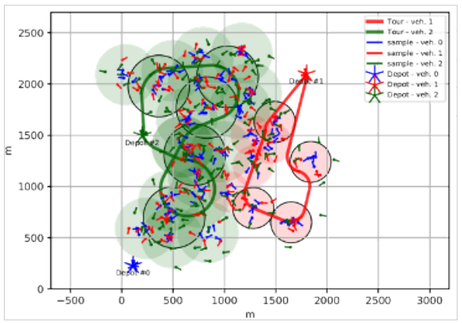
What Prof. Choi’s team has developed is an algorithm for designing efficient routes and task sequences simultaneously for multiple observatory robots with mobility constraints on multiple missions in largely dispersed locations. The team has developed an optimization technique to effectively calculate the Generalized, Heterogeneous, Multiple depot, Asymmetric Traveling Salesmen Problem (GHMDATSP) for tour design of multiple observatory robots. When approaching GHMDATSP based on sampling, candidate sites for a mission are sampled for each mission point, so it may be necessary for a single robot to visit two very close observation points. To reduce such redundancy, Prof. Choi and his team introduced the concept of NIN (Necessarily-Intersecting-Neighborhood), and further extended it, considering a sensing model called NIR (Necessarily-Intersection-Region). The team has confirmed, based on tour calculation, that the workload among the robots was properly distributed when multiple robots performed observation tasks using the proposed algorithm.

The algorithm will help efficient operation of the multi-robot system in various platforms

Prof. Choi said, “Nowadays, robots are playing wide-ranging roles, from smart agriculture, environment, to even disaster controls. And there are many factors to consider when operating multiple robots at once.” The team expects that the algorithm will help operate multi-robot systems more efficiently in diverse various platforms, including drone cars. The algorithm and the team’s achievement were published in *International Journal of Systems Science* in March 2020.

Concept of GHMDATSP (Left) and results of multi-sensor routing plans (Right)





Yeon Sik Jung
KI for the NanoCentury
Dept. of Materials Science and Engineering, Professor

100 times finer pixels than 8K display, realized by quantum dot LED printing technology

Quantum dots refer to a semiconductor material with size of several nanometers (nm). It is an inorganic light-emitting material that can emit light by itself when electrically charged, and has excellent color reproducibility. To fully utilize quantum dots in the field of displays, however, there are several technical challenges to tackle, and these require us to develop a technology that can realize quantum dot patterns elaborately and accurately without damaging the QD performance. Professor Yeon Sik Jung and other researchers have resolved this issue by proposing a new quantum dot printing technology. By utilizing the self-assembly phenomenon of quantum dots, the team separated dots into finer patterns and successfully realized high-resolution images with ultra-low pressure printing technology. "Since the QLED quantum dot pattern is extremely thin and very sensitive to external pressure, we used ultra-low pressure transfer printing technology to prevent damage to the pattern," explained Prof. Jung.

Using quantum dots in printing for sharper and clearer images

Maximizing performance of quantum dot light emitting elements using solvent-based ultra low pressure printing technology

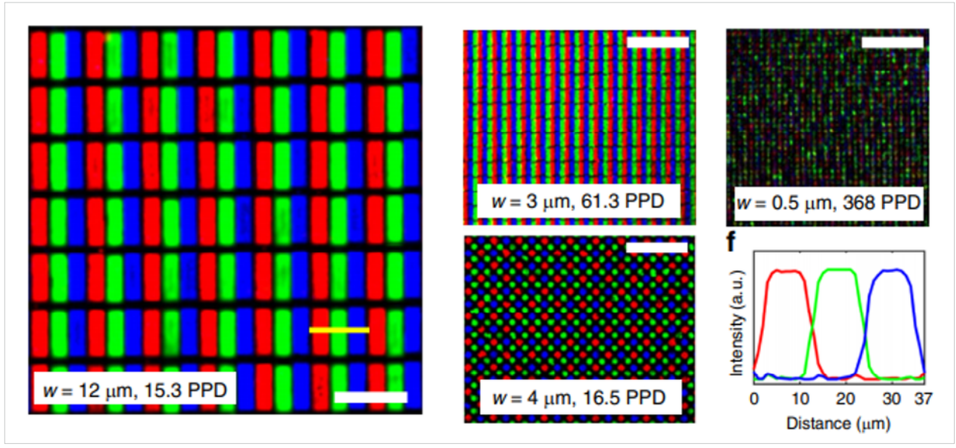
The team has successfully raised the resolution of the full-color (red, green, blue) quantum dots array to 14,000 ppi (pixels per inch). This can be applied to next-generation quantum dot LED (Light Emitting Diode) display technology. This ultra-high resolution quantum dot printing technology developed by KAIST researchers is a breakthrough that can realize more than 100 times higher resolution than that of state-of-the-art 8K displays. The ultra-low pressure transfer printing technology using a solvent is the very first attempt made in the world, and takes an entirely different approach compared to the existing quantum dot pixel pattern implementation. This is a technologically-meaningful approach in that it has maximized the resolution of the pattern, the printing yield, and the performance of the quantum dot light emitting elements.

Further studies will follow for application of ultra-fine quantum dot patterning technology to bio-sensors

Quantum dots are one of the most actively studied fields around the world, and will be used in different applications such as solar cells, image sensors, anti-counterfeiting technology, and cancer diagnosis. Therefore, quantum dot patterns generating an extremely-high level of resolution can be used in a wide range of applications, including highly sensitive sensors or optical elements, in addition to the field of next-generation displays. Indeed, Prof. Jung's team is now conducting a follow-up study collaborating with a bio sector research team to apply quantum dot patterning technology to biosensors. The team plans to pattern quantum dots with high resolution for swift diagnosis of pathogen infection and apply them to new biosensing elements with high sensitivity and accuracy by using light emission as a signal.

This research was published in *Nature Communications* on March 11, 2020, under the title "Thermodynamic-driven polychromatic quantum dot patterning for light-emitting diodes beyond eye-limiting resolution."

Quantum dot LED matrix using printing technology according to width of LED display



Development of Fire-Free, Long-Lasting, Water-Based Battery for ESS

Hee-tak Kim

KI for the NanoCentury
Dept. of Chemical & Biomolecular Engineering,
Associate Professor

New and renewable energy sources, such as sunlight and wind power, are drawing attention in response to climate change. The utilization of new and renewable energy sources demands that their intermittency be overcome by storing power in Energy Storage systems (ESS). Lithium ion battery-based ESSs, currently used in power plants, often suffer fire accidents due to battery characteristics.

To solve the problem, Professor Hee-tak Kim's group has conducted a study to improve an essentially incombustible material. The zinc/bromine redox flow battery that his group studied is basically free from fire risk, and employs a material that is cheaper than the materials required by lithium ion batteries. The group has developed elemental technology needed to establish ESS, and will conduct follow-up studies to fabricate a large-area prototype and establish the relevant system, contributing to the safe supply of new and renewable energy sources and ESS.

Long-lasting zinc/bromine redox battery enhances the utilization of new and renewable energy

Solution to intermittency issue of power generation depending on weather conditions

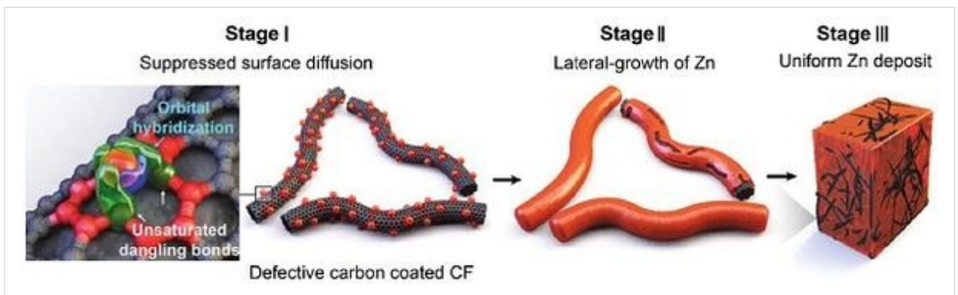
About 90% of currently used ESSs are lithium ion batteries, and water-based or sodium sulfur batteries account for the remaining portion. However, ESSs based on lithium ion and sodium sulfur batteries have a flammability problem that can cause power plants to stop operating repeatedly due to fire accidents. On the other hand, water-based batteries, such as vanadium redox and zinc bromine batteries, are non-flammable. In particular, zinc bromine batteries employ as active material zinc bromide, which is inexpensive, and thus has high applicability among various water-based redox flow batteries. In addition, zinc bromine batteries have other advantages, including high operation voltage and high energy density. Since zinc metal forms 'dendrites,' which are uneven bumps, in the charge/discharge process, the battery lifetime is short due to internal short-circuits occurring in the battery.

Development of technology for suppressing zinc dendrite to address lifetime issue of zinc bromine battery

Professor Hee-tak Kim's group has developed a technology for suppressing zinc dendrite to address the lifetime issues of zinc bromine batteries. The group investigated the zinc electrode deterioration mechanism and prevented the formation of dendrites to develop a zinc-based redox flow battery that has the longest lifetime in the world. The research has presented the possibility of developing next-generation water-based batteries by removing the risk of fire by employing a fire-free water-based electrolyte and overcoming the lifetime limitation.

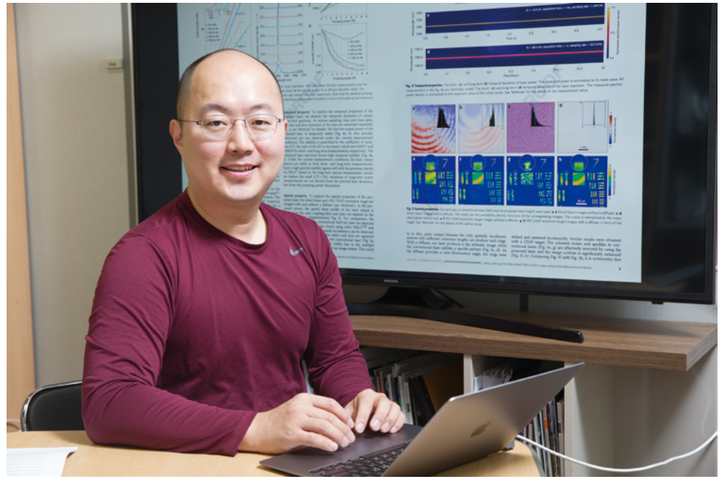
The research group noted that 'self-aggregation' occurs through 'surface diffusion' of zinc nuclei on the carbon electrode surface, which has low surface energy. After learning that surface aggregation of the zinc nuclei is the cause of the dendrite formation, the group found that the dendrite formation may be prevented by suppressing the surface diffusion of zinc nuclei in a specific carbon defective structure. A carbon electrode having such characteristics was applied to a zinc bromine redox flow battery to develop a water-based battery that has a charge/discharge current density about 30 times higher than that of lithium ion batteries and that may be repeatedly used for more than 5000 charge/discharge cycles.

Professor Kim stated, "Our goal is to develop a full ESS by completing the various element technologies for ESS batteries. We will fabricate and verify a prototype at KAIST by 2024 to increase the utilization of new and renewable energy sources and contribute to the supply of safe ESS." The results of the study were published as a front cover article of the journal ***Energy and Environmental Science*** (IF=30.289), and applications have been filed for Korean and international patents.



Uniform zinc deposition mechanism based on defective carbon current collector

YongKeun Park
KI for Health Science and Technology
Dept. of Physics, Professor



First-in-world non-resonant laser technology using scattering cavity

Laser (Light Amplification by Stimulated Emission of Radiation) technology has had a significant impact on human life thus far. It has led to various new applications, in areas such as barcode scanners, printers, ultra high-speed optical communication, GPS, and even virtual/augmented reality, aerospace, and automobile industries. Laser technology uses optical resonators installed on the left and right sides of a material and another specific material (called the "Gain material") to collect light with constant wavelengths and directions of travel and then amplify and emit them. The gain meterial, therefore, has an important role to play. Professor YongKeun Park and his research team have proposed a new approach of using a different gain medium. With its high efficiency and uni-directional properties, this new gain material for laser technology is expected to be used in various industries including military operations, bioscience, medical science, etc.

"Smart" laser technology for collecting light using cavity in form of fish trap

Higher light amplification achieved by making hole in proposed structure

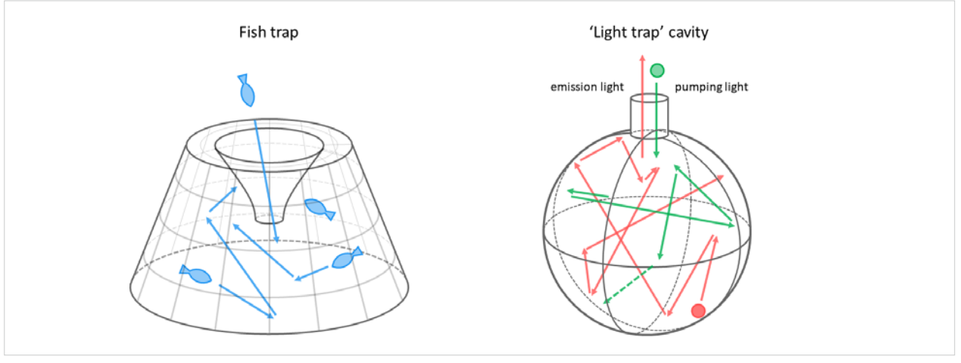
The conventional laser technology used an encapsulating structure (laser resonator) to amplify light with a medium such as a mirror. Since the path of light entering the resonator must be kept constant, a special, transparent material such as crystal had to be used until now. However, Prof. Park and his team proposed a new non-resonant approach using an opaque substance and a hole in the structure. This is meaningful in that it brings a new option for gain medium materials. Now that various elements other than crystal can be used as gain medium, the wavelength of light can be further expanded, thus enabling the use of high-powered lasers. The team made a hole in a fish-trap looking structure to collect light so that the light was continuously amplified inside, unable to escape from the cavity. This method made the path of escaping light uni-directional, as the structure was designed such that the light entering can only escape the cavity through the entryway. The results of the experiment showed that the trapped light inside continued to be amplified constantly by the surrounding gain medium.

This new structure with higher efficiency and uni-directional tendency can be used in various industries for high-powered laser technology

What Prof. Park and his team suggested was an entirely different approach with laser oscillation in this unique, spherical laser cavity with scattering surfaces, instead of the conventional laser oscillation using resonance phenomenon in a cavity. This technology has unchallenged potential as of now, since it is not subject to the influences of temperature or humidity.

"We had numerous meetings on physics and novel materials when we brainstormed at an early stage of the study, but after we decided to make a hole in the structure, the rest progressed smoothly," commented Prof. Park on the process of the study.

This study was sponsored by the Ministry of Science and ICT (Leading researcher support project by National Research Foundation), as well as by the KAIST Advanced Institute for Science-X; it was published in *Nature Communications* on January 4th, 2021.



A fish trap (Left) is designed to make it hard for the fish inside to escape, with a narrow entryway and a relatively wider cavity. The proposed scattering cavity (Right) resembles the fish trap, with the pumping light fully observed inside the cavity. While the emission light cannot escape the cavity as in the conventional laser cavity, it continues to amplify by the gain medium inside, with the coherence increasing. Since the light can only escape through the entryway, this structure can make the paths of light effectively uni-directional.

Taeyun Ku

KI for Health Science and Technology
Graduate School of Medical Science & Engineering, Assistant Professor

Clear Brain - The Core Technology is 'Tissue Elasticizing'

Clearing of biological tissues is of great interest in biomedical research, because the technology can turn the tissues transparent, allowing for high-resolution observation of cell structures and molecules inside organs. The issue involved in tissue clearing is that the lipids in the tissue, which scatter light, should be removed to view tissues clearly. However, once lipids are removed, the tissues lose their original shape and become mushy. Large tissue samples, such as human tissues, may collapse because they cannot withstand their own weight, being incapable of enduring routine experimental procedures, such as dipping into an aqueous solution or placing on a microscope slide. The tissues may harden through chemical treatment, but a hard sample is useless because substances of large molecular size, such as dyes, may not permeate into the sample.

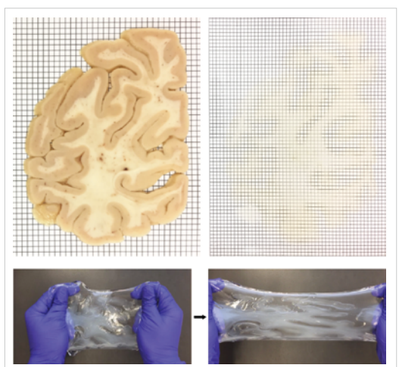
Professor Taeyun Ku's group has addressed the difficult choice between robustness and molecular permeability of tissue samples by transforming the tissue into an elastic material. An elasticized tissue sample was found to show good molecular permeability and was soft, but it was not damaged by most mechanical stresses. Prof. Ku's group demonstrated that the elasticized human tissue was not damaged but immediately recovered its original shape even after it was stretched to double the original length or compressed to one tenth of the original thickness. The research group successfully cleared a huge tissue sample of human brain size by using elasticized tissue.

Self-growing elastic gel in tissues

Elasticizing in biology - Elastic gel that can be hybridized with tissue samples

Changing the physical properties of a biological tissue was not an easy task. Prof. Ku's group decided to make such a drastic change by using an external material. First, the group explored an elastic gel that is compatible with biological tissues. The existing elastic gels required a too-complicated synthesis method or had a molecular weight that was too large to permeate into tissues. Therefore, the group invented a simple elastic gel that can be formed by self-growing in a tissue. The mechanism is similar to that of a skein of entangled thread that may be moved freely but is not easily unraveled. Surprisingly, the tissue sample that was naturally hybridized with the internally growing elastic gel showed the same properties as the elastic gel.

Such an elastic material was unfamiliar in the field of biology, but the applicability was better than expected. Although the tissue sample was converted into a material having totally different physical properties, various proteins or nucleic acids remained in their original positions. Thanks to the excellent molecular permeability of the elastic material, the biomolecules could be stained by large molecular dyes, such as antibody probes, to be observed with microscopy. The easy clearing of the sample allowed for three-dimensional observation of the deep regions.



Clearing (top) and elasticizing (bottom) of a human brain sample based on ELAST technology

"Problem-solving with a convergent idea" … Exploring hidden principles of life

The most outstanding and fresh attempt in the present study was the ultrafast staining technology. Staining is always a prerequisite of tissue sample observation. The time required for staining tissues exponentially increases with increases of tissue thickness. This was the most difficult problem in the field of tissue clearing, which is aimed at the observation of thick tissues.

Prof. Ku said, "I thought that if a tissue sample can be stretched thinly, a dye can permeate rapidly, just as we unfold a wet cloth to dry it quickly. The same was possible with the elasticized tissue. We stretched an elastic tissue in all directions to make it thin, and the staining speed became 100 times faster. Of course, when the tension is released, the tissue recovers its original shape, as if nothing happened, and thus can be observed microscopically." He added, "These good results were obtained by applying various new ideas to the study." The present study is considered an ideal convergent study in which a biological breakthrough was found by borrowing principles from other fields such as material sciences and chemical engineering.

The research group mentioned that the significance of the results is that the technology allows for detailed three-dimensional observation of large human tissues. The tissue clearing technology is expected to make great contributions to the investigation of biological structures and functions of the human body and to the development of diagnostic methods. The results of the present study were published in the June 2020 issue of ***Nature Methods***, and the researchers applied for an US patent.

MRI Diagnostic Accuracy Increased by AI … Cost and Time Reduced

Jong Chul Ye

KI for Artificial Intelligence
Dept. of Bio and Brain Engineering, Professor

Magnetic Resonance Imaging (MRI) is a diagnostic device that plays an important role in clinical diagnosis with X-rays, CT, and ultrasonograph. Unlike invasive methods in which a device for examination is inserted into the body, MRI provides high-resolution images by a noninvasive method, and thus is extensively used for observation and diagnosis of tumors and lesions. MRI can be used to produce T1 and T2 weighted images, and T1 contrast-enhanced images, which are necessary for diagnosis of brain tumors. The problem is that it is difficult to obtain all weighted images using an MRI performed in a hospital due to noise or artifacts. Different weighted images must be obtained according to the suspected disease to show, for example, specific cancer cells or blood. Therefore, patients may have to undergo imaging again, depending on their situations. For example, when a contrast medium is injected into the body to diagnose liver cancer, slight movement of the organs may hinder the acquisition of MRI images. In other cases, carious lesions, such as cerebral infarctions and cerebral hemorrhages, may be missed. To overcome these problems, Professor Jong Chul Ye's group developed a technology of using AI to recover MRI images that had disappeared. The newly developed technology is drawing attention because it allows for accurate diagnosis and can reduce the cost and time needed to perform imaging repeatedly.

Recovering disappeared images to remove inconvenience of taking MRI images repeatedly

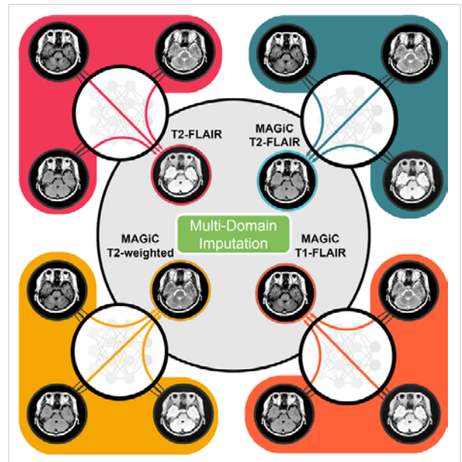
Systemized into 'Collaborative Generative Adversarial Network' technology

Recently, many studies have been conducted on technology to synthesize images by using the deep learning method called 'Generative Adversarial Network (GAN).' However, the application of the technology to the synthesis of MRI weighted images requires too many networks to be prepared and learned in advance. Professor Ye's group independently developed the Collaborative GAN (CollaGAN) technology, in which the common characteristics spaces of several MRI weighted images are learned to solve the expandability problem. The technology was also used to develop a systematic method for answering the question of whether a certain contrast image may be generated or not. When images from several weighted images disappear in an arbitrary sequence and in an arbitrary number, the disappeared images are recovered by referring to the remaining images. After this recovery technology is learned, the clinical accuracy of the synthesized image is evaluated to automatically assess the relative importance of the weighted images. The experimental findings provide important guidance for the acquisition-protocol design of MR in clinical environments. The results of the present study are significantly different from those of previous studies because computer vision, deep learning and MRI equipment technologies are combined to satisfy the demands of the medical workers.

"Patient inconvenience will decrease, and healthcare expense will be reduced"

Professor Ye commented, "Our technology shows excellent performance in generating missing images in the fields of not only healthcare but also computer vision, and thus will be applied to various areas." Currently, transfer of the technology is being discussed for the application to clinical environment. With the COVID-19 pandemic, Professor Ye is looking for how to apply the technology to AI-based studies in precise diagnosis.

Furthermore, the images synthesized by AI can minimize patient inconvenience caused by repeatedly performed imaging, and reduce the overall healthcare cost by increasing the diagnostic accuracy. The results of the study were published in the January 2020 issues of ***Nature Machine Intelligence***, and the article was included in the CVPR (2019) Best Paper Finalist.



Operational principle of Collaborative Generative Adversarial Network (CollaGAN) developed by Professor Ye's group. The missing contrast images are recovered at high accuracy by using other acquired contrast images.

June-Koo Rhee
KI for Artificial Intelligence
School of Electrical Engineering, Professor

Quantum AI algorithm surpasses AI technology

Quantum artificial intelligence is a future technology that addresses the limitations of current artificial intelligence technology. The team, led by Professor June-Koo Rhee, developed an algorithm that significantly improves artificial intelligence technology.

Artificial intelligence relies on a kernel function to represent similarity between data sets. Supercomputers used in complicated learning are approaching physical limits in terms of space and energy. On the other hand, quantum artificial intelligence is capable of performing complex calculations with less burden. However, quantum artificial intelligence processes information in a completely different way compared to conventional computers. Few studies exist on this topic despite the need for new algorithms. The team developed a quantum machine learning algorithm to handle complex data, hinting at the possibility of quantum artificial intelligence surpassing current artificial intelligence technology.

Quantum machine learning algorithm utilizes advantages of quantum computers

Similarity between quantum data sets demonstrated using the IBM Q cloud

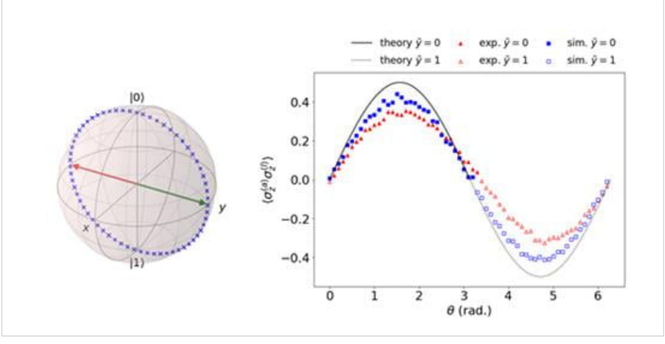
The team, led by Professor June-Koo Rhee, developed a quantum machine learning algorithm that achieves exponentially higher computational efficiency relative to the size of the training data by utilizing the advantages of quantum computing. The algorithm transfers data existing in low-dimensional input space to high-dimensional feature space, calculates the weighted power sum of the fidelities of quantum data in quantum parallel, and efficiently determines the classification of test data. One advantage offered by the algorithm is that the computational complexity of the quantum circuit increases very slowly due to logarithmic dependence.

While quantum circuits known to data were only capable of linear classification, the proposed algorithm opens up the possibility of complex nonlinear kernel classification based on the systematic design of quantum circuits. Various quantum kernels can now be effectively modeled, as optimal kernels vary with input data in kernel-based machine learning. The team also succeeded in demonstrating the superior performance of quantum kernel-based machine learning using the IBM Q cloud with five superconducting qubits in the quantum circuit.

"Quantum computers will surpass supercomputers in 3 to 5 years"

Professor June-Koo Rhee emphasized the need for follow-up research, saying, "In three to five years, quantum computers will surpass supercomputers in performance. We can expect quantum computers to have an exponential increase in computing capacity, allowing them to replace supercomputers. Thus, research in this area is essential."

If high-performance NISQ computing technology capable of controlling hundreds of cubits at 99.9% accuracy is secured in the next few years, the proposed algorithm will be actively utilized as a quantum machine learning algorithm for pattern recognition of complex nonlinear data, extending beyond kernel-based quantum supervised machine learning. The study was conducted jointly with research teams from Germany and South Africa, and the results were published in *npj Quantum Information* in May 2020.



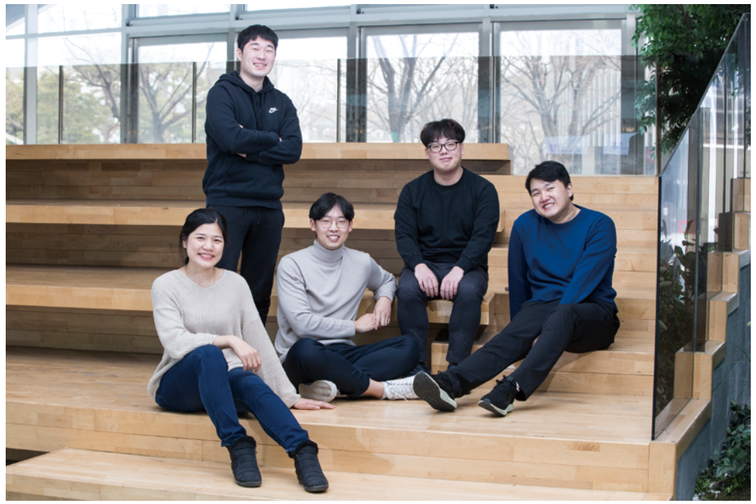
Example of quantum machine learning using the IBM quantum cloud platform

Greenhouse Gas Catching Catalyst····· Also Produces Hydrogen

The main greenhouse gases, methane and carbon dioxide, are at the center of emission regulations. Efforts to reduce greenhouse gases are being made worldwide and a Korean research team has been highlighted for developing a new catalyst that rids of methane and carbon dioxide while producing hydrogen. This catalyst, developed by the research team led by Professor Cafer T. Yavuz, is a dry reforming catalyst of methane that can maintain its performance for an extended period of time. The catalyst is expected to contribute to the prevention of global warming as stable and low production cost synthesis gas can be obtained.

Cafer T. Yavuz
King Abdullah Univ. of Science & Technology (KAUST)
Co-Research Director of Saudi Aramco-KAIST CO_2 Management Center

Youngdong Song
Saudi Aramco-KAIST CO_2 Management Center
Dept. of Chemical & Biomolecular Engineering, Ph.D.



Superiority of the nickel-molybdenum alloy on single crystalline magnesium oxide catalyst

Verified stability for 850 hour usage

The dry reforming of methane is known to simultaneously reduce methane and carbon dioxide while producing synthesis gas. The problem is with the catalyst. Generally, catalysts were developed based on precious metals like platinum and palladium. However, there were limitations in their actual industrial applications due to the high cost involved.

The research team, led by Prof. Cafer T. Yavuz, focused on nickel, which is both inexpensive and has high catalytic activity. However, the team was met with difficulties as the reaction progressed due to the coking phenomenon, which reduces reactivity from the accumulated carbon on the surface of the catalyst and the sintering phenomenon, where the nanoparticles agglomerate. The research team synthesized nickel-molybdenum alloy nanoparticles on a single crystal magnesium oxide support. The nickel-molybdenum alloy nanoparticle catalyst fabricated in this manner exhibited the stabilizing phenomenon of blocking the vertexes of the single crystal magnesium oxide support, even in the process of heating it to 800 degrees. In order to apply the developed catalyst to the dry reforming of methane, which is sensitive to temperature change, the activity was measured while varying the temperature and the results showed that the activity was stable, even for the temperature range between 700 and 800 degrees. This result was the achievement of 3 years of research.

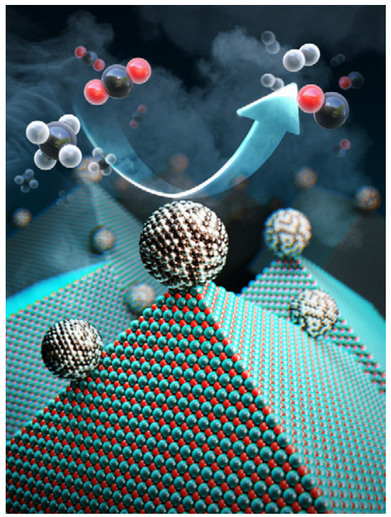
"Environmental issues can be resolved through greenhouse gas reduction"

The catalyst developed by the research team can be directly applied to the steam reforming of methane as well, which is responsible for 90% of hydrogen production today. Through this, contributions in the reduction of synthesis gas production costs, low cost nickel based catalyst production, and performance improvements are expected.

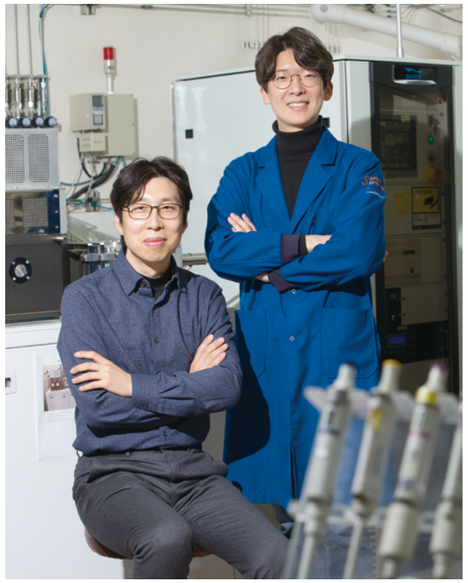
Dr. Youngdong Song, who was the first author of this research, said, "a catalyst was developed that can solve the coking phenomenon, which was a significant obstacle, without the use of expensive precious metals or complex fabrication processes" and, "the stabilized catalyst exhibited a stable conversion rate without coking or sintering for 850 hours under the reaction conditions."

The research team predicted that the method of synthesizing metal nanoparticles on single crystal catalyst supports will be applicable to various catalytic reactions as new catalysts can be developed depending on the combination of metals and metal oxides. The results of this research were published in the February 2020 issue of the prestigious academic journal, *Science*.

Diagram of the nickel-molybdenum alloy applied catalyst



Leading the Hydrogen Economy Era Through the Paradigm Innovation of “Mass Printing of High Efficiency Catalysts”



Yeon Sik Jung

Saudi Aramco-KAIST CO_2 Management Center
Dept. of Materials Science and Engineering, Professor

Hydrogen does not have carbon dioxide emissions and is an environmentally friendly, next generation energy source of high efficiency. However, a low cost method of producing hydrogen must be found. In other words, enhancing the efficiency and economic feasibility of the energy conversion process of hydrogen production-storage-transportation are important tasks in preparation of the hydrogen era. For example, reducing the amount of expensive precious metals applied in the conversion equipment between hydrogen and electric energy sources and improving equipment performance are necessary. The research team of Professor Yeon Sik Jung recognized the lack of economic feasibility due to the significant use of expensive precious metal catalyst materials in conventional hydrogen production equipment and low efficiency caused by a disorderly structure. The research team developed a new fabrication technique of the iridium catalyst with a 3-dimensional lattice structure reminiscent of a woodpile employing an ultra high resolution printing method to significantly improve the efficiency of hydrogen production equipment. Moreover, fabrication in large quantities is possible through the printing of fine catalysts instead of conventional chemical synthesis, which is costly; therefore, the economic feasibility of precious metal catalysts can increase and applications in various fields are expected, including exhaust emission reduction and carbon dioxide conversion, which can transform carbon dioxide into useful compounds in the future.

Woodpile shaped catalyst printing technique for improvement of hydrogen production economy

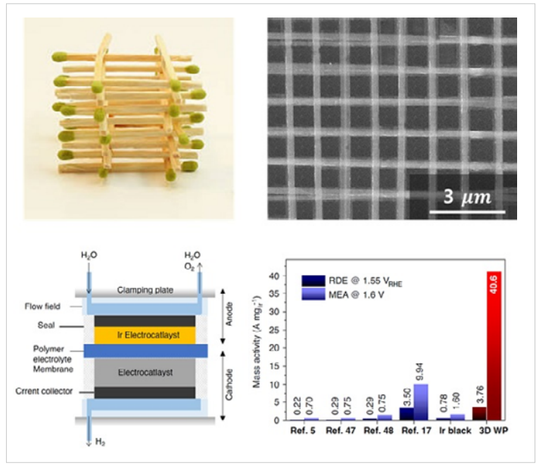
Printing woodpile shaped 3-dimensional lattice type iridium catalysts

The conventional hydrogen production process uses a large amount of expensive precious metal catalyst materials in the synthesis and coating processes through the induction of chemical reactions. The new technique of Prof. Jung's research team is groundbreaking, especially considering its high efficiency of over 20 times that of the conventional commercial catalyst when converting to the catalyst efficiency per iridium mass. A nanotransfer printing stacking technique similar to that of 3D printing was utilized to fabricate the woodpile shaped 3-dimensional lattice iridium catalyst structure. Unlike the conventional commercial iridium nanoparticle catalyst with a random shape and arrangement, the 3-dimensional lattice catalyst was designed based on the characteristic that it exhibits a regular structure. Gas bubbles formed on the catalyst surface escape efficiently so that high performance can be sustained. The efficiency and durability were verified in that the performance of electrolysis equipment can be improved using a much smaller amount of iridium.

Applications are predicted in the energy materials field for the intricate and high resolution control of fine patterns

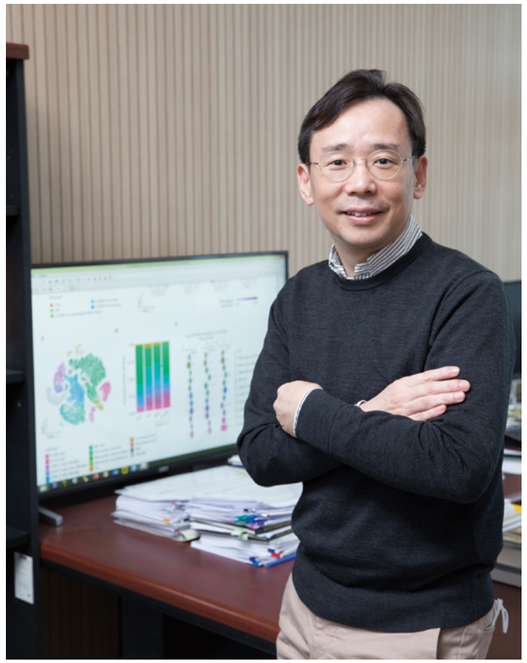
Professor Yeon Sik Jung expected that the catalyst production technology of the 3-dimensional stacked printing method will bring about a change in the existing technology paradigm that mainly relied on complex chemical synthesis, saying, “The initial approach used fuel cell catalyst technology. The result of improving durability so that it can be used for longer while using much less expensive catalysts is encouraging.” Promising applications are predicted in the energy materials or sensor materials fields, including biomaterial sensing platform development and Alzheimer's disease diagnosis technology, applying the advantages of nanomaterials where fine patterns can be intricately controlled and arranged in high resolution.

This research achievement was published in the international academic journal, *Nature Communications*. (Title: Highly efficient oxygen evolution reaction via facile bubble transport realized by three-dimensionally stack-printed catalysts)



The woodpile shaped 3-dimensional hydrogen catalyst and its performance

COVID-19 treatment presents a new paradigm



Eui-Cheol Shin
Center for Epidemic Preparedness
Graduate School of Medical Science and Engineering, Professor

Last year, a new coronavirus (SARS-CoV-2) struck countries around the world. More than 1.9 million deaths have been reported worldwide in just a year since the first known fatality. With the increase in the COVID-19 death toll, cytokine storms have emerged as an issue. A cytokine storm is the phenomenon of excessive release of immune signaling molecules known as cytokines in reaction to viral infections, where the cytokines cause hyperinflammation and injure hosts. Some patients infected with COVID-19 develop severe conditions, and certain cases that result in death have been traced to the cytokine storm. However, the specific cause of the cytokine storm remains unknown, making the treatment of severe COVID-19 patients highly challenging.

The joint research team led by Professor Eui-Cheol Shin has come under the spotlight by discovering the cause behind hyperinflammatory responses observed in severe COVID-19 patients. The team applied the latest research techniques to patients' blood samples, and succeeded in identifying the cause behind hyperinflammatory responses.

Cause of hyperinflammatory responses in severe COVID-19 patients unveiled

Interferons found to cause hyperinflammatory responses

The joint research team led by Professor Eui-Cheol Shin separated immune cells from the blood samples of patients with mild and severe COVID-19, and employed single-cell RNA sequencing to analyze their properties. Detailed observations of each cell revealed that inflammatory cytokines and interleukin-1 (IL-1) were present in the immune cells of both mild and severe COVID-19 patients. Through a comparative analysis of mild and severe cases, the team found that type I interferon, a cytokine response, was exhibited in the latter group only. Interferons are cytokines synthesized and released during viral infections. Previously, interferons were considered beneficial due to their antiviral activity, but the team proved that interferon response can be a cause of hyperinflammation in COVID-19 patients.

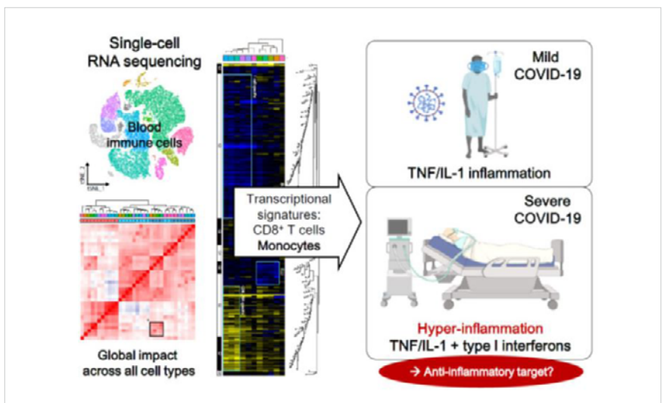
While non-specific anti-inflammatory drugs such as steroids are being used to alleviate hyperinflammatory symptoms in severe COVID-19 patients, the team has paved the way for new treatments with interferons as a target.

Working weekends for three months to "lay the basis for COVID-19 treatment strategies"

According to Professor Eui-Cheol Shin, the significance of the study lies in laying the basis for the development of effective treatment strategies. He said, "Interferons were previously known as beneficial cytokines for their antiviral effects, but our study showed that interferon response can, on the contrary, lead to hyperinflammation in COVID-19 patients."

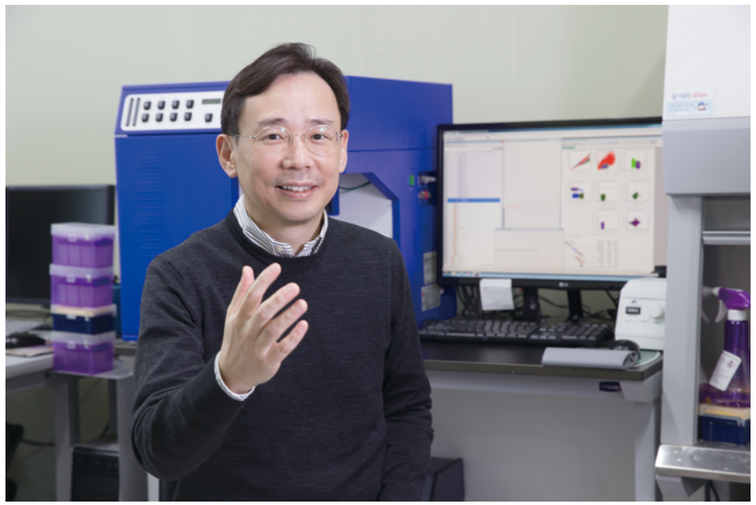
The study was given a short time frame to urgently address medical issues of severe COVID-19 patients, and the results were obtained in just three months. The team plans to continue research on immune mechanisms and individual patient-specific anti-inflammatory drugs to improve the survival rate of COVID-19.

Conducted jointly with the research team led by Professor Inkyung Jung of the Department of Biological Sciences at KAIST, Asan Medical Center, Severance Hospital, and Professor Hyewon Jeong of Chungbuk National University Hospital, the study was published in the international journal *Science Immunology* on July 10, 2020.



Schematic diagram showing that interferons can cause hyperinflammatory responses in COVID-19 patients

Eui-Cheol Shin
Center for Epidemic Preparedness
Graduate School of Medical Science and Engineering,
Professor



Team embraces challenge of COVID-19 research and produces world's first achievement

Various immune cells in the human body prevent diseases by maintaining a balanced immune system. Among them, T cells play the role of directly killing and eliminating virus-infected cells or cancer cells. Most patients infected with the novel coronavirus (SARS-CoV-2) experience mild symptoms and recover naturally, and T cell memory immune responses are known to form after recovery. SARS-CoV-2-specific T are expected to rapidly induce an immune response when encountering SARS-CoV-2 again, thereby allowing fast recovery from infection. However, due to the lack of detailed reports on the characteristics and functions of SARS-CoV-2-specific T cells in acute and convalescent COVID-19, the understanding of immune responses against SARS-CoV-2 has been limited. Against this backdrop, the research team led by Professor Eui-Cheol Shin became the world's first to determine the characteristics and functions of SARS-CoV-2-specific T cells.

Characteristics and functions of SARS-CoV-2-specific T cells revealed for the first time

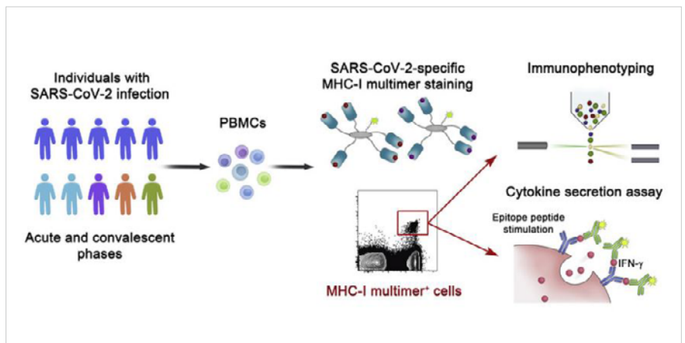
SARS-CoV-2-specific T cells activated in convalescent COVID-19

Instead of relying on conventional methods, the team led by Professor Eui-Cheol Shin employed the advanced research technique of MHC-I multimer staining to detect directly SARS-CoV-2-specific T cells. This approach made their study more challenging and difficult, but allowed higher sensitivity in T cell detection, and a more detailed examination of their characteristics and functions. The team separated immune cells from the peripheral blood samples of acute and convalescent COVID-19 patients, directly detected SARS-CoV-2-specific T cells through MHC-1 multimer staining, and then performed cytokine secretion assays. The results showed that SARS-CoV-2-specific T cells were sufficiently produced and functional in the convalescent phase of COVID-19. In addition, normal memory T cell immune responses were triggered after recovery from COVID-19 infection, and the frequency of stem-like memory cells increased in the late convalescent phase, indicating that memory T cell immune responses can be maintained for a long time in convalescent individuals.

"Proud to correct misleading information in past research"

Professor Eui-Cheol Shin said, "Contrary to past research, we proved that SARS-CoV-2-specific T cells are not exhausted in COVID-19 convalescents. Our study has been evaluated as the most elaborate research on SARS-CoV-2-specific T cells."

The study enables more sensitive and precise analysis of SARS-CoV-2-specific T cells, and will be a valuable reference for future research on COVID-19 vaccination. In particular, it is expected to contribute to the systematic analysis of how many SARS-CoV-2-specific T cells are produced and how long they are maintained following the administration of newly developed COVID-19 vaccines. The results were published in the international journal *Immunity* on December 10, 2020.



Characteristics and functions of SARS-CoV-2-specific T cells

Establishing a World Standard for “Blockchain” Technology of Distribution and Trust

Kibae Kim

KAIST Fourth Industrial Revolution Intelligence Center
The Korea Policy Center for the Fourth Industrial Revolution, Principal Researcher

Blockchain is a technology of distribution and trust. People use this blockchain technology to manage cultural and community regulations and connect networks. It is a core technology of the 4th Industrial Revolution that creates economic value for data by converging Artificial Intelligence (AI) and Internet of Things (IoT) technologies as well as automating economic activity, including global logistics and finance. However, there are always difficulties in the process of replacing human made systems with machinery and technology. While a data economy is emerging that shares and processes personal information, such as biometric data, problems still remain, such as how to simultaneously satisfy the sharing and protection of that data and how ownership of that data can be distributed. Blockchain technology has emerged as a technological solution to this problem. KAIST took part in the publication of the blockchain Global Standards Mapping Initiative (GSMI).

Achieving reliability to impartiality through the international standardization of blockchain technology

World’s first exhaustive report on blockchain technology standards, laws, regulations, and administrative guidelines of each country

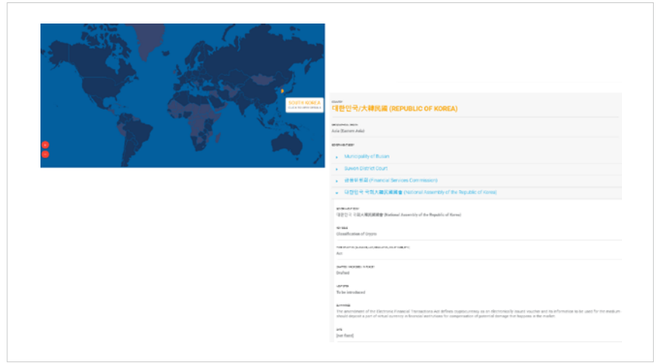
The blockchain Global Standards Mapping Initiative (GSMI) was currently published as the advancement of blockchain technology requires technological standardization that responds to different technologies, laws, regulations, and policies of each country in the world. The Global Blockchain Business Council (GBBC) and the World Economic Forum (WEF) led the initiative, and KAIST and MIT participated as a consortium. GSMI is a world-first report that encompasses blockchain technology standards, laws, regulations, and administrative guidelines for each country in the world. It presents a technology standard for the first time through the systematization of information regarding 30 international technology standards organizations, 185 national judicial institutions, and 400 industrial organizations.

Principal researcher Kibae Kim contributed to the investigation of global regulations and technology standards utilizing his experiences in the establishment of guidelines on blockchain regulation reconsideration and application along with data economy related projects. Implementation of the Korea Central Bank Digital Currency (CBDC) and improvements in the commercialization regulations through the designation of the Busan Blockchain Regulation Free Special Zone are included in the report.

Paving the way for KAIST industrial technology academia-based international joint research

Principal researcher Kibae Kim highly evaluated the official international agreement and joint research participation of KAIST, saying, “Adapting was not easy due to the physical time and unfamiliar environment while participating in the international joint project, but the experience of international joint research with global leaders was an opportunity to enhance policy research to global levels.”

Blockchain based virtual assets like Bitcoin have become a social issue, but international standards are lacking so that applications of blockchain that go beyond national borders are not being realized. This research participation will become the first step in preparing for the era where blockchain, which has universal advantages, will bring about disruptive innovation greater than rapid progress and joint research achievements are expected in the future, similar to the European Commission Joint Research Centre, National University of Singapore, and World Bank. Meanwhile, international cooperation will continue even after the publication of GSMI with a joint workshop program co-hosted with the World Economic Forum (WEF).



Interactive map of the Global Standards Mapping Initiative (https://gbbcouncil.org/gsmi/)

Research Achievements

KAIST Institute for the BioCentury

• Human Microbiome Control

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Cho, Byung-Kwan	2020.01	Iron competition triggers antibiotic biosynthesis in Streptomyces coelicolor during coculture with Myxococcus xanthus (The ISME Journal)
2	Paper		2020.03	Functional cooperation of the glycine synthase-reductase and Wood-Ljungdahl pathways for autotrophic growth of Clostridium drakei (Proceedings of the National Academy of Sciences)
3	Paper		2020.05	Transcriptome and translatome profiles of Streptomyces species in different growth phases (Scientific Data)
4	Paper		2020.12	Genome-scale determination of 5′ and 3′ boundaries of RNA transcripts in Streptomyces genomes (Scientific Data)
5	Paper	Jeong, Ki Jun	2020.01	Engineering of Klebsiella oxytoca for production of 2,3-butanediol using mixed sugars derived from lignocellulosic hydrolysates (GCB Bioenergy)
6	Paper		2020.05	Development and characterization of a Nannochloropsis mutant with simultaneously enhanced growth and lipid production (Biochemical Engineering Journal)
7	Paper		2020.08	Development of CRISPR interference (CRISPRi) platform for metabolic engineering of Leuconostoc citreum and its application for engineering riboflavin biosynthesis (International Journal of Molecular Sciences)
8	Paper	Kim, Sun Chang	2020.06	SGL 121 attenuates nonalcoholic fatty liver disease through adjusting lipid metabolism through AMPK signaling pathway (International Journal Of Molecular Sciences)
9	Paper		2020.07	Doxorubicin-induced normal breast epithelial cellular aging and its related breast cancer growth through mitochondrial autophagy and oxidative stress mitigated by ginsenoside Rh_2 (Phytotherapy Research)
10	Paper		2020.11	Ginsenoside F2 attenuates chronic-binge ethanol-induced liver injury by increasing regulatory T cells and decreasing Th17 cells (Journal Of Ginseng Research)
11	Paper		2020.11	Protective effects of SGB121, ginsenoside F1-enriched ginseng extract, on scopolamine-induced cytotoxicity and memory impairments (Journal Of Functional Foods)
12	Patent	Jeong, Ki Jun	2020.12	Novel vector having enhanced copy number and use thereof (Patent Registration, 1021988260000)
13	Patent	Kim, Sun Chang	2020.07	Ginsenoside G17 or CK production method using MT619 enzyme (Patent Application, 10-2020-0084876)

• Cancer Metastasis Control

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Heo, Won Do	2020.02	Optogenetic control of mRNA localization and translation in live cells (Nature Cell Biology, Highlighted by Nature Reviews Genetics, Nature Methods)
2	Paper	Jeong, Won-Il	2020.05	Recent advances of sterile inflammation and inter-organ cross-talk in alcoholic liver disease (Experimental Molecular Medicine)
3	Paper		2020.08	Mitochondrial double-stranded RNA in exosome promotes interleukin-17 production through toll-like receptor 3 in alcoholic liver injury (Hepatology)
4	Paper		2020.11	Ginsenoside F2 attenuates chronic-binge ethanol-induced liver injury by increasing regulatory T cells and decreasing Th17 cells (Journal of Ginseng Research)
5	Paper	Jon, Sangyong	2020.01	PEGylated bilirubin-coated iron oxide nanoparticles as a biosensor for magnetic relaxation switching-based ROS detection in whole blood (Theranostics)
6	Paper		2020.06	Nanoparticles derived from the natural antioxidant rosmarinic acid ameliorate acute inflammatory bowel disease (ACS Nano)
7	Paper		2020.08	Tubulin-based nanotubes as delivery platform for microtubule-targeting agents (Advanced Materials)

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
8	Paper	Jon, Sangyong	2020.08	Sequential and timely combination of a cancer nanovaccine with immune checkpoint blockade effectively inhibits tumor growth and relapse (Angewandte Chemie-International Edition)
9	Paper	Kim, Mi Young	2020.07	AKT drives sustained motility following MEK inhibition via promoting SNAIL and AXL in MDA-MB-231 LM2 (Biochemical And Biophysical Research Communications)
10	Paper		2020.11	PARP1 and PRC2 double deficiency promotes BRCA-proficient breast cancer growth by modification of the tumor microenvironment (FEBS Journal)
11	Paper	Oh, Byung-Ha	2020.04	A computationally designed chimeric antigen receptor provides a small-molecule safety switch for T-cell therapy (Nature Biotechnology)
12	Paper		2020.05	Structural basis for effector protein recognition by the Dot/Icm Type IVB coupling protein complex (Nature Communications)
13	Paper		2020.12	Crystal structure of PYCH_01220 from Pyrococcus yayanosii potentially involved in binding nucleic acid (Proteins-Structure Function And Bioinformatics)
14	Paper	Song, Ji-Joon	2020.06	Aldehyde-alcohol dehydrogenase undergoes structural transition to form extended spirosome for substrate channeling (Communications Biology)
15	Paper		2020.09	The polyglutamine expansion at the N-terminal of huntingtin modulates the dynamic configuration and phosphorylation of the C-terminal HEAT domain (Structure)
16	Paper		2020.09	EMPAS: Electron Microscopy Screening for Endogenous Protein Architectures (Molecules and Cells)
17	Paper		2020.12	Yeast Chd1p unwraps the exit side DNA upon ATP binding to facilitate the nucleosome translocation occurring upon ATP hydrolysis (Biochemistry)
18	Patent	Jeong, Won-Il	2020.01	Composition for preventing or treating liver cancer containing ginsenoside F2 (Patent Registration, CA 2961005)
19	Patent	Jon, Sangyong	2020.06	Method of producing cancer stem cell spheroid (Patent Registration, 10-2123550, KR)
20	Patent	Oh, Byung-Ha	2020.12	Computationally designed SARS-CoV-2 RBD specific antibody (Patent Application, 10-2020-018401)

• Brain Cognitive Function Control

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Han, Jin-Hee	2020.08	Successful In vivo calcium imaging with a head-mount miniaturized microscope in the amygdala of freely behaving mouse (Journal of Visualized Experiments)
2	Paper		2020.08	A critical role of hippocampus for formation of remote cued fear memory (Molecular Brain)
3	Paper		2020.09	Persistence of fear memory depends on a delayed elevation of BAF53b and FGF1 expression in the lateral amygdala (Journal of Neuroscience)
4	Paper	Heo, Won Do	2020.01	Non-invasive optical control of endogenous Ca^{2+} channels in awake mice (Nature Communications, This article was introduced in Commentary of Cell Calcium)
5	Paper		2020.02	Optogenetic modulation of TrkB signaling in the mouse brain (Journal of Molecular Biology)
6	Paper		2020.04	Dynamic Fas signaling network regulates neural stem cell proliferation and memory enhancement (Science Advances)
7	Patent	Han, Jin-Hee	2020.05	Frrs1l gene knockout autism spectrum disorder animal model and using thereof (Patent Registration, 10-2110600)

Research Achievements

KAIST Institute for IT Convergence

• B5G/6G Mobile Communications and Wireless Power Transfer Technology

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Cho, Dong Ho	2020.03	Performance Evaluation of Partially Clustered Access Scheme for Massive Machine Type Communications (IEEE Communications Letters)
2	Paper		2020.04	Design of Four-Port Integrated Monopole Antenna Using Refraction Effect of Dielectric Medium for Pattern Gain Enhancement (IEEE Antennas and Wireless Propagation Letters)
3	Paper		2020.04	Multi-User Hybrid Beamforming System based on Deep Neural Network in Millimeter-Wave Communication (IEEE Access)
4	Paper		2020.09	ConvAE-Advanced: Adaptive Transmission Across Multiple Timeslots For Error Resilient Operation (IEEE Communications Letters)
5	Paper	Hong, Songcheol	2020.01	28 GHz RF Front-End Structure Using CG LNA as a Switch (IEEE MICROWAVE AND WIRELESS COMPONENTS LETTERS)
6	Paper		2020.09	28 GHz CMOS Power Amplifier Linearized With Resistive Drain-Body Connection (IEEE MICROWAVE AND WIRELESS COMPONENTS LETTERS)
7	Paper	Rhee, June-Koo	2020.01	Blind nonlinearity mitigation of 10G DMLs using sparse Volterra equalizer in IM/DD PAM-4 transmission systems (Optical Fiber Technology)
8	Patent	Cho, Dong Ho	2020.01	COMMUNICATION DEVICE USING UNIFORM CIRCULAR ARRAY ANTENNA COMPRISING DUAL POLARIZED ANTENNA (Patent Registration, 10-20677270000)
9	Patent		2020.01	MOBILITY SUPPORTING METHOD USING WIRELESS INTERNET NETWORKS AND MOBILITY SUPPORTING SERVER BASED ON WIRELESS INTERNET NETWORKS (Patent Application, 2020-0132513)
10	Patent		2020.01	WIRELESS POWER TRANSFER APPARATUS AND METHOD USING IMAGE RECOGNITION (Patent Application, 2020-0006435)
11	Patent		2020.04	Wireless Electric Power Supply Apparatus (Patent Registration, 10611263)
12	Patent		2020.07	ESTIMATION METHOD AND COMPENSATION METHOD FOR RF CHAIN IMBALANCE IN UCA OAM RADIO SYSTEM (Patent Registration, 10-21318400000)
13	Patent		2020.07	A DIVIDER FOR DIVIDING WIRELESS SIGNALS IN A WIRELESS COMMUNICATION SYSTEM AND A WIRELESS DEVICE USING THE SAME (Patent Application, US16925294)
14	Patent		2020.07	METHOD FOR CALIBRATING AN ARRAY ANTENNA IN A WIRELESS COMMUNICATION SYSTEM AND APPARATUS THEREOF (Patent Application, US16926539)
15	Patent		2020.09	ANTENNA MISALIGNMENT COMPENSTAION METHOD OF OAM COMMUNICATION SYSTEM AND APPARATUS FOR PERFROMING THE SAME (Patent Application, PCT/KR2020/011906)
16	Patent	Hong, Songcheol	2020.04	A Beamforming IC for 5G mobile communication system (Patent Registration, 10-2105449-0000)
17	Patent		2020.05	Vector sum circuit and phase controller using the same (Patent Registration, 10659021)
18	Patent		2020.06	Calibration method of multiple channel beamforming transceiver IC with successive channel signal comparisons (Patent Application, PCT/KR2020/008317)

• IoT/WoT

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Choi, Jun Kyun	2020.04	Competitive Data Trading Model With Privacy Valuation for Multiple Stakeholders in IoT Data Markets (IEEE INTERNET OF THINGS JOURNAL)
2	Paper		2020.06	A Novel Resolution and Power Control Scheme for Energy-efficient Mobile Augmented Reality Applications in Mobile Edge Computing (IEEE WIRELESS COMMUNICATIONS LETTERS)
3	Paper		2020.07	Joint Demand Response and Energy Trading for Electric Vehicles in Off-Grid System (IEEE ACCESS)
4	Paper	Kim, Daeyoung	2020.03	Blockchain-Based Object Name Service With Tokenized Authority (IEEE Transactions on Service Computing)
5	Paper		2020.08	Security Offloading Network System for Expanded Security Coverage in IPv6-based Resource Constrained Data Service Networks (Wireless Networks, Springer)
6	Paper		2020.08	T Net: Encoder Decoder in Encoder Decoder architecture for the main vessel segmentation in coronary angiography (Neural Networks, Elsevier)
7	Paper	Woo, Woontack	2020.02	Physically-inspired Deep Light Estimation from a Homogeneous-Material Object for Mixed Reality Lighting (IEEE Transactions on Visualization and Computer Graphics)
8	Patent	Choi, Jun Kyun	2020.04	Building Energy management apparatus and Method (Patent Application, 10-2020-0051773)
9	Patent		2020.04	Method for DDoS detection using Metaheuristic Clustering (Patent Application, 10-2020-0051631)
10	Patent		2020.05	Energy Optimization Scheme of Mobile Devices for Mobile Augmented Reality Applications in Mobile Edge Computing (Patent Application, 10-2020-0064158)
11	Patent		2020.08	IOT GATEWAY FOR CONTROLLING DATA REPORTING INTERVAL OF IOT TERMINAL BASED ON DATA PREDICTION ACCURACY AND OPERATING METHOD THEREOF (Patent Application, 16987021)
12	Patent	Kim, Daeyoung	2020.03	ENVIRONMENT RECOGNITION METHOD USING VISIBLE LIGHT COMMUNICATION IN AR ENVIRONMENT (Patent Registration, 10-2086206-0000)
13	Patent	Woo, Woontack	2020.01	A FOCUS-CONTEXT DISPLAY TECHINIQUE AND APPARATUS USING A MOBILE DEVICE WITH A DUAL CAMERA (Patent Registration, 10-2074072-0000)
14	Patent		2020.02	NOVEL VIEW SYNTHESIS METHOD BASED ON MULTIPLE 360 IMAGES FOR 6-DOF VIRTUAL REALITY AND THE SYSTEM THEREOF (Patent Application, PCT/KR2020/002289)

Research Achievements

KAIST Institute for IT Convergence

• Integrated Sensors

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Cho, Gyuseong	2020.01	Improving spatial resolution by predicting the initial position of charge-sharing effect in photon-counting detectors (JOURNAL OF INSTRUMENTATION)
2	Paper		2020.02	A neural network approach for identification of gamma-ray spectrum obtained from silicon photomultipliers (NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH SECTION A-ACCELERATORS SPECTROMETERS DETECTORS AND ASSOCIATED EQUIPMENT)
3	Paper		2020.05	Integrated Circuit Design for Radiation-Hardened Charge-Sensitive Amplifier Survived up to 2 Mrad (sensors)
4	Paper		2020.05	Reconstruction of Compton Edges in Plastic Gamma Spectra Using Deep Autoencoder (sensors)
5	Paper	Hong, Songcheol	2020.02	Design of 94-GHz Highly Efficient Frequency Octupler Using 47-GHz Current-Reusing Class-C Frequency Quadrupler (IEEE TRANSACTIONS ON MICROWAVE THEORY AND TECHNIQUES)
6	Paper		2020.09	Phase-Extraction Method With Multiple Frequencies of FMCW Radar for Human Body Motion Tracking (IEEE MICROWAVE AND WIRELESS COMPONENTS LETTERS)
7	Patent	Cho, Gyuseong	2020.03	Method and system to improve depth resolution of 3D camera based on Time of Flight (Patent Registration, 10-2020-0034946)
8	Patent		2020.05	System for Searching Operating Voltage of Silicon Photomultipliers (Patent Application, 10-2020-0054158)

KAIST Institute for Robotics

• Future Mobility Technologies

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Shim, Hyunchul	2020.05	V2X-Communication-Aided Autonomous Driving: System Design and Experimental Validation (SENSORS)
2	Paper	Yoon, Yoonjin	2020.10	Incorporating Dynamicity of Transportation Network With Multi-Weight Traffic Graph Convolutional Network for Traffic Forecasting (IEEE Transactions on Intelligent Transportation Systems)
3	Patent	Shim, Hyunchul	2020.02	Image Processing-Based Collision Avoidance System for Flight Vehicle and Flight Vehicle Including Same (Patent Application, 16/805,240)
4	Patent		2020.10	Method for detecting and avoiding obstacles through image processing of aircraft (Patent Registration, 10-2171043-0000)

KAIST Institute for Robotics

• Fundamental Research on Future Robotics

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Choi, Han-Lim	2020.03	Deep generative models-based anomaly detection for spacecraft control systems (Sensors)
2	Paper		2020.06	Deep neural network-based landmark selection method for optical navigation on lunar highlands (IEEE Access)
3	Paper		2020.09	Min-max tours and paths for task allocation to heterogeneous agents (IEEE Transactions on Control of Network Systems)
4	Paper	Kwon, Dong-Soo	2020.01	Braille Display for Portable Device Using Flip-Latch Structured Electromagnetic Actuator (IEEE Transactions on Haptics)
5	Paper		2020.01	Cluster-Analysis-Based User-Adaptive Fall Detection Using Fusion of Heart Rate Sensor and Accelerometer in a Wearable Device (IEEE access)
6	Paper		2020.01	Rendering Strategy to Counter Mutual Masking Effect in Multiple Tactile Feedback (Applied Sciences)
7	Paper		2020.02	Effect of backlash hysteresis of surgical tool bending joints on task performance in teleoperated flexible endoscopic robot (The International Journal of Medical Robotics and Computer Assisted Surgery)"
8	Paper		2020.02	Hysteresis Compensator with Learning-Based Hybrid Joint Angle Estimation for Flexible Surgery Robots (IEEE Robotics and Automation Letters)
9	Paper		2020.03	Evaluation of a robotic arm-assisted endoscope to facilitate endoscopic submucosal dissection (with video) (Gastrointestinal Endoscopy)
10	Paper		2020.04	K-FLEX: A flexible robotic platform for scar-free endoscopic surgery (The International Journal of Medical Robotics and Computer Assisted Surgery)
11	Paper		2020.08	A Highly Intuitive and Ergonomic Redundant Joint Master Device for 4-Degrees of Freedom Flexible Endoscopic Surgery Robot (The International Journal of Medical Robotics and Computer Assisted Surgery)"
12	Paper		2020.09	A Stiffness Adjustable 6-DOF Robotic System for Pituitary Tumor Resection Under MRI (IEEE access)
13	Paper		2020.09	easyEndo robotic endoscopy system: Development and usability test in a randomized controlled trial with novices and physicians (The International Journal of Medical Robotics and Computer Assisted Surgery)
14	Paper	Yoon, Kuk-Jin	2020.04	Deceiving Image-to-Image Translation Networks for Autonomous Driving With Adversarial Perturbations (IEEE ROBOTICS AND AUTOMATION LETTERS (RA-L))
15	Paper		2020.05	SpherePHD: Applying CNNs on 360° Images with Non-Euclidean Spherical PolyHeDron Representation (IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI))
16	Paper		2020.07	Loop-Net: Joint Unsupervised Disparity and Optical Flow Estimation of Stereo Videos With Spatiotemporal Loop Consistency (IEEE ROBOTICS AND AUTOMATION LETTERS (RA-L))
17	Patent	Kwon, Dong-Soo	2020.01	METHOD OF DETERMINING HYSTERESIS OF SURGICAL ROBOT, METHOD OF COMPENSATING FOR THE SAME, AND ENDOSCOPIC SURGICAL APPARATUS (Patent Application, PCT/KR2020/000862)
18	Patent		2020.06	GRIPPER AND MASTER DEVICE FOR SURGERY COMPRISING THEREOF (Patent Application, PCT/KR2020/008017)
19	Patent		2020.06	SURICAL SYSTEM (Patent Application, PCT/KR2020/008019)

Research Achievements

KAIST Institute for Robotics

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
20	Patent	Kwon, Dong-Soo	2020.08	Information output device (Patent Registration, 16637791)
21	Patent		2020.08	Positioning arm (Patent Application, WO2020159021A1)
22	Patent		2020.08	Rotation locking device and two-degree-of-freedom (2dof) rotary arm including same (Patent Application, WO2020159020A1)
23	Patent		2020.09	AUTONOMOUS ENDOSCOPIC SYSTEM AND CONTROL METHOD THEREFOR (Patent Application, 17030331)
24	Patent		2020.09	CALCULUS REMOVING DEVICE AND METHOD (Patent Application, 17030369)
25	Patent		2020.11	ENDOSCOPIC DEVICE AND METHOD FOR CONTROLLING THE ENDOSCOPIC DEVICE (Patent Application, PCT/KR2020/015751)
26	Patent	Yoon, Kuk-Jin	2020.03	Joint Unsupervised Disparity and Optical Flow Estimation of Stereo Videos with Spatiotemporal Loop Consistency (Patent Application, 10-2020-0032979)
27	Patent		2020.03	Multi-network fusion system (Patent Application, 10-2020-0032980)
28	Patent		2020.04	A regular icosahedron based image representation method that minimizes distortion and a method of applying a convolutional neural network on the proposed representation (Patent Application, 10-2020-0048643)
29	Patent		2020.11	Adaptive Multi-scale Feature Aggregation for Video Object Detection (Patent Application, 10-2020-0155670)

• Mobile Robot Technologies

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Kim, Ayoung	2020.01	DVL-SLAM: Sparse Depth Enhanced Direct Visual-LiDAR SLAM (Autonomous Robots)
2	Paper		2020.07	PrimA6D: Rotational Primitive Reconstruction for Enhanced and Robust 6D Pose Estimation (IEEE Robotics and Automation Letters (with IROS))
3	Paper		2020.08	HDMI-Loc: Exploiting High Definition Map Image for Precise Localization via Bitwise Particle Filter (IEEE Robotics and Automation Letters (with IROS))
4	Paper		2020.08	Proactive Camera Attribute Control using Bayesian Optimization for Illumination-Resilient Visual Navigation (IEEE Transactions on Robotics)
5	Patent		2020.04	APPARATUS AND METHOD FOR CONTROLLING CAMERA ATTRIBUTE USING BAYESIAN OPTIMIZATION (Patent Registration, 10-2105787)

KAIST Institute for the NanoCentury

• NT for Climate Change

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Byon, Hye Ryung	2020.02	Mechanistic study revealing the role of the Br3-/Br2 redox couple in CO2-assisted Li-O3 batteries (Advanced Energy Materials)
2	Paper	Cho, EunAe	2020.04	Origin of the Superior Electrochemical Performance of Amorphous-Phase Conversion-Reaction-Based Electrode Materials for Na-Ion Batteries: Formation of a Bicontinuous Metal Network (ACS Applied Materials & Interfaces)
3	Paper	Choi, Siyoung	2020.09	Ultra-Stable Freestanding Lipid Membrane Array: Direct Visualization of Dynamic Membrane Remodeling with Cholesterol Transport and Enzymatic Reactions (Small)
4	Paper	Jung, Hee Tae	2020.05	Multi-Array Nanopattern Electronic-Nose (E-Nose) by High-Resolution Top-Down Nanolithography (Advanced Funtional Materials)
5	Paper	Kim, Hee-Tak	2020.06	Unraveling the Dual Functionality of High-Donor-Number Anion in Lean-Electrolyte Lithium-Sulfur Batteries (Advanced Energy Materials)
6	Paper		2020.09	Dendrite-free Zn electrodeposition triggered by interatomic orbital hybridization of Zn and single vacancy carbon defects for aqueous Zn-based flow batteries (Energy & Environmental Science)
7	Paper	Kim, Hee-Tak Seo, Myungeun	2020.05	Achieving Fast Proton Transport and High Vanadium Ion Rejection with Uniformly Mesoporous Composite Membranes for High-Efficiency Vanadium Redox Flow Batteries (ACS Applied Energy Materials)
8	Paper	Kim, Il-Doo	2020.05	A Critical Review on functionalization of air-cathodes for nonaqueous Li-O_2 battery (Advanced Functional Materials)
9	Paper	Nam, Yoon Sung	2020.07	Plasmonic Heterostructure Funtionalized with a Carbene-linked Molecular Catalyst for Sustainable and Selective Carbon Dioxide Reduction (ACS Applied Materials & Interfaces)
10	Paper	Ryu, Seunghwa Jung, Hee Tae	2020.06	Confined cavity on a mass-producible wrinkle film promotes selective CO_2 reduction (Journal of Materials Chemistry A)
11	Patent	Jeon, Seokwoo	2020.05	FUEL CELL INCLUDING INTEGRATED INTERNAL REFORMING LAYER HAVING NANO-STRUCTURE AND METHOD FOR MANUFACTURING THE SAME (Patent Registration, 10-2112029-0000)
12	Patent	Kim, Hee-Tak	2020.10	Method for Manufacturing High Purity Electrolyte for Vanadium Redox Flow Battery by Using Catalytic Reaction (Patent Application, 10-2020-0131219)

• NT for Healthcare

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Jeon, Seokwoo Kim, Il-Doo	2020.09	Focused Electric-field Polymer Writing: toward Ultralarge, Multi-stimuli-responsive Membranes (ACS Nano)
2	Patent	Jeon, Seokwoo	2020.05	PRE-CONCENTRATOR HAVING ORDERED THREE-DIMENSIONAL POROUS STRUCTURE (Patent Registration, 10-2112031-0000)
3	Patent	Kim, Il-Doo	2020.03	GAS SENSOR AND MEBBER USING METAL OXIDE NANOFIBERS INCLUDING NANOSCALE CATALYSTS AND MULTICHANNEL, AND MANUFACTURING METHOD THEREOF (Patent Registration, 10-2092-4520000)
4	Patent	Lee, Keon Jae	2020.06	Voice Recognition Sensor having Multi Frequency Channels with Curved type (Patent Registration, 10-2126204-0000)

Research Achievements

KAIST Institute for the NanoCentury

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
5	Patent	Lee, Keon Jae	2020.09	Ultra-low power flexible piezoelectric audio recognition sensor for Internet-of-Things (Patent Registration, 10-7004415-0000)
6	Patent	Nam, Yoon Sung	2020.10	GRAFTED CONJUGATES OF POLYSACCHARIDES AND siRNAs, siRNA DELIVERY SYSTEM COMPRISING THE SAME AND PREPARING METHOD THEREOF (Patent Registration, 10-2170266-0000)

• NT for Advanced Opto-Electronics

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Choi, Sung-Yool	2020.05	Synthesis of Ultrathin Metal Nanowires with Chemically Exfoliated Tungsten Disulfide Nanosheets (Nano Letters)
2	Paper		2020.07	Conductive-bridging random-access memories for emerging neuromorphic computing (Nanoscale)
3	Paper	Choi, Sung-Yool Kim, Il-Doo	2020.04	Low-Thermal-Budget Doping of 2D Materials in Ambient Air Exemplified by Synthesis of Boron-Doped Reduced Graphene Oxide (Advanced Science)
4	Paper	Jang, Min Seok	2020.01	Complete complex amplitude modulation with electronically tunable graphene plasmonic metamolecules (ACS nano)
5	Paper	Jang, Min Seok Jung, Yeon Sik	2020.09	Simulation and Fabrication of Nanoscale Spirals Based on Dual-Scale Self-Assemblies (ACS APPLIED MATERIALS & INTERFACES)
6	Paper	Jeon, Seokwoo	2020.06	Controllable Singlet-Triplet Energy Splitting of Graphene Quantum Dots through Oxidation: From Phosphorescence to TADF (Advanced Materials)
7	Paper	Jung, Hee Tae	2020.04	Recent Progress in Simple and Cost-Effective Top-Down Lithography for ≈10 nm Scale Nanopatterns: From Edge Lithography to Secondary Sputtering Lithography (Advanced Materials)
8	Paper	Jung, Yeon Sik	2020.06	Thermodynamic-driven polychromatic quantum dot patterning for light-emitting diodes beyond eye-limiting resolution (Nature Communications)
9	Paper	Lee, Keon Jae	2020.04	Multidisciplinary Materials Research in KAIST Over the Last 50 Years (Advanced Materials)
10	Paper		2020.04	Progress in Brain-Compatible Interfaces with Soft Nanomaterials (Advanced Materials)
11	Paper	Lee, Keon Jae Choi, Sung-Yool	2020.09	TFT Channel Materials for Display Applications: From Amorphous Silicon to Transition Metal Dichalcogenides (Advanced Materials)
12	Paper	Ryu, Seunghwa	2020.05	Designing an Adhesive Pillar Shape with Deep Learning-Based Optimization (ACS Applied Materials & Interfaces)
13	Paper	Seo, Myungeun	2020.09	Pore Engineering of Covalently Connected Metal-Organic Framework Nanoparticle-Mixed-Matrix Membrane Composites for Molecular Separation (ACS Applied Nano Materials, Cover Article)
14	Paper	Yu, Kyoungsik	2020.02	Rapid and broad-range thickness estimation method of hexagonal boron nitride using Raman spectroscopy and optical microscope (Applied Physics Letters)

KAIST Institute for the NanoCentury

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
15	Paper	Yu, Kyoungsik Choi, Sung-Yool	2020.02	Gap-Mode Plasmon-Induced Photovoltaic Effect in a Vertical Multilayer Graphene Homojunction (Advanced Optical Materials)
16	Patent	Choi, Sung-Yool	2020.01	Plasmon Induced Photovoltaic Effect in Vertical Homojunction of Multilayer Graphene (Patent Registration, 10-2073210-0000)
17	Patent		2020.09	Electronic devcie using two dimensional semicondoctor material (Patent Registration, 10-2153945-0000)
18	Patent	Jang, Min Seok	2020.09	GRAPHENE METASURFACE BASED MOLECULAR SENSOR WITH ENHANCED SENSITIVITY USING MULTISCALE TECHNIQUE AND MANUFACTURING METHOD THEREOF (Patent Registration, 10-2162022-0000)
19	Patent	Jung, Hee Tae	2020.01	SENSOR INCLUDING NANOSTRUCTURES AND METHOD FOR MANUFACTURING THE SAME (Patent Application, 10-2020-0005527)
20	Patent		2020.03	Method of Preparing Hierarchical Wrinkle Structure by Using Sacrificial Layer and Hierarchical Wrinkle Structure Prepared Thereby (Patent Registration, 10-2018-0135893)
21	Patent	Jung, Yeon Sik	2020.05	Large band gap bilayered hole-transport-layer of quantum dot photovoltaic to reduce open-circuit voltage issue (Patent Registration, 10-2111122-0000)

KAIST Institute for Health Science and Technology

• Neuroimaging & Neuromodulation

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Jeong, BumSeok	2020.02	Pessimistically biased perception in panic disorder during risk learning (Depression and anxiety)
2	Paper		2020.04	Aberrant Structural Network of Comorbid Attention Deficit/Hyperactivity Disorder is Associated with Addiction Severity in Internet Gaming Disorder (NeuroImage: Clinical)
3	Paper		2020.08	Effects of emotional maltreatment on semantic network activity during cognitive reappraisal (Brain imaging and behavior)
4	Paper		2020.09	Validation of the Traumatic Antecedents Questionnaire using item response theory (Brain and Behavior)
5	Paper		2020.10	Data-driven analysis using multiple self-report questionnaires to identify college students at high risk of depressive disorder (Scientific Reports)
6	Paper		2020.10	Expecting social punishment facilitates control over a decision under uncertainty by recruiting medial prefrontal cortex (SCAN)
7	Paper	Jeong, Yong	2020.02	Identifying the Functional Brain Network of Motor Reserve in Early Parkinson's Disease (MOVEMENT DISORDERS)
8	Paper		2020.05	K-EmoCon, a multimodal sensor dataset for continuous emotion recognition in naturalistic conversations (SCIENTIFIC DATA)

Research Achievements

KAIST Institute for Health Science and Technology

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
9	Paper	Jeong, Yong	2020.09	Genetic variants beyond amyloid and tau associated with cognitive decline: A cohort study. (Neurology)
10	Paper		2020.09	High-speed optical coherence tomography angiography for the measurement of stimulus-induced retrograde vasodilation of cerebral pial arteries in awake mice (Neurophotonics)
11	Paper		2020.10	Detection of gray matter microstructural changes in Alzheimer's disease continuum using fiber orientation (BMC Neurology)
12	Paper	Ku, Taeyun	2020.05	Elasticizing tissues for reversible shape transformation and accelerated molecular labeling (Nature Methods)
13	Patent		2020.05	Composition and methods relating to reversibly compressible tissue-hydrogel hybrids (Patent application, 63/020,499)

• Biophotonics

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Kim, Pilhan	2020.02	A Novel Pancreatic Imaging Window for Stabilized Longitudinal In Vivo Observation of Pancreatic Islets in Murine Model (Diabetes & Metabolism Journal)
2	Paper		2020.08	In vivo longitudinal visualization of the brain neuroinflammatory response at the cellular level in LysM-GFP mice induced by 3-nitropropionic acid (Biomedical Optics Express)
3	Paper		2020.08	Intravital longitudinal imaging of hepatic lipid droplet accumulation in a murine model for nonalcoholic fatty liver disease (Biomedical Optics Express)
4	Paper	Oh, Wang Yuhl	2020.03	Dll4 Suppresses Transcytosis for Arterial Blood-Retinal Barrier Homeostasis (Circulation Research)
5	Paper		2020.06	9.4 MHz A-line rate optical coherence tomography at 1300 nm using a wavelength-swept laser based on stretched-pulse active mode-locking (Scientific Reports)
6	Paper		2020.07	High-speed optical coherence tomography angiography for the measurement of stimulus-induced retrograde vasodilation of cerebral pial arteries in awake mice (Neurophotonics)
7	Paper		2020.07	In vivo imaging of the hyaloid vascular regression and retinal and choroidal vascular development in rat eyes using optical coherence tomography angiography (Scientific Reports)
8	Paper	Park, YongKeun	2020.02	Label-Free Tomographic Imaging of Lipid Droplets in Foam Cells for Machine-Learning-Assisted Therapeutic Evaluation of Targeted Nanodrugs (ACS NANO)
9	Paper		2020.04	Single-molecule functional anatomy of endogenous HER2-HER3 heterodimers (ELIFE)
10	Paper		2020.09	Disordered Optics: Exploiting Multiple Light Scattering and Wavefront Shaping for Nonconventional Optical Elements (ADVANCED MATERIALS)

KAIST Institute for Health Science and Technology

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
11	Patent	Kim, Pilhan	2020.01	METHOD AND APPARATUS FOR QUANTITATION OF MICROCIRCULATION (Patent application, PCT/KR2020/000549)
12	Patent		2020.03	Window apparatus for in vivo microscopic imaging of mammary tissue and method for obtaining image using the same (Patent registration, 6670385)
13	Patent	Kim, Pilhan, Oh, Wang Yuhl	2020.07	Anti-angiopoietin-2 antibodies and uses thereof (Patent application, 2019224694)
14	Patent	Oh, Wang Yuhl	2020.04	MULTIMODAL DIAGNOSTIC AND THERAPEUTIC CATHETER AND CATHETER SYSTEM (Patent application, PCT/KR2020/004537)
15	Patent		2020.08	STRETCHED PULSE MODE LOCKING WAVELENGTH SWEPT LASER DEVICE AND OPERATION METHOD THEREOF (Patent application, 10-2020-0109371)
16	Patent	Park, YongKeun	2020.02	APPARATUS FOR DETECTING SAMPLE CHARACTERISTIC USING CHAOTIC WAVE SENSOR (Patent registration, 10,551,293)
17	Patent		2020.02	APPARATUS AND METHOD FOR GENERATING TOMOGRAPHY IMAGE (Patent registration, 10-2082299-0000)
18	Patent		2020.03	APPARATUS AND METHOD FOR FORMING 3 DIMENSIONAL HOLOGRAPHIC IMAGE USING NON-PERIODICALLY STRUCTURED OPTICAL ELEMENTS (Patent registration, 10-2095088-0000)
19	Patent		2020.04	Apparatus and method for generating tomography image (Patent registration, 10-2101875-0000)

• Therapeutic Bioengineering

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Park, Ji Ho	2020.03	Cyclodextrin polymer improves atherosclerosis therapy and reduces ototoxicity (Journal of Controlled Release)
2	Paper		2020.06	Affinity-Driven Design of Cargo-Switching Nanoparticles to Leverage a Cholesterol-Rich Microenvironment for Atherosclerosis Therapy (ACS Nano)
3	Paper		2020.06	Nanomedicine for the treatment of rheumatoid arthritis (Mol. Pharm)
4	Paper		2020.06	Evaluation of Intraoperative Near-Infrared Fluorescence Visualization of the Lung Tumor Margin With Indocyanine Green Inhalation (JAMA Surgery)
5	Paper		2020.07	Convection-Enhanced Delivery of Liposomal Drugs for Effective Treatment of Glioblastoma Multiforme (Drug Delivery and Translational Research)
6	Paper		2020.10	Management of lymph node metastasis via local chemotherapy can prevent distant metastasis and improve survival in mice (Journal of Controlled Release)
7	Patent		2020.02	Preparation of protein-loaded pulmonary surfactant nanoparticles for inhalation delivery (Patent application, 10-2020-0013867)
8	Patent		2020.07	Pharmaceutical composition for preventing or treating atherosclerosis containing cyclodextrin polymer as an active ingredient (Patent application, PCT/KR2020/009926)

Research Achievements

KAIST Institute for Artificial Intelligence

• AI Fundamentals

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Patent	Choi, Key-Sun	2020.01	Conversation Leading Method and Apparatus for Knowledge Learning Dialog Agent (Patent Application, PCT/KR2020/001320)

• AI Applications

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Kim, Jong-Hwan	2020.01	Incremental Class Learning for Hierarchical Classification (IEEE Transactions on Cybernetics)
2	Paper		2020.05	A Stabilized Feedback Episodic Memory (SF-EM) and Home Service Provision Framework for Robot and IoT Collaboration (IEEE Transactions on Cybernetics)
3	Paper		2020.05	Online Incremental Classification Resonance Network and Its Application to Human-Robot Interaction (IEEE Transactions on Neural Networks and Learning Systems)
4	Paper		2020.07	D3PointNet: Dual-Level Defect Detection PointNet for Solder Paste Printer in Surface Mount Technology (IEEE Access)
5	Paper	Lee, Jae-Gil	2020.02	DTranNER: Biomedical Named Entity Recognition with Deep Learning-Based Label-Label Transition Model (BMC Bioinformatics)
6	Paper		2020.03	A Systematic Framework of Predicting Customer Revisit with In-Store Sensors (Knowledge and Information Systems)
7	Paper		2020.09	Ada-Boundary: Accelerating DNN Training via Adaptive Boundary Batch Selection (Machine Learning)
8	Paper	Ro, Yong Man	2020.02	BMAN: Bidirectional Multi-scale Aggregation Networks for Abnormal Event Detection (IEEE Transactions on Image Processing)
9	Paper		2020.04	BBC Net: Bounding-Box Critic Network for Occlusion-Robust Object Detection (IEEE Transactions on Circuits and Systems for Video Technology)
10	Paper		2020.04	Deep Virtual Reality Image Quality Assessment with Human Perception Guider for Omnidirectional Image (IEEE Transactions on Circuits and Systems for Video Technology)
11	Paper		2020.04	Encoding Features Robust to Unseen Modes of Variation with Attentive Long Short-term Memory (Pattern Recognition)
12	Paper	Ye, Jong Chul	2020.03	Adaptive and Compressive Beamforming Using Deep Learning for Medical Ultrasound (IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control)
13	Paper		2020.05	Deep Learning COVID-19 Features on Cxr Using Limited Training Data Sets (IEEE Transactions on Medical Imaging)
14	Paper		2020.07	CycleGAN with a Blur Kernel for Deconvolution Microscopy: Optimal Transport Geometry (IEEE Transactions on Computational Imaging)
15	Paper		2020.09	Unpaired Training of Deep Learning tMRA for Flexible Spatio-Temporal Resolution (IEEE Transactions on Medical Imaging)
16	Patent	Park, HyunWook	2020.04	Apparatus and Method for Motion Compensated Frame Interpolation Suitable for both Linear and Nolinear Motion (Patent Registration, 10-2105766-0000)
17	Patent	Park, Yong-Hwa	2020.01	Electronic Apparatus and Method for Identifying False Detection of Objectb by Reflection in Indoor Environment (Patent Application, EU20151284.5, US16742851)
18	Patent		2020.07	Deep Learning based Cough Recognition Camera (Patent Application, 10-2020-0084770)

• AI Emergings

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Cho, Young-Ho	2020.10	Wearable Porous PDMS Layer of High Moisture Permeability for Skin Trouble Reduction (Scientific Reports)
2	Paper	Kim, Daesoo	2020.04	Progress in Brain Compatible Interfaces with Soft Nanomaterials (Advanced Materials)
3	Paper		2020.08	Interactive Virtual Objects Attract Attention and Induce Exploratory Behaviours in Rats (Behavioural Brain Research)
4	Paper		2020.09	Optogenetic Brain Neuromodulation by Stray Magnetic Field via Flash-enhanced Magneto-mechano-triboelectric Nanogenerator (Nano Energy)
5	Paper	Lee, Sang Wan	2020.04	Behavioral Evidence for Memory Replay of Video Episodes in the Macaque (ELIFE)
6	Paper		2020.06	Dynamic Resource Allocation During Reinforcement Learning Accounts for Ramping and Phasic Dopamine Activity (Neural Networks)
7	Paper		2020.05	Quantum Classifier with Tailored Quantum Kernel (Nature Partener Journal Quantum Information)
8	Paper	Rhee, June-Koo	2020.10	Machine Learning for Practical Localization System Using Multiview CSI (IEEE Access)
9	Paper		2020.10	Quantum Error Mitigation with Artificial Neural Network (IEEE Access)
10	Patent	Cho, Young-Ho	2020.01	Elasticity Measurement Device (Patent Application, US 16/633,205)
11	Patent		2020.04	Method of Manufacturing Porous Structure (Patent Registration, 10-2106363-0000)
12	Patent	Lee, Sang Wan	2020.11	Universal Cognitive State Decoder Based on Brain Signal and Method and Apparatus for Predicting Ultra-High Performance Complex Behavior Using The Same (Patent Application, US 16950095)
13	Patent	Rhee, June-Koo	2020.11	Effective Quantum RAM Architecture for Quantum Database (PatentApplication, US 10824373)

Research Achievements

Saudi Aramco-KAIST CO_2 Management Center

• CO_2 Capture

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Bae, Tae Hyun	2020.07	CO_2/N(2)Separation Properties of Polyimide-Based Mixed-Matrix Membranes Comprising UiO-66 with Various Functionalities (Membranes)
2	Paper		2020.11	Evaluation of porous adsorbents for CO_2 capture under humid conditions: The importance of recyclability (Chemical Engineering Journal Advances)
3	Paper	Kim, Jihan Lee, Jay H.	2020.12	Isotherm parameter library and evaluation software for CO_2 capture adsorbents (Computers and Chemical Engineering)
4	Paper	Koh, Dong-Yeun	2020.09	Microporous Materials in Scalable Shapes: Fiber Sorbents (Chemistry of materials)
5	Paper	Lee, Jay H.	2020.09	Input-Output Surrogate Models for Efficient Economic Evaluation of Amine Scrubbing CO_2 Capture Processes (Industrial & Engineering Chemistry Research)
6	Patent	Koh, Dong-Yeun	2020.06	Structured MOF fiber sorbent for capturing carbon dioxide and method of manufacturing the same (Patent Application, PCT/KR2020/007939)

• CO_2 Avoidance Using Efficiency Improvement

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Patent	Lee, Jeong Ik	2020.02	S-CO_2 oxy combustion power cycle using an isothermal compressor cooled by excess nitrogen from the air separation unit (Patent Registration, 10-2075550-0000)

• CO_2 Conversion

	Paper/Patent	Chief Researcher	Date Published	Research Achievements(Representative Papers/Patents)
1	Paper	Cafer T. Yavuz	2020.02	Dry reforming of methane by stable Ni-Mo nanocatalysts on single-crystalline MgO (Science)
2	Paper		2020.10	Quaternary Ammonium Salt Grafted Nanoporous Organic Polymer for Atmospheric CO_2 Fixation and Cyclic Carbonate Formation (Catalysis Today)
3	Paper	Jung, Hee-Tae	2020.01	Ternary Hybrid Aerogels of g-C_3N_4/α-Fe_2O_3 on a 3D Graphene Network: An Efficient and Recyclable Z-Scheme Photocatalyst (ChemPlusChem)
4	Paper		2020.06	Confined Cavity on a Mass-Producible Wrinkle Film Promotes the Selective CO_2 Reduction (Journal of Materials Chemistry A)
5	Paper	Jung, Yeon Sik	2020.04	Fabrication and Applications of 3D Nanoarchitectures for Advanced Electro-catalysts and Sensors (Advanced Materials)
6	Paper		2020.10	Highly efficient oxygen evolution reaction via facile bubble transport realized by three-dimensionally stack-printed catalysts (Nature Communications)
7	Paper	Jung, Yousung	2020.03	Uncertainty-Quantified Hybrid ML/DFT High Throughput Screening Method for Crystals (Journal of Chemical Information and Modeling)
8	Paper	Lee, Doh C.	2020.01	Design of Metallic Cocatalysts in Heterostructured Nanoparticles for Photocatalytic CO_2-to-hydrocarbon Conversion (JOURNAL OF PHYSICS D-APPLIED PHYSICS)
9	Paper	Lee, H.K.	2020.10	CO_2 uptake and physicochemical properties of carbonation-cured ternary blend Portland cement-metakaolin-limestone pastes (Materials)
10	Paper	Shin, Byungha	2020.08	Tuning the wettability of the blade enhances solution-sheared perovskite solar cell performance (Nano Energy)
11	Paper		2020.04	Tuning the wettability of the blade enhances solution-sheared perovskite solar cell (Nano Energy)
12	Paper	Song, Hyunjoon	2020.01	Strategies for Designing Nanoparticles for Electro- and Photocatalytic CO_2 Reduction (Chemistry, An Asian Journal)
13	Paper		2020.10	Characterization of heterogeneous aryl-Pd(II)-oxo clusters as active species for C-H arylation (Chemical Communications)
14	Patent	Jung, Yeon Sik	2020.09	Method for manufacturing ordered metal nanowire and method for manufacturing three-dimensional nano-structured metal catalyst for water electrolysis using the same (Patent Registration, 10-2162761-0000)

2020 KI NEWS

CMC

Feb. 28, 2020

Prof. Haeng-Ki Lee wins KSCM Computational Mechanics Award

Prof. Haeng-Ki Lee received the Computational Mechanics Award from the Korean Society for Computational Mechanics (KSCM) in recognition of his outstanding achievements in the field of computational mechanics.

CEP

Apr. 14, 2020

Center for Epidemic Preparedness (CEP) established

The Center for Epidemic Preparedness (Director Eui-Cheol Shin), a research center of KI, was established to provide a preemptive, effective response to new epidemics.

KIB

Jul. 6, 2020

Prof. Hyotcherl Ihee receives the Han Man-Jung Academic Award from Korean Chemical Society

Prof. Hyotcherl Ihee received the Han Man-Jung Academic Award from the Korean Chemical Society in recognition of his outstanding research achievements in chemistry.

CMC

Jul. 13~17, 2020

Prof. Jay-Hyung Lee gives keynote speech at IFAC 2020 World Congress

Prof. Jay-Hyung Lee gave a keynote speech titled, "Reinforcement Learning for Process Control and Beyond" at the IFAC 2020 World Congress in Berlin.

KINC

May. 19, 2020

10th KINC Fusion Research Awards Ceremony held

Researchers were presented awards for their outstanding achievements in nanoconvergence research in the past year based on a review by the KINC Personnel/Operations Committee.

KIAI

Jun. 22, 2020

Prof. Jong-Hwan Kim receives presidential citation in commemoration of 33rd month of information and culture

Prof. Jong-Hwan Kim received the presidential citation in recognition of his contributions to enhancing the standard of informatization, creating a healthy information culture, and bridging the gap in digital information as the founder of robot soccer, the International Robot Olympiad, and the AI World Cup.

KIITC

Aug. 12, 2020

KIITC, LG Electronics, and KRISS sign MOU on 6G R&D

KIITC, LG Electronics and KRISS signed an MOU to cooperate on the development of 6G-related technology, technology assessment, infrastructure establishment and operation, frequency identification, and channel property analysis.

KIB

Oct. 22, 2020

Prof. SangYup Lee receives CHC grand prize from the Korean Society for Biotechnology and Bioengineering

Prof. SangYup Lee received the CHC grand prize from the Korean Society for Biotechnology and Bioengineering in recognition of his contributions to academic and industrial advancements in bioengineering.

2020 KI NEWS

FIRIC/KPC4IR

Oct. 29, 2020

Risk Quotient 2020 held

An online international conference was held with IPUR of the National University of Singapore to examine the effects of COVID-19 on technology innovation, education, labor, and economies throughout Asia, and to discuss countermeasures using 4IR technology.

KIAI

Nov. 5, 2020

Next-generation AI: Towards Human-level Intelligence workshop held

Leading researchers of KAIST, University of Oxford, and DeepMind held an international workshop to discuss the possible attainment of human-level intelligence by next-generation AI.

KINC

Nov. 25, 2020

Daejeon's Nanoconvergence Vision Declaration Ceremony and T+2B Biz Forum held

An MOU was signed for Daejeon to gain industrial competitiveness and develop into a city of nanoconvergence, building upon its network of institutes, namely, the Nano Technology Research Association, National NanoFab Center, and KAIST Institute for NanoCentury.

KIR

Nov. 25, 2020

Prof. Hyunchul Shim's team wins the 2020 AI Grand Challenge

Prof. Hyunchul Shim's team, with their indoor precise positioning and path generation techniques, emerged as the champion in the 2020 AI Grand Challenge organized by the Ministry of Science and ICT.

KIHST

Dec. 15, 2020

Prof. Taeyun Ku selected for POSCO Science Fellowship

Prof. Taeyun Ku was named an emerging faculty fellow of the POSCO Science Fellowship by the POSCO TJ Park Foundation, which seeks to foster talent in science and technology.

FIRIC/KPC4IR

Dec. 15, 2020

"Return of the Future: COVID-19 and the 4IR Great Transformation" published

A book on the post-COVID-19 era was published, with the aim of raising public awareness through the opinions and insights of 26 Korean experts in various fields such as the economy, education, healthcare, disease control, and international politics.

KIHST

Dec. 23, 2020

The International Symposium on Quantitative Phase Imaging held

KIHST, the Department of Physics, and Tomocube Inc. held an international symposium to promote research achievements in quantitative phase imaging and to enhance research capacity through exchange with international researchers.

KIITC

Dec. 30, 2020

Prof. Ho Jong Chang receives Daejeon Metropolitan City Mayor's Award

Prof. Ho Jong Chang received the Daejeon Metropolitan City Mayor's Award for being the first to propose a smart AI-based automatic disease control system for shared property (public institutions).

Faculty Information

KAIST Institute for the BioCentury

• Human Microbiome Control

Title	Name(Dept., Position)	Research Interests	Website
Director	**Kim, Sun Chang** Dept. of Biological Sciences, Professor	Synthetic Biology, Genome Engineering, Antimicrobial Peptides(AMPs)	http://bs.kaist.ac.kr/~mbtlab/
Joint Professor	**Cho, Byung-Kwan** Dept. of Biological Sciences, Associate Professor	Synthetic Biology, Genome and Transcriptome Engineering, Electrobiosynthesis	http://cholab.or.kr/
Joint Professor	**Jeong, Ki Jun** Dept. of Chemical & Biomolecular Engineering, Professor	Protein Engineering, Antibody Engineering, Protein Display and HTS	http://proteineng.cafe24.com/xe/
Joint Professor	**Kim, Hail** Graduate School of Medical Science & Engineering, Associate Professor	Diabetology, Beta Cell Biology, Serotonin Biology	https://imodkaist.wixsite.com/home
Joint Professor	**Lee, Sang Yup** Dept. of Chemical & Biomolecular Engineering, Professor	Metabolic Engineering, Biochemical Engineering, Industrial Biotechnology	http://mbel.kaist.ac.kr/
Joint Professor	**Park, Hyun Gyu** Dept. of Chemical & Biomolecular Engineering, Professor	Nucleic Acid Bioengineering, Biochips & Biosensor, Electrochemical Diagnosis	http://hgpark.kaist.ac.kr/
Research Professor	**Cho, Suhyung** KAIST Institute for the BioCentury, Research Professor	Systems Biology, Synthetic Biology, Genome Engineering	http://cholab.or.kr/
Research Professor	**Lee, Jun Hyoung** KAIST Institute for the BioCentury, Research Professor	Synthetic Biology	http://bs.kaist.ac.kr/~mbtlab/

• Cancer Metastasis Control

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Han, Yong Man** Dept. of Biological Sciences, Professor	Differentiation of Embryonic Stem Cells, Induced Pluripotent Stem Cells	http://stemcell.kaist.ac.kr/
Joint Professor	**Heo, Won Do** Dept. of Biological Sciences, Professor	Bio-Imaging, Cell Signaling, Neuroscience	https://sites.google.com/view/heolab/home
Joint Professor	**Jeong, Won-Il** Graduate School of Medical Science & Engineering, Professor	Pathology, Cell Engineering	http://labofliver.kaist.ac.kr/
Joint Professor	**Jon, Sangyong** Dept. of Biological Sciences, Professor	Targeted Therapy, Drug Delivery System, Nanoparticle Based Vaccine	http://www.bionanolab.co.kr/
Joint Professor	**Kim, Jaehoon** Dept. of Biological Sciences, Associate Professor	Biochemistry, Epigenetics, Molecular Biology	https://sites.google.com/a/kaist.edu/biochem-molbiol-lab/
Joint Professor	**Kim, Mi-Young** Dept. of Biological Sciences, Associate Professor	Metastasis, Epigenetics, Stem Cell	https://sites.google.com/kaist.edu/cmel/home
Joint Professor	**Kim, Seyun** Dept. of Biological Sciences, Associate Professor	Biochemistry, Cell Biology, Molecular Biology	https://sites.google.com/site/seyunkimlab/

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Lee, Daeyoup** Dept. of Biological Sciences, Professor	Chromatin Biology, Biochemistry, Bioinformatics	https://sites.google.com/site/kaistchromatin/
Joint Professor	**Lee, Gyun Min** Dept. of Biological Sciences, Professor	Cell Engineering, Proteomics, Cell Therapy	https://sites.google.com/view/kaistacelab
Joint Professor	**Lhee, Hyotcherl** Dept. of Chemistry, Professor	Molecular Structural Dynamics, Chemical Reaction Dynamics, Protein Structural Dynamics	https://www.iheelab.com/
Joint Professor	**Oh, Byung Ha** Dept. of Biological Sciences, Professor	Chronosome Codensation, Infection and Immunity	https://sites.google.com/view/tpdsb/
Joint Professor	**Song, Ji-Joon** Dept. of Biological Sciences, Professor	Histone Methyltransferases, Chromatin Assembly, Nucleosome Recognition	https://www.song-kaist.org/

• Brain Cognitive Function Control

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Han, Jin-Hee** Dept. of Biological Sciences, Associate Professor	Neurobiology, Neural Circuit, Animal Behavior	https://sites.google.com/site/neuralcircuitandbehaviorlab/
Joint Professor	**Jung, Min Whan** Dept. of Biological Sciences, Professor	Decision Making, Episodic Memory, Interval Timing	https://sites.google.com/site/systemsneurolaboratory/
Joint Professor	**Kim, Daesoo** Dept. of Biological Sciences, Professor	Behavioral Neuroscience, Movement Disorders	https://sites.google.com/site/bglabkorea/
Joint Professor	**Kim, Jin Woo** Dept. of Biological Sciences, Associate Professor	Developmental Neurobiology, Neuro-regeneration, Retinal Degeneration	http://bs.kaist.ac.kr/~neurodev/Home.html
Joint Professor	**Lee, Seung-Hee** Dept. of Biological Sciences, Associate Professor	Neurobiology, Neurophysiology, Neuromodulatory Systems	https://sites.google.com/site/leelab2013/
Research Professor	**Chae, Sujin** KAIST Institute for the BioCentury, Research Professor	Behavioral Neuroscience, Movement Disorders	https://sites.google.com/site/bglabkorea/
Research Professor	**Kim, Dae-Gun** KAIST Institute for the BioCentury, Research Professor	Behavioral Neuroscience, Movement Disorders	https://sites.google.com/site/bglabkorea/

Faculty Information

KAIST Institute for IT Convergence

• B5G/6G Mobile Communications and Wireless Power Transfer Technology

Title	Name(Dept., Position)	Research Interests	Website
Director	**Rhee, June-Koo** School of Electrical Engineering, Professor	Quantum key distribution, Quantum computing, Wireless mesh networking	https://www.quic.kaist.ac.kr/
Joint Professor	**Cho, Dong Ho** School of Electrical Engineering, Professor	5G mobile communication, Wireless power transfer, System biology	http://umls.kaist.ac.kr/
Joint Professor	**Yu, Jong-Won** School of Electrical Engineering, Professor	RF Microelectronics, RF and Microwave System Integration	http://rfss.kaist.ac.kr
KI Fellow	**Lee, Ju Yong** KAIST Institute for IT Convergence, Research Associate Professor	5-th Generation Wireless Communication	http://itc.kaist.ac.kr
Research Professor	**Gil, Gye-Tae** KAIST Institute for IT Convergence, Research Associate Professor	Communication signal processing, Advanced Multi-user MIMO technology, Adaptive filter design	http://itc.kaist.ac.kr

• Integrated Sensors

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Cho, Gyuseong** Dept. of Nuclear & Quamtum Engineering, Professor	Radiation image sensor, Medical diagnosis equipment, Radiation detector	https://radiation.kaist.ac.kr
Joint Professor	**Cho, Seungryong** Dept. of Nuclear & Quantum Engineering, Associate Professor	Medical imaging, Radiation therapy	http://mirlab.kaist.ac.kr/
Joint Professor	**Park, Chong-Ook** Dept. of Materials Science Engineering, Professor	Chemical sensors	http://mse.kaist.ac.kr/~copark
Joint Professor	**Won, Yong Hyub** School of Electrical Engineering, Professor	Advanced Sensors and Optical Network	http://code.kaist.ac.kr
Research Professor	**Chang, Ho-Jong** KAIST Institute for IT Convergence, Research Associate Professor	Medical Device Biosignal Measurement	http://itc.kaist.ac.kr

• IoT/WoT

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Choi, Jun Kyun** School of Electrical Engineering, Professor	Energy-saving network, Internet of Things, Knowledge engineering	http://mnlab.kaist.ac.kr
Joint Professor	**Jung, Myoungsoo** School of Electrical Engineering, Professor	Computer Architecture, Flash, Solid State Drive (SSD), Storage Systems and Non-Volatile Memory (NVM)	http://camelab.org
Joint Professor	**Kim, Dae-Shik** School of Electrical Engineering, Professor	Systems neuro science, Neuro robotics, Brain decodes	http://brain.kaist.ac.kr

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Kim, Daeyoung** School of Computing, Professor	Realtime and Embedded Systems, Internet of Things	http://www.resl.kaist.ac.kr/
Joint Professor	**Kim, Yongdae** School of Electrical Engineering, Professor	Network and Distributed System Security, Applied Cryptography	http://syssec.kaist.ac.kr/~yongdaek/
Joint Professor	**Lim, Youn-kyung** Dept. of Industrial Design, Associate Professor	Human-Computer Interaction, Ubiquitous Computing, Experience-centered Design	http://cixd.kaist.ac.kr/
Joint Professor	**Woo, Woontack** Graduate School of Culture Technology, Professor	3D Vision, Context-aware Interaction, Augmented Human	http://uvrlab.org/

• Integrated Sensors, B5G/6G Mobile Communications and Wireless Power Transfer Technology

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Hong, Songcheol** School of Electrical Engineering, Professor	Integrated High frequency sensor, 5G communication	http://weis.kaist.ac.kr

KAIST Institute for Robotics

• Future Mobility Technologies

Title	Name(Dept., Position)	Research Interests	Website
Director	**Shim, Hyunchul** School of Electrical Engineering, Professor	Unmanned Aerial Vehicle, Autonomous Car, Robotic Systems	http://unmanned.kaist.ac.kr
Joint Professor	**Yoon, Yoonjin** Dept. of Civil & Environmental Engineering, Associate Professor	Traffic Flow Prediction, Mobility Pattern Mining	http://true.kaist.ac.kr

• Fundamental Research on Future Robotics

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Choi, Han-Lim** Dept. of Aerospace Engineering, Associate Professor	Decision Making, Intelligent Defense Systems, Multi-Agent Coordination	http://lics.kaist.ac.kr/

Faculty Information

KAIST Institute for Robotics

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Kwon, Dong-Soo** Dept. of Mechanical Engineering, Professor	Human-Robot Interaction, Medical robots, Haptics	http://robot.kaist.ac.kr
Joint Professor	**Yoon, Kuk-Jin** Dept. of Mechanical Engineering, Associate Professor	Computer Vision, Machine Learning, Pattern Analysis	http://vi.kaist.ac.kr/

• Mobile Robot Technologies

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Kim, Ayoung** Dept. of Civil & Environmental Engineering, Associate Professor	SLAM, Navigation, Path planning	https://irap.kaist.ac.kr
Joint Professor	**Kim, Jinwhan** Dept. of Mechanical Engineering, Associate Professor	Unmanned Systems, Navigation and Control, Marine Robotics	http://morin.kaist.ac.kr

KAIST Institute for the NanoCentury

• NT for Climate Change

Title	Name(Dept., Position)	Research Interests	Website
Director	**Jung, Hee Tae** Dept. of Chemical & Biomolecular Engineering, Professor	Molecular Self-Assembly, Soft-building blocks, Organic Opto-electronic Devices: Display, Energy Devices & Sensor	http://ooem.kaist.ac.kr
Joint Professor	**Byon, Hye Ryung** Dept. of Chemistry, Associate Professor	Li-O_2 batteries, Li-S batteries, Redox flow batteries	http://www.emdl.kaist.ac.kr/
Joint Professor	**Cho, Eun Seon** Dept. of Chemical & Biomolecular Engineering, Assistant Professor	Design and Synthesis of Functional Hybrid Nanomaterials (Inorganic Nanocrystals, Carbon Materials, Polymer)	https://fhnl.kaist.ac.kr
Joint Professor	**Cho, EunAe** Dept. of Materials Science & Engineering, Associate Professor	Fuel Cell, Battery, Electrolysis	http://ecsm.kaist.ac.kr

KAIST Institute for the NanoCentury

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Choi, Minkee** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Nanoporous Material Design, Energy and Environmental Catalysis, Gas Storage	http://neutron.kaist.ac.kr
Joint Professor	**Choi, Siyoung** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Transport Science (Rheology and Mass Transfer), Fluids in Porous Media, Lipid Bilayers Membranes	https://mpcomplexfluids.wordpress.com/
Joint Professor	**Chung, Sung-Yoon** Dept. of Materials Science & Engineering, Associate Professor	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/
Joint Professor	**Han, Sang Woo** Dept. of Chemistry, Professor	Noble Metal Nanocrystals and Their Designed Assembly	http://ntl.kaist.ac.kr
Joint Professor	**Han, Seung Min Jane** Dept. of Materials Science & Engineering, Associate Professor	Mechanical Properties of Nano-Structured Energy Materials	http://mpnano.kaist.ac.kr
Joint Professor	**Jang, Dong Chan** Dept. of Nuclear & Quantum Engineering, Associate Professor	Nanomechanics and Radiation Materials Science	http://sth528.wix.com/nanomechalab
Joint Professor	**Jeon, Seokwoo** Dept. of Materials Science & Engineering, Professor	Flexible Nanoelectronics, Advanced Photonic Materials	http://fdml.kaist.ac.kr
Joint Professor	**Jung, Woo Chul** Dept. of Materials Science & Engineering, Associate Professor	Solar Fuels, Fuel Cells, Electro-catalysis	http://seml.kaist.ac.kr
Joint Professor	**Jung, Yousung** Dept. of Chemical & Biomolecular Engineering, Professor	Advanced Materials High-Throughput Computational Design	http://qchem.kaist.ac.kr
Joint Professor	**Kang, Jeung Ku** Dept. of Materials Science & Engineering, Professor	Computational Materials Science, Molecular Nanowire	http://nanosf.kaist.ac.kr/
Joint Professor	**Kim, Bumjoon** Dept. of Chemical & Biomolecular Engineering, Professor	Functional Polymers, Nanoparticles	http://pnel.kaist.ac.kr/
Joint Professor	**Kim, Do Kyung** Dept. of Materials Science & Engineering, Professor	Nano Ceramics for Energy and Structural Applications	http://mse2.kaist.ac.kr/~ncrl
Joint Professor	**Kim, Heetak** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Fuel Cells, Lithium Batteries, Redox Flow Batteries	http://eed.kaist.ac.kr/
Joint Professor	**Kim, Jihan** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Molecular Simulations, High-Performance Computing, Carbon Capture	http://molsim.kaist.ac.kr/
Joint Professor	**Koh, Dong-Yeun** Dept. of Chemical & Biomolecular Engineering, Assistant Professor	Membrane Separations, Adsorptive Separations, Nanoporous	https://mmml.kaist.ac.kr

Faculty Information

KAIST Institute for the NanoCentury

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Lee, Doh Chang** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Quantum Dots, Photocatalysis, QLED	http://dclee.kaist.ac.kr/
Joint Professor	**Lee, Jae Woo** Dept. of Chemical & Biomolecular Engineering, Professor	CO_2 conversion to energy materials, Energy efficient designs, Clathrate hydrates	http://efdl.kaist.ac.kr
Joint Professor	**Lee, Jay Hyung** Dept. of Chemical & Biomolecular Engineering, Professor	Model Predictive Control, Approximate Dynamic Programming for Stochastic MDPs, Real-Time Optimization	http://lense.kaist.ac.kr
Joint Professor	**Lee, JinWoo** Dept. of Chemical & Biomolecular Engineering, Professor	Electrocatalysts for CO_2 conversion and Fuel Cells, Rechargeable Battery, Inorganic-Organic Hybrid Materials	http://cens.kaist.ac.kr/
Joint Professor	**Li Sheng** Dept. of Chemical & Biomolecular Engineering, Assistant Professor	Block Copolymer, Hybrid Polymer	https://bcpolymer.wordpress.com
Joint Professor	**Park, Inkyu** Dept. of Mechanical Engineering, Professor	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/
Joint Professor	**Ryu, Ho Jin** Dept. of Nuclear & Quantum Engineering, Associate Professor	Nuclear Fuel Development and Fuel Cycle Materials Research	http://fuel.kaist.ac.kr/
Joint Professor	**Shin, Byungha** Dept. of Materials Science & Engineering, Associate Professor	Photovoltaic Materials and Devices, Electronic Materials, Thin Film Physics and Technology	http://energymatlab.kaist.ac.kr
Joint Professor	**Song, Hyunjoon** Dept. of Chemistry, Associate Professor	Gold Nanocrystals for Sensing Applications, Metal/metal Oxide Nanocomposites for Alternative Energy Production, Metal/metal Oxide Particles for Electronics	http://small.kaist.ac.kr/wordpress/index.php

• NT for Healthcare

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Bae, Tae-Hyun** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Water treatment, Air purification, Gas separation, Resource recovery	https://sites.google.com/site/thebaeresearchgroup
Joint Professor	**Chung, Hyun Jung** Dept. of Biological Sciences, Associate Professor	Nanobiomedicine	https://sites.google.com/site/nanobiomedlab/
Joint Professor	**Daniel Seungbum Hong** Dept. of Materials Science & Engineering, Associate Professor	Domain and Domain Wall Engineering Using Advanced Scanning Probe Microscopies, Visualization of Polarization Domains and Ionic Charges at Solid/Liquid Interfaces, Mechanism of Resistivity Change in Oxide Materials	http://mii.kaist.ac.kr
Joint Professor	**Kang, Kibum** Dept. of Materials Science & Engineering, Assistant Professor	Nano/2D Materials, Next-Generation Semiconductors	https://www.kang.kaist.ac.kr/
Joint Professor	**Kim, Hak-Sung** Dept. of Biological Sciences, Professor	Molecular Evolution, Biomolecular Recognition	http://bel.kaist.ac.kr/

KAIST Institute for the NanoCentury

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Kim, Il-Doo** Dept. of Materials Science & Engineering, Professor	Inorganic Nanomaterials for Energy and Nanoelectronics	http://advnano.kaist.ac.kr
Joint Professor	**Lee, Haeshin** Dept. of Chemistry, Professor	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
Joint Professor	**Lee, Hyun Joo** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Neurotransmitter sensing, Development of Neuroscience Tools	http://bmm.kaist.ac.kr
Joint Professor	**Lee, Sang Yup** Dept. of Chemical & Biomolecular Engineering, Professor	Metabolic Engineering, Systems Biotechnology, Synthetic Biology	http://mbel.kaist.ac.kr/
Joint Professor	**Lee, Wonhee** Dept. of Physics, Associate Professor	Development of Microfluidic Calorimeters and Applications for Cell Biology, High-throughput Self-assembly of Nano-, Microparticles using Inertial Microfluidics	http://mfbsl.kaist.ac.kr/
Joint Professor	**Nam, Yoon Sung** Dept. of Materials Science & Engineering, Associate Professor	Nanostructured Biointerfaces	http://nabi.kaist.ac.kr
Joint Professor	**Nam, Yoonkey** Dept. of Bio & Brain Engineering, Professor	Neural Microsystems and Instrumentation, Neural Interfacing, Neuron-on-a-chip	http://neuros.kaist.ac.kr/
Joint Professor	**Park, Chan Beum** Dept. of Materials Science & Engineering, Professor	Biomaterials for Energy and Medicine	http://biomaterials.kaist.ac.kr
Joint Professor	**Park, Je-Kyun** Dept. of Bio & Brain Engineering, Professor	Nanobiotechnology, Integrative Bioengineering, Microfluidics	https://nanobio.kaist.ac.kr/
Joint Professor	**Park, Ji Ho** Dept. of Bio & Brain Engineering, Associate Professor	Biomaterials, Cancer Nanotechnology	https://openwetware.org/wiki/Park_Lab
Joint Professor	**Park, Steve** Dept. of Materials Science & Engineering, Assistant Professor	Nanoelectronics, Printed Organic Electronics, Stretchable Electronics and Sensors, Bioelectronics	http://steveparklab.kaist.ac.kr/
Joint Professor	**Suh, Greg** Dept. of Biological Sciences, Associate Professor	AI - Behavior Interface, Interoceptive Nutrient Sensing, Brain-Gut Axis, Flies and Mice	-
Joint Professor	**Yeom, Jihyeon** Dept. of Materials Science & Engineering, Assistant Professor	Bioanalytic platforms, Spectroscopic platforms, Nanomedicines	http://yeom-lab.com
Joint Professor	**Yoon, Jun-Bo** Dept. of Electrical Engineering, Professor	Nano/micro-switch for DC & RF applications, N/MEMS for Optical Components, Nano-sensor devices for future electronics	http://MEMS.kr

Faculty Information

KAIST Institute for the NanoCentury

• NT for Advanced Opto-Electronics

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Bae, Byeong-Soo** Dept. of Materials Science & Engineering, Professor	Optical and Display Materials, Sol-Gel Technology	http://www.sol-gel.net
Joint Professor	**Choi, Pyuck-Pa** Dept. of Materials Science & Engineering, Associate Professor	Material Characterization, Structural Materials, Alloy Design	http://nmac.kaist.ac.kr
Joint Professor	**Choi, Sung-Min** Dept. of Nuclear & Quantum Engineering, Professor	Neutron Scattering Studies of Nano-Materials and Superconductivity Nuclear Magnetic Resonance Imaging and Spectroscopy	http://egcl.kaist.ac.kr
Joint Professor	**Choi, Sung-Yool** Dept. of Electrical Engineering, Professor	Graphene & 2D Materials and Applications, Flexible/Wearable/Soft Electronics	http://mndl.kaist.ac.kr
Joint Professor	**Cho, Yong-Hoon** Dept. of Physics, Professor	Semiconductor Physics	http://qnp.kaist.ac.kr
Joint Professor	**Im, Sung Gap** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Biomaterials, Surface-Cell Interaction, Chemical Vapor Deposition of Functional polymers	http://ftfl.kaist.ac.kr
Joint Professor	**Jang, Min Seok** Dept. of Electrical Engineering, Associate Professor	Nanophotonics, Plasmonics, Metamaterials	http://jlab.kaist.ac.kr
Joint Professor	**Jung, Yeon Sik** Dept. of Materials Science & Engineering, Professor	Self-assembly Nanofabrication, Memory Devices, Energy Capture and Storage Materials	http://funnano.kaist.ac.kr
Joint Professor	**Kang, Jiheong** Dept. of Materials Science & Engineering, Assistant Professor	Dynamic materials, Soft electronics, Bioelectronics, Energy storage devices	http://jiheongkanglab.com
Joint Professor	**Kim, Sang Ouk** Dept. of Materials Science & Engineering, Professor	Soft Nanomaterial Self-Assembly, Carbon Nanotubes & Graphene, Energy Storage & Conversion	http://snml.kaist.ac.kr
Joint Professor	**Kim, Sang Youl** Dept. of Chemistry, Professor	Functional Single Macromolecules	http://macro.kaist.ac.kr/
Joint Professor	**Kim, Shin-Hyun** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Droplet-based Microfluidics, Microencapsulation and Controlled Release, Synthesis of Functional Microparticles	http://isml.kaist.ac.kr/
Joint Professor	**Kim, Taek-Soo** Dept. of Mechanical Engineering, Associate Professor	Graphene, Microelectronics, Fuel Cells, Flexible Electronics	http://aptf.kaist.ac.kr/
Joint Professor	**Kyung, Ki-Uk** Dept. of Mechanical Engineering, Associate Professor	Soft Robotics, Human-Robot Interaction, Flexible Actuators & Sensors, Haptics	http://irobot.kaist.ac.kr/
Joint Professor	**Lee, Hansuek** Dept. of Physics, Assistant Professor	Light Matter Interactions and Opto-mechanics in Nano-Structures and their Applications	https://sites.google.com/site/hleelab/
Joint Professor	**Lee, Hyuck Mo** Dept. of Materials Science & Engineering, Professor	Alloy Phase Equilibria, Application of Nanomaterials	http://triangle.kaist.ac.kr

KAIST Institute for the NanoCentury

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Lee, Keon Jae** Dept. of Materials Science & Engineering, Professor	Self-powered Flexible Energy, Flexible Large Scale Integration, Flexible Optoelectronics	http://fand.kaist.ac.kr
Joint Professor	**Oh, IlKwon** Dept. of Mechanical Engineering, Professor	Actuators, Transducers & Artificial muscles, Graphene & Nano-Engineering	http://sdss.kaist.ac.kr
Joint Professor	**Park, Byong Guk** Dept. of Materials Science & Engineering, Associate Professor	Magnetic materials, Spintronic devices, Magnetic memory (MRAM)	http://nanospin.kaist.ac.kr/
Joint Professor	**Ryu, Seunghwa** Dept. of Mechanical Engineering, Associate Professor	Mechanics and Materials Science at Nanoscale, Development of Multiscale Simulation Methods, Interaction of Chemistry and Mechanics	https://sites.google.com/site/seunghwalab/
Joint Professor	**Seo, Myungeun** Dept. of Chemistry, Associate Professor	Self-assembled Organic Nanostructures, Particularly based on Block Polymers	http://nanopsg.kaist.ac.kr/
Joint Professor	**Shin, Jonghwa** Dept. of Materials Science & Engineering, Associate Professor	Nanophotonics, Metamaterials, Energy and Information Devices	http://apmd.kaist.ac.kr
Joint Professor	**Yang, Chan-Ho** Dept. of Physics, Professor	Complex Oxide Heterostructures and Multiferroics	http://oxide.kaist.ac.kr
Joint Professor	**Yoo, Seunghyup** Dept. of Electrical Engineering, Professor	OLEDs for Display and Lighting, OPVs for Energy Havesting, OTFTs for Integrated Printed Electronics	https://www.ioel-kaist.org/
Joint Professor	**Yoon, Dong Ki** Graduate School of Nanoscience & Technology, Associate Professor	Novel Bio-vehicles and Organic Nanodevices Including Photovoltaics, OLED	http://yoon.kaist.ac.kr/
Joint Professor	**Yoon, Yong Jin** Dept. of Mechanical Engineering, Associate Professor	Hearing Mechanics & Applications, IoE based Health Monitoring with Bio-Big-Data and AI, Si-μSOFC	https://jdl.kaist.ac.kr/
Joint Professor	**Yu, Kyoungsik** Dept. of Electrical Engineering, Associate Professor	Nanophotonics, Optoelelctronics, MEMS	http://yu.kaist.ac.kr/

Faculty Information

KAIST Institute for Health Science and Technology

• Neuroimaging & Neuromodulation

Title	Name(Dept., Position)	Research Interests	Website
Director	**Jeong, Yong** Dept. of Bio & Brain Engineering, Professor	Neuroimage, Neurodegenerative disease, Cognitive function	http://ibrain.kaist.ac.kr/
Joint Professor	**Chang, JaeByum** Dept. of Materials Science & Engineering, Assistant Professor	Super-Resolution Optical Imaging, Polymer, Hydrogel	https://sites.google.com/site/jbchang03/
Joint Professor	**Cho, Seungryong** Dept. of Nuclear & Quantum Engineering, Associate Professor	Data acquisition, Image reconstruction, Image processing	http://mirlab.kaist.ac.kr/
Joint Professor	**Jang, Mooseok** Dept. of Bio & Brain Engineering, Assistant Professor	Optical Imaging, Biomedical Optics, Neurophotonics	http://mooolab.kaist.ac.kr/
Joint Professor	**Jeong, BumSeok** Graduate School of Medical Science & Engineering, Associate Professor	Clinical Neuroscience, Neuroimaging, Neuromodulation	https://drshrink.github.io/
Joint Professor	**Kim, Daesoo** Dept. of Biological Sciences, Professor	Neuroscience, Animal behavior, Artificial intelligence	https://sites.google.com/site/bglabkorea/
Joint Professor	**Ku, Taeyun** Graduate School of Medical Science & Engineering, Assistant Professor	Tissue engineering, 3D microscopic imaging	http://tkulab.org/
Joint Professor	**Lee, Hyunjoo Jenny** School of Electrical Engineering, Associate Professor	MEMS, Bio/medical microsystems, Brain Engineering	https://hyunjoojlee.wixsite.com/kaistbmm/
Joint Professor	**Lee, Sang Ah** Dept. of Bio & Brain Engineering, Associate Professor	Neural basis of Episodic memory, Spatial navigation, Cognitive development and aging	http://leelab.kaist.ac.kr/
Joint Professor	**Lee, Sang Wan** Dept. of Bio & Brain Engineering, Associate Professor	Computational Neuroscience, Brain-inspired Artificial Intelligence	https://aibrain.kaist.ac.kr/
Joint Professor	**Paik, Se-Bum** Dept. of Bio & Brain Engineering, Assistant Professor	Computational & Systems Neuroscience, Neural Network Models, Visual System	http://vs.kaist.ac.kr/
Joint Professor	**Park, Jinah** School of Computing, Associate Professor	Visual Computing, Interactive Computing	http://cgv.kaist.ac.kr
Joint Professor	**Park, Seongjun** Dept. of Bio & Brain Engineering, Assistant Professor	Bio/Neural Interface, Optogenetics, Nanomaterials for Brain Engineering	https://www.bnilab.com/
Joint Professor	**Park, Sung-Hong** Dept. of Bio & Brain Engineering, Associate Professor	Anatomical, Physiological, Functional Magnetic Resonance Imaging	http://vs.kaist.ac.kr/
Joint Professor	**Park, Young-Gyun** Dept. of Bio & Brain Engineering, Assistant Professor	Neural Engineering, System Neuroscience, Single-cell Brain Mapping	https://ygparklab.org/
Joint Professor	**Ye, JongChul** Dept. of Bio & Brain Engineering, Professor	Machine Learning, Biomedical Imaging, Bio-signal Processing	https://www.bnilab.com/

• Biophotonics

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Cho, Won-Ki** Dept. of Biological Sciences, Assistant Professor	Genetics, Molecular Biology, Biophysics	https://www.wonkicholab.com/
Joint Professor	**JEONG, KI-HUN** Dept. of Bio & Brain Engineering, Professor	Ultrathin Microscope Micro-Optics for In vivo Imaging Molecular DIagnostics	https://biophotonics.kaist.ac.kr/
Joint Professor	**Kim, Pilhan** Graduate School of Medical Science & Engineering, Associate Professor	Bio-Imaging	http://ivmvl.kaist.ac.kr/
Joint Professor	**Oh, Wang Yuhl** Department of Mechanical Engineering, Associate Professor	Development and Application of Optical Imaging System	https://phil.kaist.ac.kr/
Joint Professor	**Park, YongKeun** Dept. of Physics, Professor	Biomedical Optics	http://bmol.kaist.ac.kr/
Joint Professor	**Yoo, Hongki** Dept. of Mechanical Engineering, Associate Professor	Optical System Design, Biomedical Optics, Optical Metrology	http://boom.kaist.ac.kr/
Joint Professor	**Yoon, Young-Gyu** School of Electrical Engineering, Assistant Professor	Neuro-engineering, Brain imaging, Optical instrumentation	https://www.nicalab.com/

• Therapeutic Bioengineering

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Chung, HyunJung** Dept. of Biological Sciences, Associate Professor	Bioengineering, Drug Delivery, Nano-bio technology	http://nanomedicine.kaist.ac.kr/
Joint Professor	**G.Churchill, David** Dept. of Chemistry, Professor	Neurodegenerative Disease research, Dementia, Bioinorganic Chemistry	http://churchill.kaist.ac.kr
Joint Professor	**Jeon, Jessie Sungyun** Dept. of Mechanical Engineering, Associate Professor	Microfluidics for biological applications, Organ-on-a-chip	http://jeon.kaist.ac.kr/
Joint Professor	**Kim, Jin Kuk** Graduate School of Medical Science & Engineering, Assistant Professor	Bioinformatics and Integrative Genomics	https://sites.google.com/view/jinkukkim
Joint Professor	**Kim, Pilnam** Dept. of Bio & Brain Engineering, Associate Professor	Biomaterials/Tissue Engineering, Biochip, Mechanobiology	https://www.pilnam.kaist.ac.kr/
Joint Professor	**Kim, YeuChun** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Biomedical device, Drug delivery, Gene therapy	https://bmnd.kaist.ac.kr
Joint Professor	**Kim, Yoosik** Dept. of Chemical & Biomolecular Engineering, Assistant Professor	Quantitative Imaging, Bioinformatics, RNA Biology	https://qcbio.kaist.ac.kr/
Joint Professor	**Lee, Heung Kyu** Graduate School of Medical Science & Engineering, Associate Professor	Tumor Immunology, Viral Immunology, Vaccine development	https://www.heungkyulee.kaist.ac.kr/

Faculty Information

KAIST Institute for Health Science and Technology

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Lee, Wonhee** Dept. of Physics, Associate Professor	BioMEMS sensor, Micro-nanofluidics, Cryo-EM	http://mfbsl.kaist.ac.kr/
Joint Professor	**NAM, YOONKEY** Dept. of Bio & Brain Engineering, Professor	Neural Microsystems and instrumentation, Neural Interfacing, Neuron-on-a-chip	https://neuros.kaist.ac.kr/
Joint Professor	**Nam, YoonSung** Dept. of Materials Science & Engineering, Associate Professor	Molecular biosensor, Drug delivery, Phage therapy	http://ysnamgroup.com/
Joint Professor	**Park, Je-Kyun** Dept. of Bio & Brain Engineering, Professor	Nanobiotechnology, Integrative Bioengineering, Microfluidics	https://nanobio.kaist.ac.kr/
Joint Professor	**Park, Ji Ho** Dept. of Bio & Brain Engineering, Associate Professor	Biomaterials, Drug Delivery, Nanomedicine	https://openwetware.org/wiki/Park_Lab
Joint Professor	**Shin, Eui-Cheol** Graduate School of Medical Science & Engineering, Professor	Virology, Immunology	http://liid.kaist.ac.kr/
Joint Professor	**Yeom, Jihyeon** Dept. of Materials Science & Engineering, Assistant Professor	Nanomaterials, Chiral Materials, Nanotechnology	https://yeom-lab.com/

• Smart Healthcare

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Choi, MoonJeong** Graduate School of Science & Technology Policy, Associate Professor	Aging and Disability, Gerontechnology, Quality of Life Technology	http://aging.kaist.ac.kr
Joint Professor	**Kim, Chul** Dept. of Bio & Brain Engineering, Assistant Professor	Brain-body-machine interface, Energy efficient biosensors, Miniaturized implantable systems	https://beee.kaist.ac.kr/
Joint Professor	**Lee, Uichin** School of Computing, Associate Professor	Interactive Computing	http://ic.kaist.ac.kr
Research Professor	**Kim, Heepyung** KAIST Institute for Health Science & Technology, Research Assistant Professor	Smart Healthcare, Biomedical Engineering, Human Computer Interface (HCI)	-

KAIST Institute for Artificial Intelligence

• AI Fundamentals

Title	Name(Dept., Position)	Research Interests	Website
Director	**Oh, Alice** School of Computing, Associate Professor	Machine Learning, Natural Language Processing, Social Media Analysis	https://uilab.kaist.ac.kr/
Joint Professor	**Choi, Key-Sun** School of Computing, Professor	Natural Language Processing, Machine Reading, Semantic Web	http://semanticweb.kaist.ac.kr/
Joint Professor	**Kim, Kee-Eung** Graduate School of AI, Professor	Computing Theory, AI-Information Service	http://ailab.kaist.ac.kr/
Joint Professor	**Myaeng, Sung-Hyon** School of Computing, Professor	Text Mining, Question Answering, Natural Language Processing	http://ir.kaist.ac.kr
Joint Professor	**Noh, Junyong** Graduate School of Culture Technology, Professor	Character, Facial Animation Image, Video Manipulation Immersive Display	http://vml.kaist.ac.kr/
Joint Professor	**Whang, Euijong** School of Electrical Engineering, Associate Professor	Big Data-AI Integration, Big Data Analytics, Big Data Systems	http://stevenwhang.com

• AI Applications

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Cho, Seungryong** Dept. of Nuclear & Quantum Engineering, Associate Professor	Deep Learning Applications in Medical Imaging, Radiation Therapy, Nondestructive Testing	http://mirlab.kaist.ac.kr/
Joint Professor	**Kim, Hyun Uk** Dept. of Chemical & Biomolecular Engineering, Assistant Professor	Systems Biology, Systems Medicine, Metabolic Engineering	https://sbml.kaist.ac.kr
Joint Professor	**Kim, Jong-Hwan** School of Electrical Engineering, Professor	Machine Intelligence Learning, AI-based Anomaly Detection, Artificial Evolution	http://rit.kaist.ac.kr
Joint Professor	**Kwon, Dong-Soo** Dept. of Mechanical Engineering, Professor	Surgical Robot, Human-Robot Interaction, Haptics	http://robot.kaist.ac.kr/
Joint Professor	**Lee, Hyuck Mo** Dept. of Materials Science & Engineering, Professor	Electrochemical Catalyst, CALPHAD (Thermodynamic calculation), Materials Discovery using Machine Learning	http://triangle.kaist.ac.kr/
Joint Professor	**Lee, Jae-Gil** School of Computing, Associate Professor	Big Data Analysis, Spatio-Temporal Data Mining, Stream Data Mining	http://dm.kaist.ac.kr/
Joint Professor	**Lee, Jae Woo** Dept. of Chemical & Biomolecular Engineering, Professor	CO_2 Conversion to Valuable Carbon Materials, Energy Efficient Design, Process Intensification	http://efdl.kaist.ac.kr/
Joint Professor	**Lee, Jay Hyung** Dept. of Chemical & Biomolecular Engineering, Professor	Reinforcement Learning based Multi-scale Multi-stage Desicion Making Strategy, Deep Learning based Function Approximation and Model Estimation, Design and Optimization of Sustainable System	http://lense.kaist.ac.kr/
Joint Professor	**Lee, Sang Yup** Dept. of Chemical & Biomolecular Engineering, Professor	Biotechnology, Metabolic Engineering, Systems Biology	http://mbel.kaist.ac.kr

Faculty Information

KAIST Institute for Artificial Intelligence

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Lim, Youn-kyung** Dept. of Industrial Design, Professor	Human-computer Interaction, User Experience Design, Smart Home	http://cixd.kaist.ac.kr/
Joint Professor	**Myung, Hyun** School of Electrical Engineering, Professor	Autonomous Robot Navigation, Object/Behaviour Recognition, Bio-inspired Neural Networks	http://urobot.kaist.ac.kr/
Joint Professor	**Park, HyunWook** School of Electrical Engineering, Professor	Medical Imaging, Video Processing, MRI	http://athena.kaist.ac.kr/
Joint Professor	**Park, Yong-Hwa** Dept. of Mechanical Engineering, Associate Professor	3D Vision Recognition, Voice Recognition, Biometric Recognition	http://human.kaist.ac.kr/
Joint Professor	**Ro, Yong Man** School of Electrical Engineering, Professor	Deep Learning in Computer Vision and Image Processing (2D, 3D, VR), Medical Imaging	http://ivylab.kaist.ac.kr
Joint Professor	**Ryu, Seunghwa** Dept. of Mechanical Engineering, Associate Professor	Multiscale Mechanics and Materials Modeling, Machine Learning-Aided Materials & Composite Design	https://sites.google.com/site/seunghwalab/
Joint Professor	**Shin, Jonghwa** Dept. of Materials Science & Engineering, Associate Professor	Metamaterials, Photonics, Artificial Intelligence-Based Designs	http://apmd.kaist.ac.kr
Joint Professor	**Ye, Jong Chul** Dept. of Bio & Brain Engineering, Professor	Deep Learning for Image Reconstrucxtion, Medical Imaging, Biomedical Signal Processing	http://bispl.weebly.com/

• AI Emergings

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Cho, Young-Ho** Dept. of Bio & Brain Engineering, Professor	Emotion Monitoring Skin Patches, Physiological Emotion Symptoms, Emotion Evaluation Criteria	http://mems.kaist.ac.kr/
Joint Professor	**Chung, Hye Won** School of Electrical Engineering, Assistant Professor	Data Science, Information Theory, Statistical Inference	http://iids.kaist.ac.kr
Joint Professor	**Jo, Sungho** School of Computing, Professor	Robotic Intelligence, Augmented Intelligence, Neuro-Machine Intelligence	http://nmail.kaist.ac.kr/
Joint Professor	**Kim, Daesoo** Dept. of Biological Sciences, Professor	Optogenetics, Animal Behavior, Brain-machine Interface	https://sites.google.com/site/bglabkorea/
Joint Professor	**Lee, Keon Jae** Dept. of Materials Science & Engineering, Professor	IoT Sensor, Flexible Electronic Device	http://fand.kaist.ac.kr/
Joint Professor	**Lee, Sang Wan** Dept. of Bio & Brain Engineering, Associate Professor	Computational Neuroscience, Brain-inspired AI, Neuroimaging	http://aibrain.kaist.ac.kr/

KAIST Institute for Artificial Intelligence

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Rhee, June-Koo** School of Electrical Engineering, Professor	Quantum Computing, Quantum Machine Learning, Quantum information	http://quic.kaist.ac.kr

Saudi Aramco-KAIST CO_2 Management Center

• CO_2 Conversion

Title	Name(Dept., Position)	Research Interests	Website
Director	**Lee, Jay H.** Dept. of Chemical & Biomolecular Engineering, Professor	Model Predictive Control, Approximate Dynamic Programming, Production Scheduling	http://lense.kaist.ac.kr/
Joint Professor	**Hong, Soon Hyeok** Dept. of Chemistry, Associate Professor	Homogeneous Catalysis, Sustainable Chemical Synthesis, Polymer Functionalization	http://sites.google.com/site/hongshgroup/
Joint Professor	**Jung, Hee-Tae** Dept. of Chemical engineering, Professor	Molecular Assembly, Opto-electronic Materials, Nanopatterning	http://ooem.kaist.ac.kr/
Joint Professor	**Jung, WooChul** Dept. of Materials Science & engineering, Associate Professor	Solar Fuels, Fuels Cells, Electro-catalysis	http://seml.kaist.ac.kr/
Joint Professor	**Jung, Yeon Sik** Dept. of Materials Science & Engineering, Professor	Sub 10nm self assembly, Nano structure applications, Energy applications	http://funnano.kaist.ac.kr/
Joint Professor	**Jung, Yousung** Dept. of Chemical & Biomolecular Engineering, Professor	Atomistic materials design for CO_2 capture and conversion, Energy storage materials, Computational methods developments	http://qchem.kaist.ac.kr/
Joint Professor	**Kim, Hyunwoo** Dept. of Chemistry, Associate Professor	Organic Synthesis, Green Chemistry, Catalyst Development	http://mdos.kaist.ac.kr/
Joint Professor	**Lee, Doh Chang** Dept. of Chemical and Biomolecular Engineering, Associate Professor	Photocatalysis, Quantum dot display, Self-assembly	http://dclee.kaist.ac.kr/
Joint Professor	**Lee, Hyunjoo** Dept. of Chemical and Biomolecular Engineering, Professor	Fundamental Understanding of Catalysts, Applications for Energy and Environment	https://catmat.kaist.ac.kr/
Joint Professor	**Lee, Yunho** Dept. of Chemistry, Associate Professor	Inorganic/Bioorganometallic	http://sites.google.com/site/yunholab/

Faculty Information

Saudi Aramco-KAIST CO_2 Management Center

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Seo, Myungeun** Graduate School of Nanoscience and Technology, Associate Professor	Chemistry, Polymer Science, Nanoscience	http://nanopsg.kaist.ac.kr/
Joint Professor	**Song, Hyunjoon** Dept. of Chemistry, Professor	Plasmon Nanocrystals, Photochemical Catalysts, Electroactive Materials	http://small.kaist.ac.kr/

• CO_2 Capture

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Bae, Tae Hyun** Dept. of Chemical & Biomolecular Engineering, Associate Professor	CO_2 Capture, Membrane technology, Nanoporous materials	https://sites.google.com/site/thebaeresearchgroup/
Joint Professor	**Kim, Jihan** Dept. of Chemical & Biomolecular Engineering, Associate Professor	Molecular Simulations, Multi-scale Modeling, Materials Design	http://molsim.kaist.ac.kr/
Joint Professor	**Koh, Dong-Yeun** Dept. of Chemical & Biomolecular Engineering, Assistant Professor	Molecular Separations, Adsorption, Membranes	https://mmml.kaist.ac.kr/

• CO_2 Avoidance Using Efficiency Improvement

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Bae, Joongmyeon** Dept. of Mechanical Engineering, Professor	Solid oxide fuel cell, Steam reforming, Autothermal reforming	http://fuelcell.kaist.ac.kr/
Joint Professor	**Kim, Nam Il** Dept. of Mechanical Engineering, Associate professor	Combustion theory (laminar flames), Mild Combustion, Combustion application	http://combustion.kaist.ac.kr/
Joint Professor	**Lee, Jeong Ik** Dept. of Nuclear & Quantum Engineering, Associate Professor	Nuclear enegy and system engineering, Power conversion and propulsion, Supercritical CO_2 power cycle	http://npnp.kaist.ac.kr/
Joint Professor	**Park, Steve** Dept.of Materials Science & engineering, Associate Professor	Nanoelectronics, Printed Organic Electronics, Stretchable Electronics and Sensors, Bioelectronics	http://steveparklab.kaist.ac.kr/
Joint Professor	**Shin, Byungha** Dept. of Materials Science & Engineering, Associate Professor	Perovskite Optoelectronics, Inorganic Chalcogenide Energy Devices, Photoelectrochemical Water Splitting	http://energymatlab.kaist.ac.kr/

• CO_2 Storage

Title	Name(Dept., Position)	Research Interests	Website
Joint Professor	**Lee, H.K.** Dept. of Civil & Environmental Engineering, Professor	Construction Materials, Structural Analysis	http://samlab.kaist.ac.kr/

2020 KAIST INSTITUTES ANNUAL REPORT

Campus Map

Address

KAIST INSTITUTES
Hong & Park KI Building, 291 Daehak-ro, Yuseong-gu, Daejeon, Republic of Korea
TEL. +82-42-350-2381~9 FAX. +82-42-350-2080

Contact

Institute / Center	TEL
KAIST Institute for the BioCenter	+84-42-350-4462
KAIST Institute for IT Convergence	+84-42-350-4293
KAIST Institute for Robotics	+84-42-350-7139
KAIST Institute for the NanoCentury	+84-42-350-7271
KAIST Institute for Health Science and Technology	+84-42-350-7164
KAIST Institute for Artificial Intelligence	+84-42-350-8491
Saudi Aramco-KAIST CO_2 Management Center	+84-42-350-8251
Fourth Industrial Revolution Intelligence Center	+84-42-350-8671
Center for Epidemic Preparedness	+84-42-350-4286