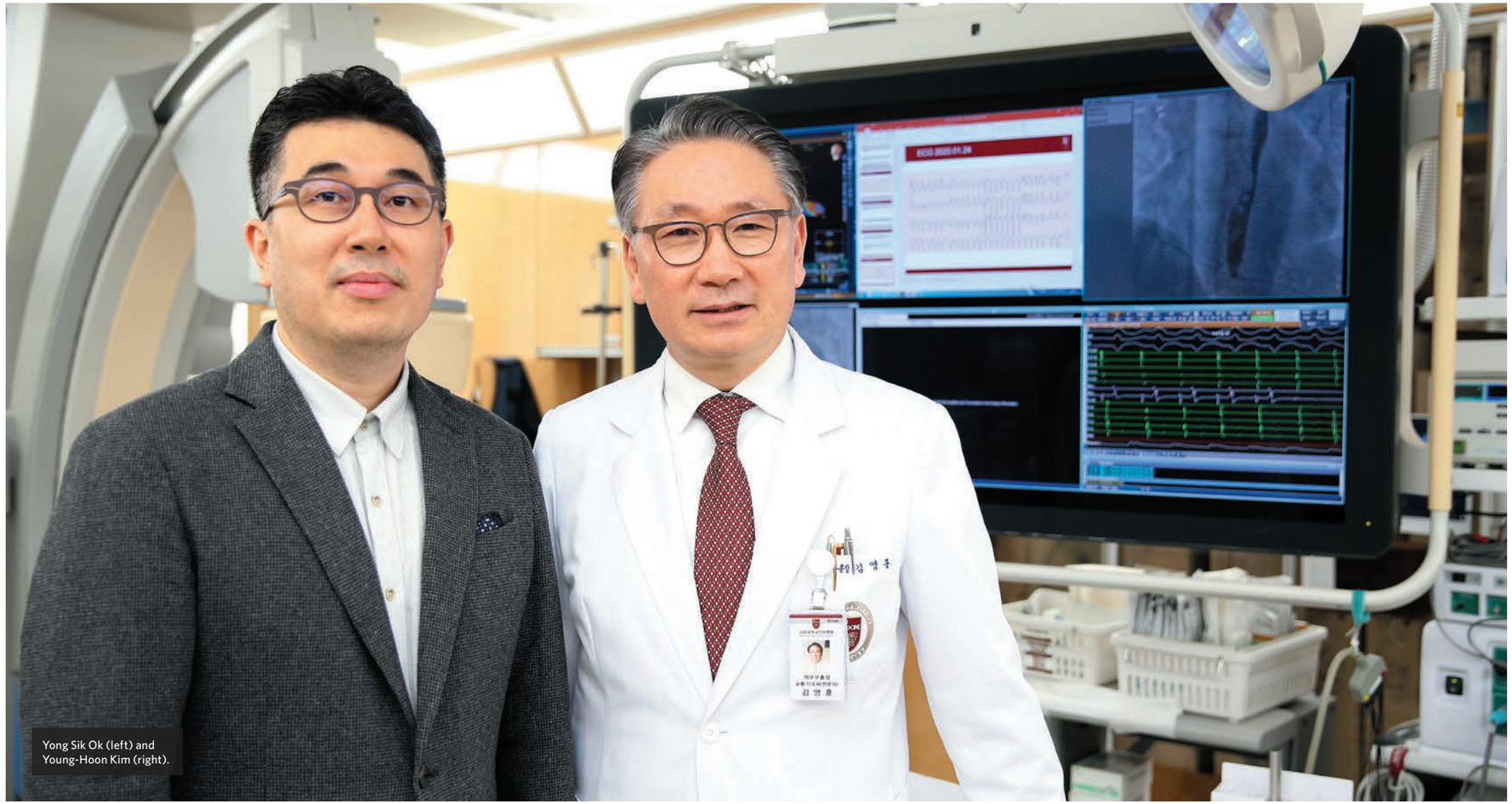
ADVERTISEMENT FEATURE

A PRIVATE UNIVERSITY WITH A GLOBAL OUTLOOK

KOREA UNIVERSITY is a prestigious academic institution with a focus on creativity, innovation, and excellence that is helping to drive positive change.



Yong Sik Ok (left) and Young-Hoon Kim (right).

A global centre of excellence for international collaboration and multi-disciplinary research, Korea University has been ranked the top private university in Asia for the fourth consecutive year, on the Quacquarelli Symonds (QS) world rankings list.

State-of-the-art research facilities and a track record of innovative research from world-renowned experts (seven of whom are 2019 Global Highly Cited Researchers) have placed Korea University in the top global 100 universities assessed by QS.

"WE NEED TO DEVELOP BETTER STRATEGIES FOR MANAGING OUR WASTE."

Research conducted at the university is helping to tackle some of the major challenges facing the world, such as climate change, environmental degradation, and chronic disease.

The United Nations' 2030 Agenda for Sustainable Development contains 17 Sustainable Development Goals (SDGs) that address issues such as inequality, climate change, and economic growth. Achieving these goals in a sustainable manner for both people and the planet poses significant technical and engineering obstacles.

Realizing the Sustainable Development Goals

Korea University's global research director, Yong Sik Ok, leader of the Association of Pacific Rim Universities (APRU) Sustainable Waste Management programme, is chairing a conference series on engineering sustainable development, organized by The American Institute of Chemical Engineers, together with William Mitch (the programme co-leader), a professor at Stanford University. Academic researchers, industrial practitioners, and government departments, will gather to discuss the development of integrated solutions to realize the UN's 17 SDGs.

Participants will also work on an efficient sustainable management agenda for biological waste and remediation of soil, water and air in the local context.

"We will deliberate on state-of-the-art treatment technologies, advanced management strategies, and political issues pertaining to recycling and recovery of waste. It's a timely opportunity for knowledge exchange among professionals from all over the world, and will actively feed into ongoing policy discourse," says Ok.

In 2019, Ok was the first South Korean to be selected as a highly cited researcher (HCR) in the field of environment and ecology by the Web of Science's HCR index, with 60 highly cited papers and hot papers. He is working at the vanguard of global efforts to develop sustainable waste management strategies and technologies to address the rising crisis in electronic and plastic waste, and pollution of soil and air with particulate matter.

"Waste management on the land and the seas has become a major national, regional, and global challenge," says Ok. "We need to develop better strategies for more effectively managing our waste. We must also seek to derive value from the waste we generate through, for example, conversion to energy and value-added products such as biochar."

By bringing together international experts, policymakers, and local communities, Ok believes the APRU Sustainable Waste Management programme and the conference series on engineering sustainable development will "play a vital role in helping to achieve the Sustainable Development Goals." Ok will host the first *Nature* conference among South Korean universities in Seoul in 2021 on the theme of waste management and valorization for a sustainable future.

Clean energy

In efforts to tackle climate change, scientists from Korea University are also creating the next generation of solar cells and helping the world transition to more efficient and cleaner renewable energy technologies.

"Imagine a solar panel as thin as a piece of paper that can be used on windows, vehicles, and other irregularly shaped surfaces," says Jun Hong Noh, associate professor in Civil, Environmental and Architectural Engineering at Korea University.

Noh's research has been focussed on developing solar cells made from halides with a perovskite crystalline structure. Perovskite solar cells are lighter, cheaper, and easier to produce than conventional silicon-based cells, and can be made into flexible devices. "The main focus of my work has been to improve the efficiency of perovskite solar cells, as this is the most important factor in the commercialization of solar cell technologies," explains Noh.

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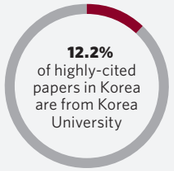
ADVERTISEMENT FEATURE

KOREA UNIVERSITY AT A GLANCE

Korea University was founded in 1905. Today, the university consists of the Seoul Campus, the Sejong Campus, three auxiliary hospitals, and has more than 36,000 students.

HIGHLY-CITED PAPERS



Source: InCites, as of March 2020

HIGHLY-CITED RESEARCHERS (HCR) FROM KOREA UNIVERSITY IN 2019

- **Jong Seung Kim**, Chemistry
- **Yong Sik Ok**, Environment and Ecology
- **Choon Ki Ahn**, Engineering
- **Jun Hong Noh**,Cross-field
- **Klaus-Robert Müller,** Cross-field
- **Kwangmeyung Kim**, Cross-field
- **Ick Chan Kwon,** Pharmacology & Toxicology

Source: Web of Science Group

UNIVERSITY RANKINGS

QS WORLD UNIVERSITY RANKINGS 2020

#83 overall

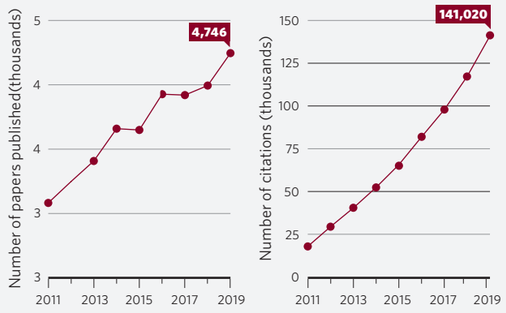
#1 private university in Korea

QS ASIA UNIVERSITY RANKINGS 2020

#1 private university in Asia

Source: QS World University Rankings 2020

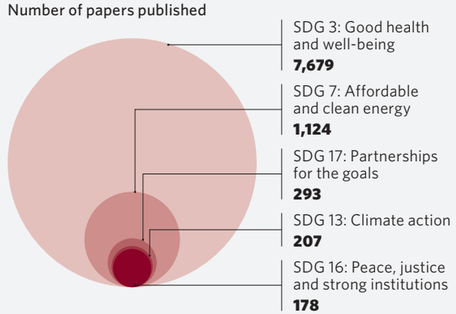
NUMBER OF PAPERS AND CITATIONS



Source: Scopus

CONTRIBUTION TO UN SUSTAINABLE DEVELOPMENT GOALS

Number of papers published



Source: SciVal

Rapid increases in their efficiency compared with conventional single-crystal silicon solar cells over the past several years has led to increased interest and investment in research into perovskite-based solar cell technologies.

Noh's pioneering work has led to the development of halide perovskite solar cells, which have higher energy conversion efficiencies than conventional thin-film-type cells made from semiconductor materials, such as cadmium telluride. The superior performance of Noh's halide perovskite cells comes from their unique combination of structural and optoelectronic properties, which include a high degree of crystalline order, a long carrier lifetime, and a high optical absorption coefficient.

In 2020, Noh and his team achieved a halide perovskite solar cell with a certified efficiency of 25.2%. The results are yet to be published, but it is the most recent world record as measured by the National Renewable Energy Laboratory (NREL). "Thin-film halide perovskite solar cells have unique characteristics that make them ideal for photovoltaics," explains Noh. "So, our next goal is to exploit these characteristics to create solar cells with efficiencies of more than 30%, which is close to the theoretical limit for a single-junction solar cell."

Improving human health

Atrial fibrillation is one of the most common heart rhythm disorders, and can lead to blood clots, stroke, heart failure, and other ailments. With tens of millions suffering from the condition globally, it is a major public health concern.

Young-Hoon Kim, vice president, professor and executive director of the Cardiovascular Center at Korea University Anam Hospital, has spent more than 30 years researching atrial fibrillation and his pioneering work has led to improved diagnoses and treatments.

"People suffering from heart conditions like atrial fibrillation often require very dramatic and timely interventions," says Kim. "Therefore, it is paramount that clinicians make the right choices when prescribing treatments or therapies."

In 1988, Kim performed Korea's first catheter ablation on a patient with atrial fibrillation. Since then, he has carried out more than 10,000 procedures on people suffering from complex tachyarrhythmias, a type of atrial fibrillation characterized by a very rapid irregular heartbeat.

"The successful treatment of atrial fibrillation is dependent on how well we understand the mechanisms of the heart and how it behaves in people with the condition," explains Kim. "Our work has led to a better understanding of the underlying causes of the condition, and on the development of more effective catheter ablation techniques for patients with persistent atrial fibrillation."

Kim is now collaborating with leading experts from around the world to develop a powerful new 3D imaging technique that could lead to better outcomes, particularly for patients suffering from complex atrial fibrillation.

"With 3D mapping, we can provide clinicians with a tool that more precisely maps the intricate functions of the heart and could lead to better treatments and greatly improved patient outcomes," says Kim.

Spectro-imaging breakthroughs

Researchers at Korea University are also developing state-of-the-art spectroscopy and imaging techniques like coherent multidimensional spectroscopy and deep-tissue imaging, which have allowed scientists to capture real-time images of the high-speed chemical reactions that occur at the molecular level, leading to breakthroughs in chemistry, molecular biology, and the material sciences.

"Because of the advantages of coherent multidimensional spectroscopy over conventional spectroscopic techniques, research in the field is expanding rapidly," explains Minhaeng Cho, a professor in the Department of Chemistry, and director of the Institute for Basic Science (IBS) Center for Molecular Spectroscopy and Dynamics (CMSD) at Korea University.

"TO WHAT EXTENT THESE PROPERTIES DIFFER FROM THOSE OF BULK WATER IS STILL A HOTLY DEBATED SUBJECT."

Cho and his team recently used the technology to create 'molecular motion pictures' that capture the ultrafast chemical and biological changes that could take place in living cells, which can often last for only a few quadrillionths (one millionth of one billionth) of a second.

"The motion pictures allow us to better understand the chemical changes and conformational transitions that biomolecules undergo in cells, providing deeper insights into the functioning of living cells," explains Cho.

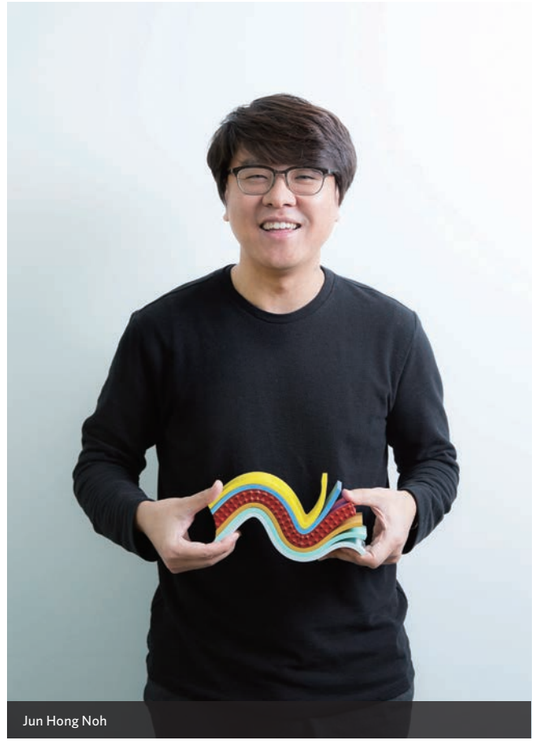
In addition, one of their teams, led by Wonshik Choi, an associate director of CMSD, has developed a deep-tissue imaging technique that has led to the creation of the world's highest depth-of-field optical microscope.

The microspectroscopy combining imaging and time-resolved spectroscopy techniques use ultrafast pulses of laser light to observe the chemical and biochemical reactions in biological systems, which can help in the early diagnoses of diseases, including cancer.

He is now working on developing the next generation of spectro-imaging technologies that bring together high-resolution imaging and ultrasensitive detection techniques used in spectroscopy and microscopy. He aims to address a key question for molecular biologists: how does the behaviour of water and biological molecules contained in human cells differ to the properties of bulk water?

Water plays a critical role in many cellular processes, such as protein folding and enzymatic reactions. Thus understanding the structure and dynamics of intracellular water is very important.

"To what extent these properties differ from those of bulk water is still a hotly debated subject," says Cho. "My goal is to combine both multidimensional spectroscopy with microscopy to develop an imaging technique that can help us better understand the properties and dynamics of water and a single protein in different regions of living cells, such as the nucleus, cytoplasm or mitochondria." ■



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