YONSEI UNIVERSITY
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YONSEI RESEARCH

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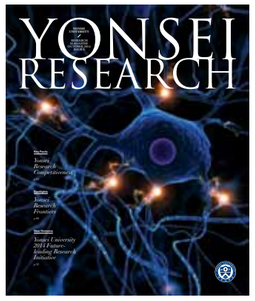

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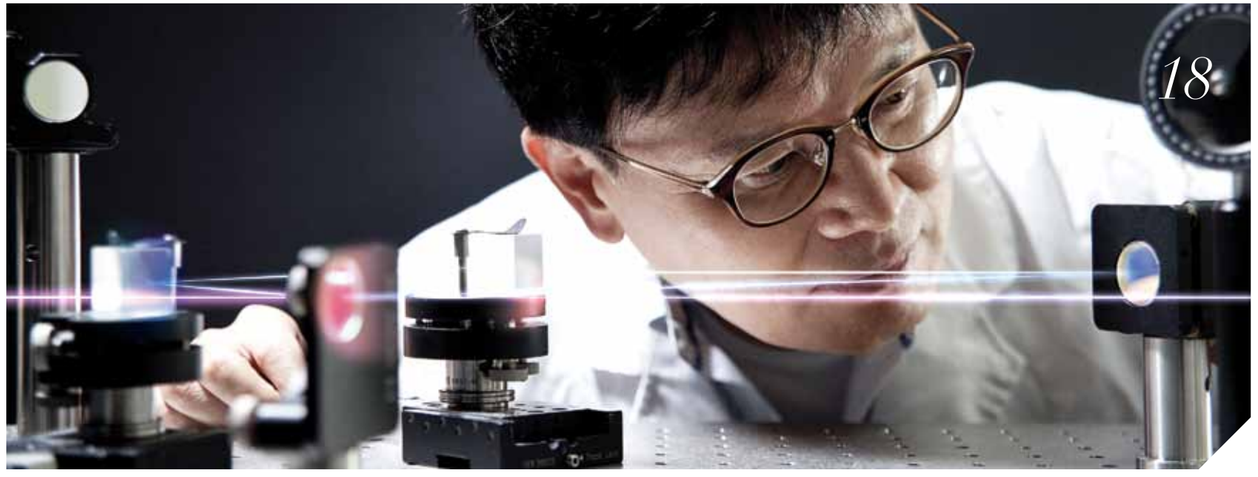
EDITING
Office of Research Affair / University-Industry Foundation
Editor-in-chief: Kim Eunkyoung
Editor: Heo Dahye
Editing Advisor: Yi Sang Doo, Kim Yunmi

DESIGN
PROST ideas
T. +82-2-544-4811 / E. yttyee@gmail.com

CONTACT
T. +82-2-2123-5193 / E. yonsei-research@yonsei.ac.kr



Greetings from the President

This year, Yonsei University celebrates its 129th anniversary since its first founding in 1885. In recent days, external circumstances surrounding universities are becoming increasingly difficult and are rapidly changing. The paradigm is shifting towards interdisciplinary convergence and away from traditional teaching and research on single fields of study. In the midst of such changes and challenges, Yonsei University is now faced with the Third Founding initiative to open the future of a global Yonsei. Yonsei is in the process of taking a historical leap to become Asia's World University by creatively embracing the digital civilization and leading the challenges of the global era.

Yonsei University has continuously kept its unparalleled reputation as the best private university in Korea and Asia. In addition to achieving the top 106 on the renowned QS World University Rankings, The Times Higher Education World Reputation Rankings ranked us in the top 80 in the world for the first time in Yonsei's history. Yonsei also ranked in the top 20 around the world and the best in Asia in private university rankings excluding national and public universities. Such splendid accomplishments were led by our school's outstanding research capabilities.

Yonsei University is making outstanding research accomplishments, represented by research funds amounting to $278 million, approximately 3,600 publications in renowned domestic and international academic journals and 900 patents achieved annually. Such fruitful outcome was made possible through our leading research center, the Institute of Convergence Science, in addition to 165 school research laboratories and 1,600 outstanding faculty affiliated with more than 50 programs at five campuses.

It is an important social responsibility for universities to undertake in-depth investigations into complex issues that need to be resolved for the development of mankind, such as water, food, health, energy, and security. By moving forward, Yonsei University will transcend the inter-university competitions and strive to create world-renowned research accomplishments to contribute to the history and future of humanity. Yonsei, where we make history!

Jeong Kap-Young, Ph.D.
President
Yonsei University

Yonsei University's Rankings

Yonsei in **the World**
2014 QS World University Rankings

106th

114th 2013 ▶ 8up ▶ 106th 2014

Yonsei **in Asia**
2014 QS Asian University Rankings

16th

16th 2013 ▶ 16th 2014

Yonsei **in Asia**
2014 The Time Higher Education World Reputation Rankings
(in Private University)

1st

Yonsei Research Competitiveness

Publication
(as of 2013)

3,626

Cases

External Research Funds
(as of 2013, million USD)

27.6

Patent Application & Registration
(as of 2013)

1,426

Application: 890, Registration: 536

IMAGE: Baekyang-ro Reconstruction Project

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Cancer Stem Cell Activation by Oncogenic K-Ras

Professor Choi Kang-Yell's Research Team

Identify a Role of Oncogenic K-Ras in Cancer Stem Cell Activation

Colorectal cancer (CRC) is one of the most common cancers worldwide, and approximately 50% of patients with CRC develop liver metastases. Although cancer stem cells (CSC) represent a small subpopulation of the tumor cells, they play important roles in the development of primary and metastatic CRC. Adenomatous polyposis coli (APC) loss-of-function and K-Ras gain-of-function mutations are both common abnormalities in CRC that occur during the initiation and intermediate adenoma stages of colorectal tumorigenesis, respectively. K-Ras acts as a molecular switch to regulate multiple effector pathways including the extracellular signal-regulated kinase (ERK) and phosphatidyl inositol 3-kinase (PI3K)-Akt signaling pathways, and mutations fixing K-Ras in its GTP-bound active forms are found in approximately 40% of human CRCs. Although mutation of K-Ras is known to play important roles in the progression and metastasis of tumors, its involvement in CSC-mediated tumorigenesis is poorly understood. Prof. Choi Kang-Yell (Biotechnology) and his research team have discovered a role of oncogenic K-Ras in CSC activation by aberrant Wnt/ß-catenin signaling and investigated how this activation contributes to the tumorigenesis and metastasis.

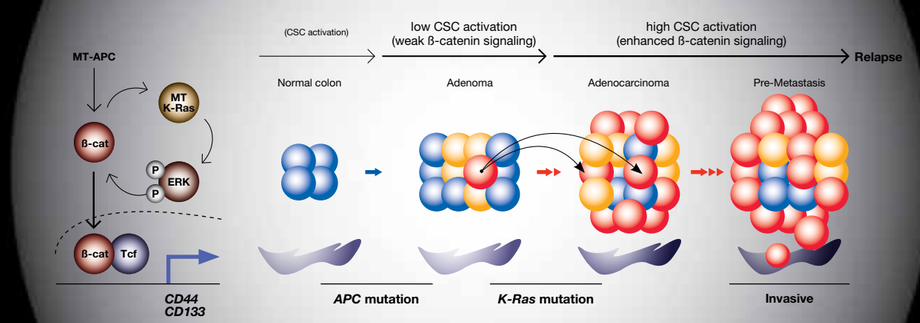

IMAGE: A working model for CSC activation by oncogenic K-Ras in colorectal tumorigenesis. Normal colon. Colon cancer. Cancer Stem Cell

The oncogenic K-Ras mutation induces stemness of CRC cells carrying an APC mutation as shown by comparisons of sphere formation, transforming potential, chemoresistance, differentiation, and expression of stem cell markers between isogenic APC mutated CRC cells harboring either wild-type or mutant K-Ras. The activation of CSC by K-Ras mutations in CRC requires an additional APC mutation, as revealed by the induction of cancer stem cell marker; CD44, CD133, and CD166 in intestinal tumor tissues of APCMin/+/K-RasLA2 double mutant mice, but not in K-RasLA2 mice. Moreover, association between K-Ras mutation and CSC activation in colorectal tumorigenesis was observed in CRC patients tissues. Overall, the progression and metastasis of CRC induced by K-Ras mutation occurs via initial activation of CSC by APC loss and further activation of Wnt/ß-catenin signaling via subsequent activation of Ras-ERK signaling. The study findings have been published on February 4, 2014 in Journal of the National Cancer Institute (IF 15.161), a leading journal in cancer research. Prof. Choi said, "Considering the highly complex interaction between the Wnt/ß-catenin and Ras-ERK pathways, a therapy targeting both pathways is an ideal approach for the treatment of colorectal cancer."

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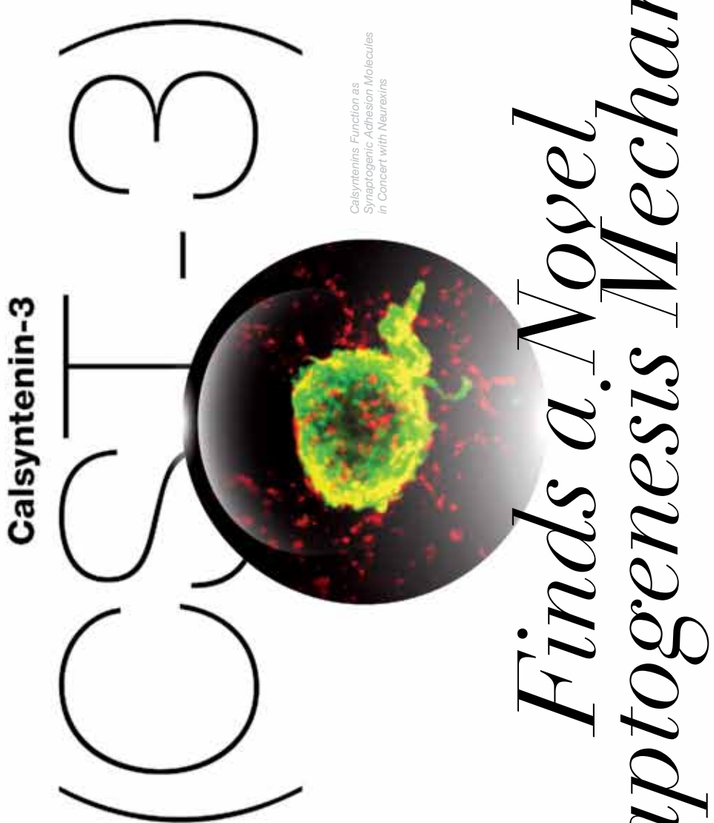
Professor Ko Jaewon's Research Team

Discovers Novel Synaptogenic Protein Involved in Synapse Formation and Function

A research team led by Prof. Ko Jaewon from the Department of Biochemistry of the College of Life Science and Biotechnology has uncovered the crucial role of the protein Calsyntenin-3 (CST-3) in regulating synapse formation and function and neuronal development. Identification of the synapse organizers has been essential for understanding how a brain works, considering huge number of neurons and synapses in it. The research team found that CST-3 is specifically required for inhibitory synapse formation and function, partly in conjunction with neurexins, critical players in presynaptic organization. The results of the research were published March 6 in the online version of Cell Reports—the sister journal of Cell—under the title "Calsyntenins Function as Synaptogenic Adhesion Molecules in Concert with Neurexins." The other members of Prof. Ko's international team were Yonsei Research Prof. Um Ji Won (Biochemistry; first author of the study), Yonsei PhD candidate Ko Ji Seung (Biochemistry), Nobel Laureate Thomas C. Südhof (Molecular and Cellular Physiology, Stanford University), Katsuhiko Tabuchi and Gopal Pramanik (Molecular and Cellular Physiology, Shinsu University), Kim Hyun and Lee Dongmin (Anatomy and Neuroscience, Korea University), and Park Kang-Sik and Song Min-Young (Physiology and Neuroscience, Kyung Hee University). The project received funding support from a variety of sources, including the Ministry of Science, ICT and Future Planning, the National Research Foundation of Korea (NRF), and the Ministry of Public Health and Welfare. According to the authors, the research will have important implications in terms of better understanding and designing therapeutic strategies against several neurological disorders associated with dysfunctions of CSTs.



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Sleep spindles are generated in the absence of T-type calcium channel-mediated low-threshold burst firing of thalamocortical neurons

(PNAS 2013; 110(50):20266-71)

Professor Cheong Eunji's Research Team

Finds Clues for Sleep Rhythm Generation

Sleep is characterized by the altered consciousness, relatively inhibited sensory activity, and inhibition of nearly all voluntary muscles in animals. Although the functions of sleep are still unresolved, a great effort has been made to understand the brain mechanisms that control sleep and wakefulness. An understanding of these mechanisms is of enormous importance to our daily life. Sleeping tablets are among the most widely prescribed medicines, and disturbances in sleep are associated with a wide range of medical and psychiatric conditions.

Sleep is defined in the sleep laboratory, in both humans and animals, by recording the electrical field activity of large groups of cortical neurons and muscle cells, represented as electroencephalogram (EEG) and electromyogram (EMG). According to the electrical activity in EEG and EMG, sleep is composed of REM (rapid eye movement) sleep and Non-REM sleep. Sleep spindle is one of major rhythmic brain waves that appear in EEG during NREM sleep. A surge of interest in sleep spindles sparked in the past years in the context of sleep's implication in learning and memory formation. Sleep spindle consists of characteristic waxing-and-waning EEG pattern, grouped into 7-14 Hz oscillations that last for 1 to 3 seconds and recur once every 5 to 10 seconds in the thalamus and the cortex in humans and experimental animals.

Our study suggested a neural mechanism how the sleep spindles are generated. The significance of our study is in that it addresses the most fundamental issues in sleep spindle generation. This existing theory that low-threshold burst firing mediated by T-type calcium channels in thalamocortical neurons is essential for the sleep spindles has been accepted as a dogma and appear as a fact in many literatures. Here we showed that T-type channels in thalamocortical neurons are not required for sleep spindles. Therefore, the current view on the essential role of T-type channels in all kind of thalamocortical oscillations is not valid. We believe that our study will advance the current knowledge on sleep and vigilance control into another level of understanding.

Professor Lee Insuk's Research Team

Finds a New Way to Study Human Diseases

Like a social network service such as Facebook and Twitter, genes working in human bodies are functionally wired for cooperation. Prof. Lee's research team has previously developed one of the world's largest networks of human genes, dubbed "HumanNet" (www.functionalnet.org/humannet), which connects more than 16,000 human genes with a half million cooperative relationships (see the figure below). To develop this network, his team used Big Data mining approaches, analyzing more than 50 million data points about biological molecules. This network has proven useful in various human disease studies such as discovery of disease genes and classification of cancer patients.

More recently, his team demonstrated that HumanNet can find nonobvious connections between human disease systems and laboratory organism phenotypes. Laboratory organisms are indispensable for human disease research, because they have many disease systems evolutionally conserved. However, finding disease systems from laboratory organism is often prohibitively difficult due to their seemingly unrelated phenotypes. To overcome this hurdle, his team developed a new HumanNet-based software, MORPHIN (model organisms projected on a human integrated gene network; http://www.inetbio.org/morphin), to find hidden disease systems from various laboratory organisms such as yeast, worm, fly, fish, frog, mouse, and rat. For example, using MORPHIN, his team found that worm genes regulating 'fat associated bodies' are associated with human disease 'hyperhomocysteinemia.' This connection between worm phenotype and human disease was not detectable by any previous methods. This finding was also validated by independently reported clinical implication of association between hyperhomosysteinemia and Type 2 diabetes.

This research results were published in Nucleic Acids Research online on May 26, 2014.

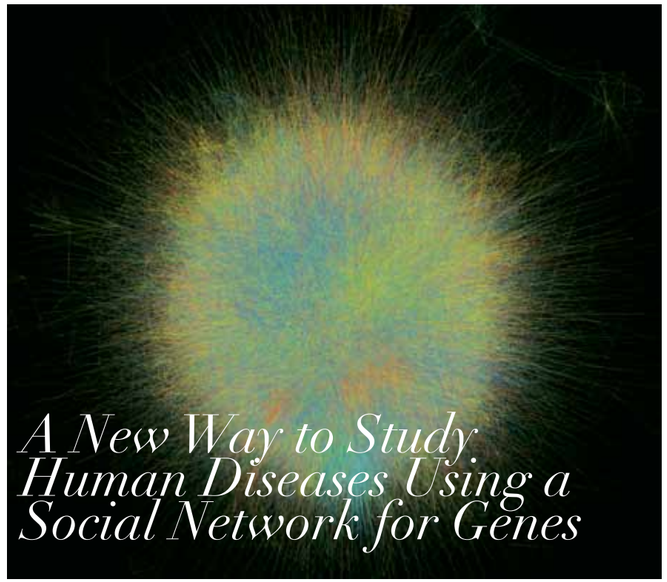
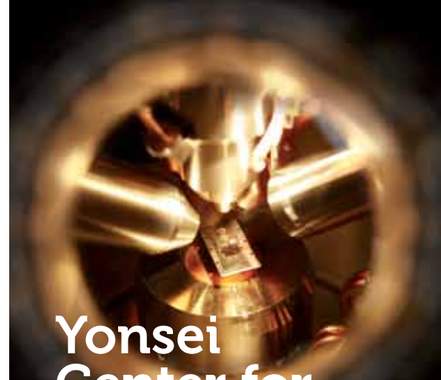


IMAGE: HumanNet



Yonsei Center for Research Facilities

In the era of globalization, the requirements of the facilities for preoccupy the advantageous position in academic research areas are more and more increased. In other words, the facilities and analysis equipment should be provided to achieve a high level of researches. In order to jump up to be a world-class educational · research institution beyond the nation's premier facilities, Yonsei Center for Research Facilities (YCRF) has supported the activation of research and the improvement of facilities in the innovation process of university.

YCRF which retain 50 kinds of the facilities and analysis equipment worth more than 10 billion won is an institution for bio, inorganic, organic, and surface analysis. Experts in the center can provide advanced material analysis for enhancement of research support and cooperation between industry and school.

YCRF expects that the designation as Korea Laboratory Accreditation Scheme (KOLAS) by Korea Agency for Technology and Standards will significantly expand analytical capabilities to become a leading center of the world. In this respect, the facilities in YCRF are retained consistently for the purpose of construction of the research infra that offers the most advanced scientific technology research. Moreover, YCRF also have been hold workshops for specific/whole equipments and run the tour through the center.

Based on these total active supports, YCRF possesses capability for the high level of analytical techniques and education especially on the most advanced scientific technology research.

http://ycrf.yonsei.ac.kr

Molecular Mechanism of Membrane Transport

Professor Lee Min-Goo's Research Team

Elucidates New Trafficking Pathway of Membrane Proteins

Prof. Lee has been studying the transport of small molecules across the cell membrane and its implications in human health and disease throughout his 24-year career as a basic scientist. This resulted in more than 100-publications, mostly in major peer-reviewed journals such as *Cell, Nature, J Clin Invest, Gastroenterology, and PNAS USA*. He has focused his research on the following three topics: i) molecular mechanism of transmembrane transport of ions and small molecules, ii) genetic variations in the membrane transporter genes and their implications in human disease, and iii) intracellular trafficking and processing of membrane transporting proteins. Recently, his research team discovered that GRASP restores mutant CFTR function and rescues survival of mouse models of cystic fibrosis without apparent toxicity (*Cell*, 2011). Mutations in membrane transporter genes cause human diseases, in many cases due to defects in protein folding and trafficking from the ER to the cell surface. The most common disease-causing (cystic fibrosis) mutation of CFTR is the deletion of phenylalanine at position 508 (ΔF508), which leads to defects in cell surface expression of CFTR. Prof. Lee's team found that ΔF508-CFTR surface expression can be rescued *in vitro* and *in vivo* by directing it to an alternative unconventional GRASP-dependent secretion pathway. This finding provides insight into how an unconventional protein secretion is activated and offers a promising new therapeutic strategy for the treatment of diseases stemming from misfolded proteins. Meanwhile, his research team also made several other important discoveries on the molecular mechanisms of membrane transport, which include the involvement of Shank2 in autism (*Nature*, 2012) and the regulation of epithelial bicarbonate transport (*Physiol Rev*, 2012; *PNAS USA*, 2013).

Professor Bok Jinwoong's Research Team

Publishes Research Results in PNAS

Abnormal Primary Cilia Cause ECO Syndrome

Endocrine-cerebro-osteodysplasia (ECO) syndrome is a human genetic disorder associated with anomalies in endocrine, cerebral, and skeletal systems. Although a genetic mutation in the intestinal cell kinase (ICK) gene has been implicated in ECO syndrome, it was not clear how the ICK mutation causes such a wide range of congenital defects in humans. To elucidate the role of ICK in ECO syndrome, Prof. Bok's research team generated and characterized a mouse model in which the ICK gene is genetically deleted. ICK mutant mice displayed specific defects that closely resemble clinical features observed in human ECO syndrome. Interestingly, these abnormalities in ICK mutant mice and ECO syndrome patients have features in common with other human genetic disorders collectively called ciliopathies, which are caused by inappropriate formation or maintenance of primary cilium. Primary cilium is an antenna-like structure protruding from the surface of nearly all the cells in the body and acts as a control tower for various signaling pathways important for animal development and homeostasis. Indeed, Prof. Bok's research team found that the architecture of primary cilia (plural of cilium) was disrupted in ICK mutant mice. In addition, the ciliary proteins important for mediating Hedgehog signaling were mislocalized and Hedgehog signaling was compromised. Prof. Bok noted that ICK plays a critical role in controlling ciliary architecture and function, which explains how a mutation of single gene, ICK, can cause such a variety of defects throughout the body in ECO syndrome.

Network Analysis and Neural Theories for Unraveling the Complexity of the Brain

Professor Park Hae-Jeong

Authored a Review and Perspective Article for SCIENCE (IF 31.027)

Appearing November 1 2013 in a special issue on 'The Heavily Connected Brain', their article, "Structural and Functional Brain Networks: From Connections to Cognition," suggests that the brain's network architecture may provide the key to resolving a puzzling paradox presented by the human brain; namely, that despite the brain's fixed anatomy, characterized by its connectivity, it possesses a vast functional repertoire, enabling action, perception, and cognition. Professors Park and Friston emphasized that the emergence of dynamic functional connectivity, from static structural connections, calls for computational and theoretical approaches to neuronal information processing that may resolve the dialectic between structure and function.

One of new trends in the brain science is to establish Human Connectome, a map of neuronal interconnections among the whole brain regions. This trend is well represented by the 'Human Connectome Project' initiated in 2009 by NIH of USA. Prof. Park is one of pioneer researchers in this area of macroscale brain science. He first introduced whole brain fiber tractography and automated parcellation of axonal bundles using diffusion tensor imaging in 2003, which later becomes a standard method for human connectome researches. He has developed various neuroimaging methods and tools for brain network analysis, which are open to research communities and some of his works appeared coverpages of top neuroimaging journals. However, he thinks that systems approach based on human connectivity maps is just a first step towards unraveling the nature of the brain. Now, he focuses on theoretical approaches - how the brain works- to explain diverse information processing over the fixed networks. Prof. Park leads MoNET (molecular neuroimaging technology lab, http://neuroimage.yonsei.ac.kr) team that explores principles of brain organisation and brain working mechanism from the perspective of systems and theoretical neuroscience using multimodal neuroimaging techniques such as diffusion tensor MRI, functional MRI, electro/magnetoencephalogram (EEG/MEG) and positron emision tomography (PET).

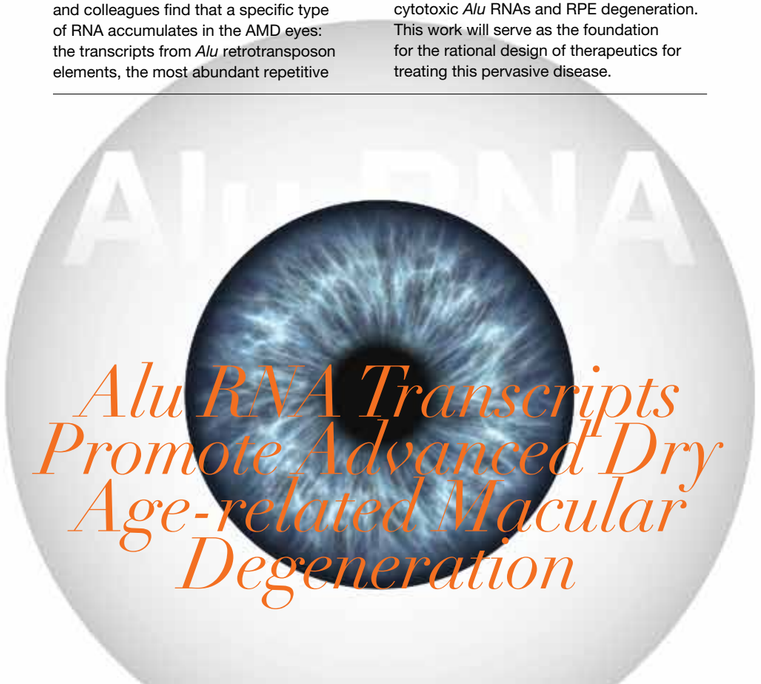
Professor Cho Won-gil's Research Team

Finds Novel Mechanism of Eye Disease

Alu RNA Transcripts Promote Advanced Dry Age-related Macular Degeneration

The RPE is a monolayer of cells that provides nutrients to and shuttles waste away from the neighboring retina. In ~9% of individuals between the ages of 66 and 74, the central, or "macular," RPE begins to break down, which eventually damages retinal photoreceptors and causes an incurable form of age-related macular degeneration known as "dry" AMD or geography atrophy. Prof. Cho and colleagues uncover an unexpected cause of this common disease: reduced levels of *DICER1*, the ribonuclease that is required for silencing genes by RNA interference.

The study begins with the interesting observation that *DICER1* mRNA is ~60% lower in the RPE of eyes with AMD compared to healthy eyes or those with other eye diseases. Indeed, when Kaneko et al. decrease the expression of Dicer1 in only the RPE of mice, the RPE cells degenerate. However, when they disrupt other components of the RNA interference machinery, such as Drosha and Ago, they see no changes, suggesting that Dicer's effect on RPE cells is not simply due to a general disruption of RNA processing. Instead, Prof. Cho and colleagues find that a specific type of RNA accumulates in the AMD eyes: the transcripts from *Alu* retrotransposon elements, the most abundant repetitive sequences in the human genome. Injecting long *Alu* strands into mice retina induces RPE degeneration, but when the RNA is first digested with Dicer1, the RPE cells stay healthy. Together, these results indicate that decreased DICER1 levels trigger the accumulation of cytotoxic *Alu* RNA, which leads to RPE cell death and "dry" AMD. Interestingly, reduced DICER1 activity is connected to numerous diseases outside of the eye, hinting that this *Alu*-mediated mechanism of cytotoxicity may be "more than meets the eye." The team further identified downstream molecules which mediate cytotoxicity of Alu RNAs such as NLRP3, PYCARD, IL-18 & other molecules that have critical function in inflammasome activation. In GA, the abundance of Dicer1 is reduced which leads to accumulation of cytotoxic *Alu* RNAs and RPE degeneration. This work will serve as the foundation for the rational design of therapeutics for treating this pervasive disease.



YONSEI UNIVERSITY

All About Yonsei Research!

Yonsei Research Map

The Office of Research Affairs at Yonsei University launched the Yonsei Research Map (YRM) in March 2013. Yonsei Research Map is an information tool designed for users to search research projects, articles and patents of Yonsei researchers anytime and anywhere. By providing search engine results according to specific subject fields and research themes, YRM will strengthen research networks within Yonsei and promote convergence of interdisciplinary research. In addition, researchers outside of Yonsei can search for relevant experts for their projects.

There are currently **2,466** Yonsei researchers registered in the Yonsei Research Map. The tool can be accessed by the Yonsei University main website (http://**www.yonsei.ac.kr**) or the Yonsei Researcher Information (YRI) website (http://**yri.yonsei.ac.kr**).

Identification of Obesity-associated Protein, Dexras1

Professor Kim Jae-woo's Research Team

Finds a Critical Mediator of Glucocorticoid in Adipogenesis

This study, collaborated with Dr. Solomon H. Snyder in Johns Hopkins University, has been recently published in the *Proceedings of the National Academy of Sciences in the United States of America* (PNAS). They identified Dexras1 as a new gene involved in adipocyte differentiation, and this discovery has the potential to lead Dexras1 as a target molecule in the treatment of obesity as well as Cushing's syndrome. An excessive level of adipogenesis potentially causes obesity, a strong risk factor for metabolic diseases, and glucocorticoid has a role in fat deposition and adipocyte differentiation. However, its mechanism has been barely known.

According to the results using 3T3-L1 pre-adipocyte model, in which glucocorticoid is necessary for the differentiation, Prof. Kim and Dr. Kim Hyo Jung (Medicine) in his laboratory found that Dexras1 is expressed in response to glucocorticoid and acts as a critical mediator of this hormone. Without Dexras1, adipogenesis is significantly impaired. Using Dexras1 knockout mice, they also found that the weight gain in Dexras1 knockout mice was significantly less than that in wild type mice, with no significant change in the amount of food intake and exercise. Moreover, visceral fat mass and the size of adipocytes were markedly reduced, and the insulin resistance and blood sugar level were also improved in the knockout mice.

Prof. Kim's noted that this result provides an answer for a long standing question about the mechanism of metabolic effect of glucocorticoid. It will improve the situation we are facing now in terms of curing metabolic syndrome including obesity. Moreover, it has a value since it proposes a novel target molecule which can be used in the treatment of diseases related to metabolic imbalance due to the over-production of steroid like Cushing's syndrome.

Professor Lee Yun-Han's Research Team

Publishes Research Results in *Cancer Research*

Aistone deacetylase 2 (HDAC2) is a chromatin modifier involved in epigenetic regulation of cell cycle, apoptosis, and differentiation that is upregulated commonly in human hepatocellular carcinoma (HCC). Prof. Lee's research team found that specific targeting of HDAC2 isoform by RNAi is sufficient to inhibit HCC progression. siRNA-mediated silencing of HDAC inhibited HCC cell growth by blocking cell-cycle progression and inducing apoptosis. These effects were associated with deregulation of HDAC-regulated genes that control cell cycle, apoptosis, and lipid metabolism, specifically, by upregulation of p27 and acetylated p53 and by downregulation of CDK6 and BCL2. They also proved that HDAC2 silencing in HCC cells strongly inhibited PPARγ signaling and other regulators of glycolysis (ChREBPα and GLUT4) and lipogenesis (SREBP1C and FAS), eliciting a marked decrease in fat accumulation. Notably, systemic delivery of HDAC2 siRNA encapsulated in lipid nanoparticles was sufficient to blunt the growth of human HCC in a murine xenograft model. Prof. Lee said that, "Our findings offer preclinical proof-of-concept for HDAC2 blockade as a systemic therapy for HCC". The research results were published in *Cancer Research* on September 1, 2014.

Found a Way of Specific Molecular Targeting of HDAC2 to Treat HCC

Professor Hwang Chung-Ju's Research Team

Honored by the College of Diplomates of the American Board of Orthodontics for Best Case Report of the Year

The College of Diplomates of the American Board of Orthodontics (CDABO) selected the Case Report by Prof. Hwang Chung-Ju and Dr Choi Sung-Hwan, Dept of Orthodontics College of Dentistry Yonsei University, "Orthognathic treatment with autotransplantation of a third molar", as the 2013 CDABO Case Report of the Year Award.

This Award originated in the year 2000 by the College of Diplomates of the American Board of Orthodontics for the purpose of placing greater emphasis on improving the finishing of orthodontic treatment. The College also wanted to encourage more clinicians to publish their case reports in the *American Journal of Orthodontics & Dentofacial Orthopedics* (AJO-DO).

This article was published in the November 2013 issue of AJO-DO. These authors demonstrated successful orthognathic treatment that included autotransplantation of a maxillary left third molar in a patient with a missing mandibular right first molar, mandibular protrusion, and facial asymmetry. A 20-year-old woman had mandibular protrusion and facial asymmetry. Five years previously, her mandibular right first molar had been extracted because of dental caries. After preoperative orthodontic treatment with extraction of the maxillary first premolars and using temporary skeletal anchorage devices, we performed a LeFort I procedure and a bilateral intraoral vertical ramus osteotomy to correct the patient's mandibular protrusion and facial asymmetry. During the postoperative orthodontic treatment, the maxillary left third molar was autotransplanted into the mandibular right first molar site. As a result of these therapeutic treatments with autotransplantion of a third molar, the patient's facial appearance was improved, and an implant was unnecessary. The autotransplanted tooth effectively supported the adjacent teeth and maintained her chewing ability.

Prof. Hwang Chung-Ju and Dr Choi Sung-Hwan were presented with a framed certificate of the Award during the Annual CDABO Luncheon on Saturday, April 26th, 2014, at the Annual Session of the American Association of Orthodontists in New Orleans, La.

Engineering Aromaticity: From Hückel to Möbius

Professor Kim Dongho

Celebrates his 25th Article in *Angewandte Chemie* through Angewandte Author Profiles

Prof. Kim Dongho (Chemistry) was introduced in the Author Profiles in May 2014 Issue of *Angewandte Chemie International Edition* (Impact Factor: 11.336), a leading chemistry journal. The Angewandte Author Profiles celebrate an author's 10th, 25th, 50th or 100th article in the journal in the last ten years. Prof. Kim has published the most papers in *Angewandte Chemie* as a Korean researcher (25 papers including 4 cover articles).

Prof. Kim's research focuses on various dimensions of (anti)aromaticity in π-conjugated molecular systems. Aromaticity is a key concept in chemistry, which governs chemical properties and reactivity of a wide variety of molecules and reactive intermediates. In addition to Hückel aromaticity, another major class of aromaticity, represented by the famous single-sided twisted topology, is Möbius aromaticity, which can be regarded as the converse of Hückel aromaticity, [4n] π systems being aromatic and [4n+2] π antiaromatic. Prof. Kim's group has been making strenuous efforts to control the topology and degree of (anti)aromaticity in various expanded porphyrins by modulation of external environment such as temperature, solvent polarity as well as by metallation and ring fusion. His research has also been published in many top chemistry journals other than *Angewandte Chemie*, including *Nature Chemistry*, *Chemical Society Reviews*, and *Journal of the American Chemical Society*.

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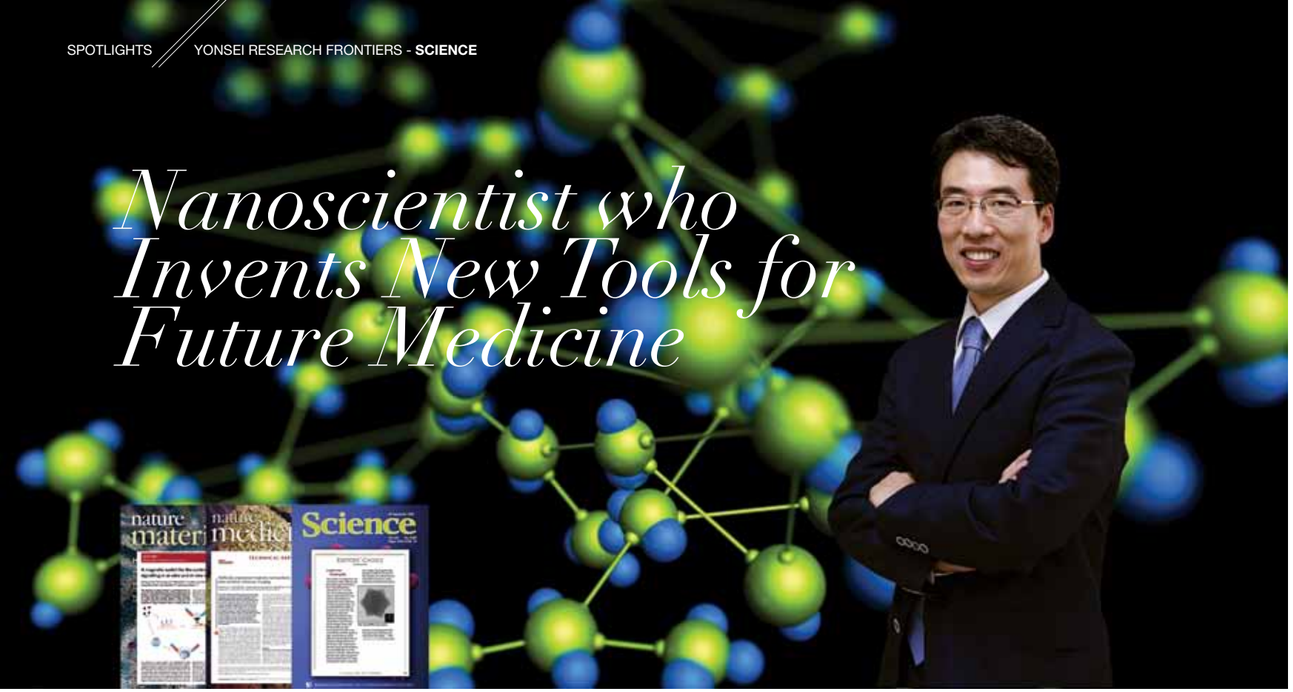


Nanoscientist who Invents New Tools for Future Medicine

Professor Cheon Jinwoo

Named One of "The World's Most Influential Scientific Minds" of 2014

Thomson Reuters identified the most influential scientific minds of 2014 which was conducted by Web of Science and InCites. Prof. Cheon who has pioneered the field of nanoscience and nanomedicine with a number of breakthroughs in the "design of nanomaterials" and "new concepts of nano-imaging and therapeutics" received recognition for his highly cited research papers produced between 2002 and 2012. The publications of his work are found in journals such as *Nature Materials, Nature Medicine, Nature Nanotechnology, Proceedings of the National Academy of Sciences, Accounts of Chemical Research, Journal of the American Chemical Society, and Angewandte Chemie* and have received over 10,200 citations according to ISI Web of Science.

One of Prof. Cheon's achievements is the establishment of mechanisms for shape guided synthesis of nanomaterials that serve as the guiding principles for the preparation of complex inorganic nanomaterials [*JACS* 2001, *JACS* 2002, *Adv*. *Mater*. 2003, *Angew*. *Chem*. 2006]. Based on these design concepts, Prof. Cheon has utilized nanomaterials as new and important tools for studying next-generation biomedical sciences. He demonstrated, for the first time, the nanoscale size-dependent magnetic resonance imaging (MRI) contrast effect which opened a new gateway to "nanomedicine" [*JACS* 2005]. Shortly after this discovery, Professor Cheon unveiled the world's most advanced nano-MRI technology, MEIO (magnetism-engineered iron oxide) [*Nature Medicine* 2007], in which the as-developed nanoparticle agent displayed 10 times stronger MRI signals compared to those of conventional contrast agents. Additionally, he has developed multi-mode probes to enhance the imaging accuracy by designing opto-magnetic probe, PET-MRI probes, dual-mode T_1-T_2 MRI probes. Successful discrimination of true signal of biological targets could be attained by these developments, opening a new avenue for accurate diagnosis of disease.

In recent studies, he has focused on developing "NanoSwitch" that controls cell functions. He demonstrated that nanoparticles have the potential of becoming useful tools to control cell signaling pathways in a spatio-temporally regulated fashion. He developed "Magnetic NanoSwitch" to selectively regulate cellular fate such as programmed cell death (*i.e.*, apoptosis) [*Nature Materials* 2012] and cell growth [*Angew*. *Chem*. 2010]. Another successful demonstration of nanomaterials for medicine is the invention of world best heat-emitting nanoparticle which can effectively lead to the cancer cell death by hyperthermia [*Nature Nanotech*. 2011]. These achievements have envisioned a new era of imaging and therapeutics for modern medicine catalyzed by nanoscience.

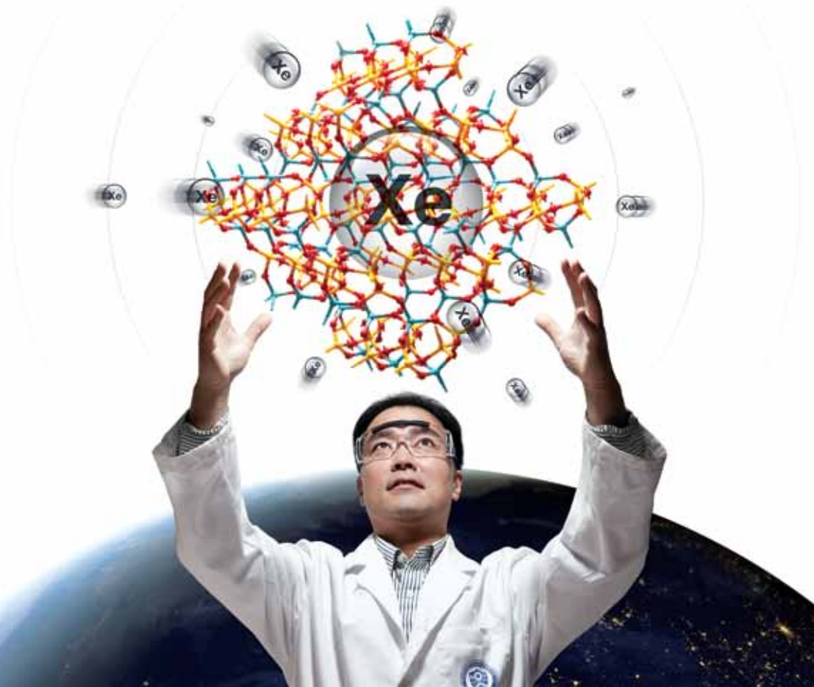
Professor Lee Yongjae's Research Team

Shows Missing Xenon might be Trapped inside the Earth

The research team of Prof. Lee Yongjae (Earth System Sciences) recently discovered that xenon can be trapped inside a mineral's structure under Earth's crustal pressure and temperature conditions. "Irreversible xenon insertion into a small-pore zeolite at moderate pressures and temperatures" was published on July 20, 2014, in the online version of Nature Chemistry.

Xenon is an extremely rare and expensive noble gas. It is because the atmospheric xenon content of the Earth is less than 0.1 ppm. It is only the Earth and Mars in the solar system that has such depleted xenon content in its atmosphere. This has been called the "Missing Xenon" problem, and scientists have been trying to find where those missing xenon might be inside the Earth. Prevailing hypothesis has been that as xenon is heavy it could be trapped in the Earth's core or in the mantle during the planet's formation. The research team of Prof. Lee has suggested a new possibility that a large quantity of xenon can be trapped inside a zeolite mineral under moderate pressure and temperature conditions such as those found in the Earth's crust. This new solution can now be applied to Mars, which is about half the size of the Earth and does not exert enough pressure and temperature conditions to trap xenon in its mantle and core.

"More interesting is the chemical change that xenon exerts on the host zeolite mineral upon trapping," said Prof. Lee. "Xenon pushes away half of its surrounding cations and change charges of the remaining half, turning the zeolite to have an unusual oxidation state for further chemical reactions." The research team has used a miniature pressure device called diamond-anvil cell and synchrotron light at Pohang (PAL), Chicago (APS), and Stanford (SSRL). The first author of this paper, Seoung Donghoon, is a Ph.D student of Prof. Lee and is scheduled to work at Stanford, which is one of the partner institutions of the Global Research Laboratory program led by Prof. Lee. The mission of Prof. Lee's research team is to use pressure to understand the Earth and to uncover hidden properties in materials. "Pressure is a clean, powerful, yet underexplored thermodynamic variable," added Prof. Lee. "When pressure is applied, things have to change as we work harder under pressure."



Professor An Soon-Il and his Colleagues

Find How El Nino will be in a Warming Climate

El Nino is an abnormal tropical Pacific warming phenomena happening with a quasi-regular cycle of 2-7 years. It has climatic and socioeconomic impacts all over the globe through local and remote teleconnections, and the damage is greatly severe. In this regard, 'how El Nino will be in a future due to a global warming' is a hot issue in climate science society. The 5th assessment of Intergovernmental Panel on Climate Change (IPCC AR5) reported that changes in the intensity and spatial pattern of El Nino in a warming climate couldn't be significantly identified. In general, change in El Nino intensity due to global warming may be insignificant. However, when it comes to the extreme El Nino (or super El Nino), because of the weakening of climatological equatorial zonal surface current in a warmer climate, the frequency of extreme El Nino event due to global warming is expected to increase as proposed by Prof. An and his colleague in 'Nature'. Furthermore, in another paper in 'Nature Climate Change', he and his colleague also showed that change in El Nino intensity due to global warming is non-monotonic. In other words, the ENSO intensity will increase until the early 21st century and afterward decrease. Different from the conventional approach on exploring future El Nino in other studies, these two studies took unique approaches that have not been introduced, which sheds light on our understanding on the future change in El Nino properties.

Great & Valuable Challenge to

Smart Grid via Yonsei -

Power & Control System Laboratory!

Professor Park Jung-Wook

Wins the Young Scientist Presidential Award and 2014 National TOP 100 Excellent Progress in Research

Throughout the research of smart grid with renewable energies, Prof. Park Jung-Wook has attracted a lot of attention in power system and power electronics societies in the world. Prof. Park won the 2012 Hae-Dong Young Scientist Award from the Institute of Electronics and Information Engineers (IEIE) in 2012. Also, He has led the National Leading Research Laboratory (NLRL) designated by Ministry of Science, ICT, and Future Planning, Korea government from 2011. In particular, he had the greatest honor to win the *Young Scientist Presidential Award* in electrical and electronic engineering *from the Korean Academy of Science and Technology, Korea*, with the best research achievement of NLRL project to the subject of integrated optimal operation for smart grid, in 2013.

Moreover, this project was selected as the *national TOP 100 excellent progress* among all national researches and developments funded by government in 2014. By carrying out this big project, it is expected to improve the reliability of smart grid with energy storage devices and renewable energies such as wind and photovoltaic, etc. Also, it can enhance the energy utilization and optimize the system with demand response reflecting the accurate load characteristics in the effective and efficient manner.

Prof. Park said that “It is completely different matter to operate the system in practice even though you have simulated the same system with the good analysis in several times. Although it requires the painful effort and difficulties *to verify the valuable outputs in practice*, it is worth to challenge for the real creation of new future.”

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Professor LEIGH Seung-Bok's Research Team

Integrated Project Delivery (IPD) which is a Process to Maximize the Energy Efficiency and Optimization of Green Buildings

Integrated project delivery (hereafter referred to as IPD) is a process that allows architects and energy consultant as well as electrical, mechanical engineer and IDP facilitators to participate in the design process from the initial design phase, which is not offered by conventional design approaches. Utilizing IPD, it is possible to save energy and reduce costs since we can minimize repeated design changes. It also helps to understand the entire construction process easily like major tasks, sustainable strategies, technologies and evaluations on each stage. Thus, IPD can serve as a standard guide for the spread of green buildings by presenting high-performance green buildings optimized through the projects. IPD planner is being developed for the production for future users to help their practice. An open source-based web platform, which helps search the elements required for the process, is also under construction. Through these transitions, it is expected to provide an opportunity to understand and have access to the overall progress of green buildings to professionals as well as publics.

The pilot model (Test-bed: POSCO Green Building) was completed in Songdo, Inchoen. The test-bed consists of offices, modular housing and residences, and more than 100 kinds of green element technologies were applied. Geothermal and solar energy were used, moreover reuse-type structural bonding technology and high-insulation prefabricated wall system were utilized in the structural system. In addition, seven kinds of new technologies such as thermal labyrinth, chilled beam, light ducts, external integrated vacuum insulation, etc. were introduced in Korea for the first time. Aside from these, the BEMS (Building Energy Management System) which can optimize the use of energy in the operational phase of the green building was applied to the test-bed utilizing the integrated process.

Predictable energy usage and reduction are directly related to the evaluation of the economic efficiency of the building. Such data can be utilized in assessing activities such as finance, technology application and business throughout the building life cycle, which can lead to a reduction in energy consumption as well as building energy and maintenance costs. In this regard, the development of a prototype of green building model which will be suitable for market demand is necessary. Ensuring business feasibility contributes to building a virtuous circulation loop to allow sustainable development by promoting the activation of the green building market and forming industrial composition to achieve win-win development for stakeholders. Thus, development of an integrated design, construction and operating system is needed, to increase the capacity to capture the overseas construction market subsequently.

IMAGE: POSCO Green Building

Development of Integrated Project Delivery Process Synthesizing Green Technologies to Promote Green Buildings in Domestic Construction Markets

IMAGE: 2013 Global Green Building Forum

Heterogeneously Integrated Sensors for Smart Living Environments

Professor Oh Jungwoo's Research Team

Develops 3D Nano-Semiconductor Chemical Etching Technology

Prof. Oh Jungwoo and researcher Song Yunwon, both from Yonsei's School of Integrated Technology, have developed technology using a metal catalyst for the chemical etching of semiconductors. The results of the research were published in August 2014 as the cover paper entitled "In-plane and out-of-plane mass transport during metal-assisted chemical etching of GaAs" in the Journal of Materials Chemistry A, a prestigious publication of the Royal Society of Chemistry in Britain.

Semiconductor micro- and nano-structures with high aspect ratios are found to be versatile for a wide range of applications, such as sensors, micro-electromechanical systems, electronic, and opto-electronic devices. As the geometries of devices are scaled down to enhance performance, devices require three-dimensional architecture to address critical challenges associated with feature size and cost-per-function issues. Since metal-assisted chemical etching is a simple wet-based anisotropic technique, it has attracted much attention for applications in various fields such as energy conversion and information-processing semiconductor devices.

According to the authors, "To our knowledge, this is the first report that experimentally verifies vertical and lateral mass transport during metal-assisted chemical etching of semiconductors. Metal-assisted chemical etching of GaAs with a controlled metal catalyst thickness suggests that this technique is attractive and useful for a wide range of practical applications."

This research was funded by the National Research Foundation (Ministry of Education, Science and Technology) of Korea and the IT Consilience Creative Program (Ministry of Science, ICT and Future Planning).

IMAGE: Showcasing the work on mass transport of metal assisted chemical etching of GaAs

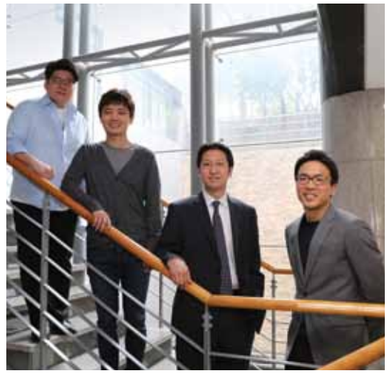
Professors Park Cheolmin and Lee Hyungsuk's International Research Team

Develops Foldable and Bendable Memory Devices

Development of Non-volatile Field Effect Transistor Memory with Extreme Mechanical Flexibility

Professors Park Cheolmin (Materials Science and Engineering) and Lee Hyungsuk (Mechanical Engineering) and Prof. Jean-Charles Riberre of Kyushu University in Japan has successfully developed high performance, non-volatile organic memory devices that can operate under various mechanical deformations such as bending and folding. On April 8, 2014, the article "Non-volatile organic memory with sub-millimetre bending radius" was published in Nature Communications.

To realize the electronic devices that can operate at extreme mechanical deformations, various organic materials were developed as semiconductors and insulators. In particular, organic memories with severe bending have rarely been demonstrated and bending radii lower than 1 mm remain exceptional, preventing rational and low-cost strategies from developing. Furthermore, no memory device has been properly operated with extreme mechanical deformation, i.e. folding which results in permanent, plastic deformation of a device.



From left: Researcher Richard Hahnkee Kim, Researcher Kim Hae jin, Professor Lee Hyungsuk and Professor Park Cheolmin

Prof. Park's team reported on the realization of high-performance non-volatile organic memory with ultimate mechanical flexibility. The solution-processed ferroelectric field effect transistor memory with ferroelectric poly (vinylidene fluoride-trifluoroethylene) (PVDF-TrFE) and semiconducting dicyanomethylene-substituted quinoidal quaterthiophene derivative [QQT(CN)4] exhibited p-type and n-type current hysteresis, and in both switching modes, the memory device showed outstanding mechanical flexibility. They were highly reliable with excellent data retention and endurance of more than 6000 s and 100 cycles, respectively even after both multiple bending cycles at extreme bending radii as low as 500 μm and sharp folding involving inelastic deformation of the device. Through the stress analysis of composite films during bending in combination with nano-indentation and nano-scratch experiments, Prof. Park's team then suggest that both the plasticity of QQT(CN)4 and its firm interface with PVDF-TrFE are responsible for resisting inelastic mechanical deformation such as folding. This work represents a major step in the development of ultra-flexible organic memories.

Prefessor Moon Jooho's Research Team

Develops an All-Solution-Processed Transparent Composite Electrode Based on Silver Nanowire and Metal Oxide for Solar Cells

Prof. Moon Jooho's research team (Dept. of Materials Science and Engineering) developed an all-solution-processed transparent composite electrode showing high transparency and high conductivity. Due to its cost-efficient and scalable fabrication process, the solution-processed transparent electrode is expected to be applied for next-generation transparent electrode by substituting the conventional indium tin oxide (ITO) film deposited under high vacuum condition.

On January 7, 2014, the team announced the development of fully solution-processed Al-doped ZnO/silver nanowire (AgNW)/Al-doped ZnO/ZnO multi-stacked composite electrodes as a transparent, conductive window layer for thin-film solar cells. Among the alternative materials to ITO, AgNW networks are an attractive candidate due to their outstanding optical, electrical properties and easy deposit methods via scalable coating or printing. However, their poor mechanical and thermal properties cause poor adhesion to substrate and make them difficult to be used in the real device applications. Prof. Moon's team solved these problems by composing sandwich-like hybrid structure of AgNWs and conductive metal oxide. Conductive metal-oxide layers protect the AgNWs from local melting-induced disconnection, thus enhancing the thermal stability of the AgNWs. Metal-oxide overcoating layers also improve the adhesiveness of the AgNWs to the substrate. This composite electrode is successfully applied in $Cu(In_{1-x},Ga_x)S_2$ (CIGS) thin-film solar cells showing high power conversion efficiency comparable with commercial ITO used device.

Prof. Moon explains, "this fully solution-processed indium-free composite film has potential for applications in various optoelectronic and photovoltaic devices as a cost-effective and sustainable alternative electrode."

Professor Kwon Soo-Young

Invents Healing Mirror, Inducing Abdominal Respiration

Inspire Your Breath, Heal Your Hearts

Psychiatrists and psychologists say taking a long, deep breath helps people relax. Although many people are aware of the advantages of abdominal respiration, they find it difficult to do. Children and adolescents find abdominal respiration especially difficult; they become short of breath and lose control of rhythmic breathing. Thus, the recent development of a visual tool coined the 'Healing Mirror: In-Spire', which assists in naturally inducing people to practice abdominal respiration has been well-received in the community of physiological psychology. Surprisingly enough, Kwon Soo-Young, the inventor of the Healing Mirror, is a theologian and professor to teach counseling and coaching at the United Graduate School of Theology, Yonsei University.

Often, the older generation is concerned about young children and adolescent using the computer or internet because it is heavily used among them. And yet, Prof. Kwon focuses upon the fact that young generation can be easily involved in digital devices and naturally they are able to concentrate on the changing visual images. He finally developed the new patent, *display device for inducing psychological stability* to promote deep breathing by using the emerging visual images.

In order to induce deep breathing, the Healing Mirror displays famous paintings (such as paintings of Leonardo Da Vinci and Marc Chagll) on the screen. When a person exhales through a heart-shaped tube connected to the mirror, paintings change. As he or she breathes, paintings change from either black-and-white paintings to color paintings; other times they change slowly from blurry images to clearer images. This motivating process effectively induces deep breathing. However, children with ADHD are less likely to be motivated to practice abdominal respiration under such predictable conversion of images. Thus, another version of the Healing Mirror provides unpredictable scenes. Instead of freeze-frame of paintings, motion pictures are played unexpectedly to promote deep breathing. According to Prof. Kwon, the Healing Mirror was originally intended to enhance psychological stability of children and adolescents. Nonetheless, his experiment with 20 resident nurses at Severance Hospital, Yonsei University implies that the Healing Mirror is also effective for adults and such emotional laborers as nurses for stress management.

20 participants in the Healing Mirror study measured stress index, fatigue index, and general health index by a stress/autonomic nerve analyzer (Canopy 9). And they are asked to use the Healing Mirror for only two minutes and thirty seconds, and measured health indexes again. Every participant in this study had improved every health index by Canopy 9. A participant with the most notable improvement showed stress index decreased by 77.7%, fatigue index decreased by 80%. Prof. Kwon states, "regularly using the Healing Mirror might be helpful for those who are struggling with emotional difficulties and stress."

Prof. Kwon stresses a theological insight for the invention of the Healing Mirror; "God instilled God's breath (in-spire) when creating human. Thus, life means breath and in order to find peace in our minds, we have to recover the first breath from God. Stop your work for a moment and take a deep breath. Taking this short break can enhance your life."

ICONS

Institute of Convergence Science

A year and a half has passed since the foundation of Yonsei Institute of Convergence Science (ICONS, Director: Jeong Kap-young). With three appointments in the research center and two interim evaluations, the ICONS now has a total of 48 research centers and 511 researchers engaged in convergence science research. In May 2013, the Institute invited Choi Yang-hee, the current Minister of Science, ICT and Future Planning, who was then the Chairman of the Samsung Science & Technology Foundation, to discuss the future direction of convergence science research. In December of the same year, an ICONS workshop took place in the official residence of Yonsei University's president. Individual research centers held poster sessions and introduced their research areas, which was a valuable opportunity to strengthen Yonsei's convergence science research network.

The member research centers regularly present their recent convergence science research in ICONS Forums, which have been held twice a month since the Institute was founded. Already 34 research centers have presented their research at 24 ICONS Forums. The Forums are lunchtime sessions open to everyone where attendees can extend their knowledge of convergence science and centers can share and develop insights and find opportunities to collaborate.

Upon the appointment of Vice-Chairman Kim Dong-ho in 2014, ICONS has been planning and hosting ICONS Seminars in conjunction with university departments and research centers to serve as a place for communication on convergence science research. ICONS invited Dr. Nam Hak-hyun, the Chief Technical Officer at I-SENSE, to speak at the first seminar on May 23rd about encouraging cases of university research labs turning their projects into successful business opportunities. On September 16th, Professor Hwang Nong-mun of Seoul National University was invited to talk about how his famous "active immersion in thinking" can help people succeed in life. Many members of the Yonsei community attended the lecture and the Q&A session to find out about effective study methods and career paths. On October 21st, Director Shin Cho of the Yonsei Institute of Convergence Technology will be invited to discuss the direction of ICT development. His talk will be held in the Engineering School auditorium. Prof. Jang Dae-ik of Seoul National University and Won Jong-woo, the director of Science People, will lead a discussion seminar on the impact of high technologies on humans in the Jang Ki-won Memorial Room on November 25th.

ICONS Workshop

511
Researchers

Professor Hwang Nong-mun of Seoul National University

24
ICONS Forums

48
Research Centers

Dr. Nam Hak-hyun, the Chief Technical Officer at I-SENSE

Media Arts Research & Design Center
Director: Kim Hyungsu
E-mail: artware@yonsei.ac.kr
Tel.: +82-2-2123-3991

Interdisciplinary Research Center on Medical Humanities
Director: Kim So Yoon
E-mail: syoonkim@yuhs.ac
Tel.: +82-2-2228-2532

Research Center for Global Korean Study
Director: Hur Kyoungjin
E-mail: hur@yonsei.ac.kr
Tel.: +82-2-2123-2267

Center for Coexistence & Cooperation
Director: Sung Taeyoon
E-mail: tsung@yonsei.ac.kr
Tel.: +82-2-2123-5494

Center for Science Public Relations
Director: Kim Eungbin
E-mail: eungbin@yonsei.ac.kr
Tel.: +82-2-2123-2651

Integrative Research Team for Personal Healthcare System Developed by Oral Biometric Information
Director: Kim Jin
E-mail: op2@yuhs.ac
Tel.: +82-2-2228-3030

Management of Technology Research Center
Director: Kim Jinwoo
E-mail: motrc@yonsei.ac.kr
Tel.: +82-2-2123-4484

Center for Interdisciplinary Approaches on Aging
Director: Youm Yoosik
E-mail: yoosik@yonsei.ac.kr
Tel.: +82-2-2123-2431

Global Convergence Research Center for Implementation Oriented Development of Molecular Based Diagnostic Medical Technology
Director: Lee Hyeyoung
E-mail: hyelee@yonsei.ac.kr
Tel.: +82-33-760-2740

Data Science Center
Director: Byun Hyeran
E-mail: datascience@cs.yonsei.ac.kr
Tel.: +82-2-2123-7759

Group for Physical Drug Delivery
Director: Seo Jongbum
E-mail: jongbums@yonsei.ac.kr
Tel.: +82-33-760-2478

Innovative Basic Nanomedicine Institute
Director: Cheon Jinwoo
E-mail: cen_jshim@yonsei.ac.kr
Tel.: +82-2-2123-8228

Center for Imagination and Contents
Director: Lim Jeong Taeg
E-mail: limjt@yonsei.ac.kr
Tel.: +82-2-2123-2334

Yonsei Law and Mind Sciences Center
Director: Park Sang-Ki / Kim Min-Shik
E-mail: ys.sanghoon.han@gmail.com
Tel.: +82-2-2123-5436

Big Data Application Research Center
Director: Lee Zoonky
E-mail: zlee@yonsei.ac.kr
Tel.: +82-2-2123-4528

Socio-Culturomics
Director: Song Min
E-mail: min.song@yonsei.ac.kr
Tel.: +82-2-2123-2416

Various Environment Interaction Research Center
Director: Lee Joon Sang
E-mail: joonlee@yonsei.ac.kr
Tel.: +82-2-2123-5820

Sports Care Techno-Design Research Center
Director: Lee Haedong
E-mail: xbridge1997@yonsei.ac.kr
Tel.: +82-2-2123-6188

Space Time & Symmetry Convergence Center
Director: Kim Choong Sun
E-mail: cskim@yonsei.ac.kr
Tel.: +82-2-2123-8514

Drug Discovery Platform Technology Center
Director: Jeong Jin Hyun
E-mail: organicjeong@yonsei.ac.kr
Tel.: +82-32-749-4509

Yonsei Convergence Research Institute of Personalized Cancer Control
Director: Huh Yong-Min
E-mail: ymhuh@yuhs.ac
Tel.: +82-2-2228-0856

Exercise Medicine Center for Diabetes & Cancer
Director: Jeon Justin Y.
E-mail: jjeon@yonsei.ac.kr
Tel.: +82-2-2123-6197

Emotion Science Research Center
Director: Kim Do Hyung
E-mail: hyung@yonsei.ac.kr / bhlee@yuhs.ac
Tel.: +82-2-2123-3335

Center for Religion and Public Issues
Director: Chung Jae-Hyun
E-mail: crpi@yonsei.ac.kr
Tel.: +82-2-2123-3242

Center for Sustainable Culture & Service
Director: Ko Eunju
E-mail: cs2_ys@yonsei.ac.kr
Tel.: +82-2-2123-8361

Convergence Research Center for Integrated Medical Imaging System
Director: Suh Jin-Suck
E-mail: jykim@yuhs.ac
Tel.: +82-2-2228-2365

Institute for Creativity & Humanities
Director: Lee Sang-O
E-mail: solee21@yonsei.ac.kr
Tel.: +82-2-2123-6267

Center for Advanced Intravascular Endomicroscopy
Director: Joo Chulmin
E-mail: cjoo@yonsei.ac.krac
Tel.: +82-2-2123-5822

The Research Community of Medical Device for Vascular Diseases
Director: Jang Yangsoo
E-mail: hongsy@yuhs.ac
Tel.: +82-2-2228-0322

Human Wellness Research Center
Director: Jung Hyo-Il
E-mail: uridle7@yonsei.ac.kr
Tel.: +82-2-2123-7767

Center for Human Science and Technology
Director: Chong Sang Chul
E-mail: scchong@yonsei.ac.kr
Tel.: +82-2-2123-2447

Urban Socio-Spatial Informatics
Director: Kim Yong-Chan
E-mail: yongckim@yonsei.ac.kr
Tel.: +82-2-2123-2974

Research Center for Business and Government
Director: Chung Seungwha
E-mail: chungs@yonsei.ac.kr
Tel.: +82-2-2123-7551

Carbon-based Nanodevice Fusion Research Center
Director: Jun Seong Chan
E-mail: scj@yonsei.ac.kr
Tel.: +82-2-2123-5817

Research Center for National R&D Policy
Director: Lee Sam Youl
E-mail: samyoul@yonsei.ac.kr
Tel.: +82-2-2123-2958

Center for Interdisciplinary Research on Technology & Mental Health
Director: Song In Han
E-mail: isong@yonsei.ac.kr
Tel.: +82-2-2123-6217

Center for Interdisciplinary Studies on the Identity of Korea
Director: Hong Hoon
E-mail: hoonhong@yonsei.ac.kr
Tel.: +82-2-2123-2485

International Development Research Center for Global Poverty Eradication
Director: Kim Chang-Soo
E-mail: kimc@yonsei.ac.kr
Tel.: +82-33-760-2331

Yonsei Center for Plant Engineering
Director: Lee Soo Hong
E-mail: shlee@yonsei.ac.kr
Tel.: +82-2-2122-2823

Integrated Neurocognitive Functional Imaging Center
Director: Lee Seung-Koo
E-mail: slee@yuhs.ac
Tel.: +82-2-2228-2373

Yonsei Research Center for Global Safety Technologies
Director: Moon Il
E-mail: ilmoon@yonsei.ac.kr
Tel.: +82-2-2123-2761

Science & Technology Alliance for Research in Space
Director: Park Junsoo
E-mail: junsoo@yonsei.ac.kr
Tel.: +82-33-760-2560

Center for Neuro-Science & Technology
Director: Park Seung-Han
E-mail: shpark@yonsei.ac.kr
Tel.: +82-2-2123-2617

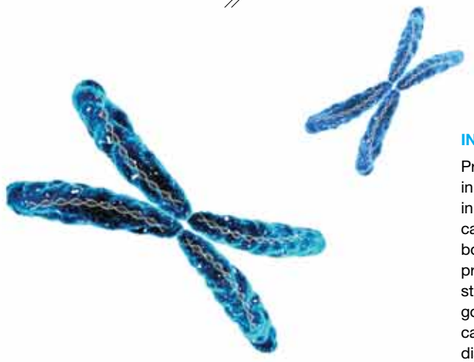
Tailor-made Theranostic Nanomaterials for Stem Cell Engineering
Director: Lim Yong-beom
E-mail: yblim@yonsei.ac.kr
Tel.: +82-2-2123-5836

Work Science Research Center
Director: Lee Jungwoo
E-mail: jlee@yonsei.ac.kr
Tel.: +82-2-2123-4526

Warming Associated Relief through Medical and Healthcare Research and Technology
Director: Jung Mihyun
E-mail: gocmh@yonsei.ac.kr
Tel.: +82-2-2123-5041

Research Center for the Future of Higher Education
Director: Choi Kang-Shik
E-mail: kangchoi@yonsei.ac.kr
Tel.: +82-2-2123-5496

Convergence Research Center for Ecology and Culture
Director: Jun Hyun Shik
E-mail: hsjun2691@yonsei.ac.kr
Tel.: +82-2-2123-5920



Yonsei Leads the Global Human Proteome Project, C-HPP

Paik Young-Ki
Underwood Distinguished Professor
Chair, Executive Committee of
C-HPP Consortium

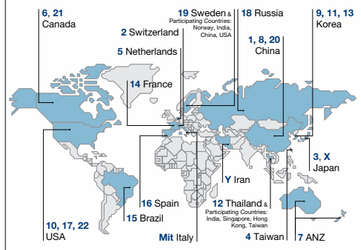
INTRODUCTION

Proteins are synthesized from genes located in chromosomes, and are key biomolecules in all living organisms including humans. They carry out many important functions in our body, functioning as enzymes, transporters, protectors against pathogenic micobials, and structural components; therefore, if something goes wrong with proteins, people get sick (e.g., cancer, metabolic disease) and often die of disease. Although the human genome project was completed in 2003, much of the information about the function, isoforms, structural modifications, and cellular locations of proteins remains elusive. To characterize the entire set of human proteins in each chromosome, the international Human Proteome Organization (HUPO) officially launched the chromosome-centric human proteome project (C-HPP) in Boston, USA in 2012. The concept of this project was initially crafted by Prof. Paik Young-Ki at Yonsei University (Dept. of Biochemistry, College of Life Science and Biotechnology), former presidents of HUPO (2009-2010), AOHUPO (2008-2010) and KHUPO (2001-2005), at the Amsterdam HUPO Congress in 2008, and has been further developed since then. The C-HPP concept bore fruit in terms of research activity when the research groups of Profs. Paik and Hancock published a landmark paper on C-HPP in the high-impact journal Nature Biotechnology (IF=39.08) in 2012. With this momentum, they were also successful in organizing the international C-HPP consortium, which is composed of 25 national teams.

GOALS of GLOBAL C-HPP

The C-HPP, a 10-year project (2012. 9-2022. 9), aims to characterize and annotate the entire set of human proteins encoded in each chromosome. From this project, the research community will have a full catalogue of proteins, including new diagnostic biomarkers, novel drug targets, and a full list of isoforms of cellular regulators such as those involved in major signaling pathways. The human genome makes up ~20,000 human proteins, but the presence and function of 20-30% of these proteins remain ambiguous. These are called 'missing proteins' and lack protein evidence when the proteome is examined by mass spectrometric analysis or antibody detection.

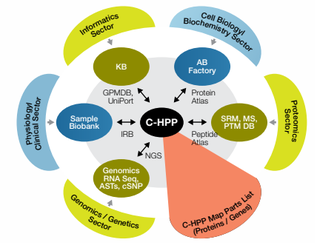
GLOBAL C-HPP CONSORTIUM MEMBERS



Project Period: 2012. 9-2022. 9
HQ: Yonsei Proteome Research Center (Yonsei University, Seoul, Korea)

ROLE of YONSEI LEADERSHIP

In 2012, Prof. Paik Young-Ki, Yonsei University, chair of the C-HPP consortium, and his co-chairs, Prof. William Hancock, former WCU Professor of Yonsei Univ. and Prof. Gyorgy Marko-Varga (Lund Univ., Sweden), established the headquarters of C-HPP at Yonsei Proteome Research Center (YPRC), Yonsei University. To stimulate the scientific activity of the consortium, the CHPP leadership has also organized many scientific workshops and published more than 80 SCI Journal papers in two consecutive special issues of J. Proteome Research, a leading journal in this field, in 2013 and 2014. Publication of this special issue will be continued until the end of the project period, 2023.



Concept of C-HPP (from Paik YK et al., Nature Biotech, 30, 221-223 (2012)

PERSPECTIVES

With vibrant scientific meetings and collaborative efforts among the research teams, the C-HPP is entering its 3rd year in 2015. The C-HPP consortium led by Paik and his co-chairs has hosted several scientific meetings during the past years that have contributed to the global dissemination of this project. These include the following: the Proteomic Forum in Berlin, Germany (March 17-21, 2013), the 38th FEBS Congress in St. Petersburg, Russia (July 10-11, 2013), several national proteomics meetings (KHUPO, USHUPO, CNHUPO, and Taiwanese HUPO) in 2013, Busan workshop (March 26, 2014), Sydney conference (July 30, 2014), Bangkok workshop (August 9, 2014), Madrid workshops (Oct 5-8, 2014) and Segovia workshop (Oct 9, 2014). In 2015, the C-HPP consortium will continue its scientific endeavors by hosting workshop in Milano, Italy (June 23, 2015) and Vancouver, Cananda (Sept 27-30, 2015), in addition to publication of a special issue of J. Proteome Research in June, 2015. Thus, C-HPP becomes one of the most active scientific initiatives in the biomedical community.

Yonsei University 2014 Future-leading Research Initiative

In order to strengthen our leadership in the global arena and to enhance excellence in research, Yonsei University presents the 2014 Yonsei University Future-leading Research Initiative under the Office of Research Affairs and the University-Industry Foundation, with an annual budget of 4.5 billion won led by Professor Kim Eunkyoung, the Dean of Research Affairs and the President of the University-Industry Foundation.

This research initiative aims to use interdisciplinary convergence to create the future of high level research-based education. It is composed of 7 programs including Yonsei's Leading Researcher Support Project, Challenge Support Project, Problem-solving Convergence Research Support Project, International Cooperation Research Support Project, Global Specialization Project, and Free Assignment support project. The principal researcher of each project is to propose research objectives and strategies that are appropriate to solve interesting problems and tasks. Each project is to be evaluated annually to determine funding for the following year.

This programs designed to enable all faculties at Yonsei University including Sinchon, Sinchon Severance, Wonju, Wonju Severance, and Songdo International campus to reach their full potential as research professionals. The objective of this initiative is to inspire the passion, creativity, and adventure among Yonsei professors. Through this program, we will eventually establish Yonsei as a globally recognized leader in world-class research as well as contribute to national creative economy. And Yonsei takes a leading role in solving social problems through interdisciplinary collaborative research.

We would like to invite all creative applications that can identify emerging research areas and lead a paradigm shift in major research areas.

For more information or to ask questions, please contact:

Office of Research Affairs
50 Yonsei-ro, Seodaemun-gu,
Seoul 120-749, Korea

Website: research.yonsei.ac.kr
E-mail: yonsei-research@yonsei.ac.kr

PROGRAM PERIOD AND FUNDING SIZE

- **Project Period** (The continuation and the amount of funding will be based on annual review.)

Up to 5 years

- **Total Amount** (per year)

4.5 billion won

LIST OF PROGRAMS

This call for proposals is open to all full-time permanent faculty members in the university. Particular sub-programs and areas of interest include basic and interdisciplinary research, international and industrial joint research but are not limited to:

1. Research Leaders Program

Discovers current and prospective research leaders performing creative research and cultivates them as exceptional, world-class research leaders/research groups

- Type I: Individual entry
- Type II: Group entry

2. Challenging Research Program

Collects and supports original and groundbreaking research ideas to create new research fields and carry out emerging research

- Applicants: Within 10 years after completion of a doctoral degree or 5 years after their employment as a full-time faculty member

3. Problem-solving Convergence Research Program

Supports creative and groundbreaking convergence research among humanities, social sciences, natural sciences and engineering that can help address social issues, thereby contributing to realizing the creative economy and enhancing the standard of people's lives

4. University-Industry Collaborative Research Program (for Industrial Technology Demand)

Coordinates industrial demand in technology with research works and supports R&D, technology transfer and subsequent commercialization

5. International Collaborative Research Program

Joint research projects of individual/group with outstanding researchers outside the country in order to build international research network in emerging area and create world-class research output

6. Global Specialization Project

Specializes the university's research capacity and prepares a follow-up project for BK21/WCU

- Organized by the graduate school. Application details to be announced by the graduate school in the future

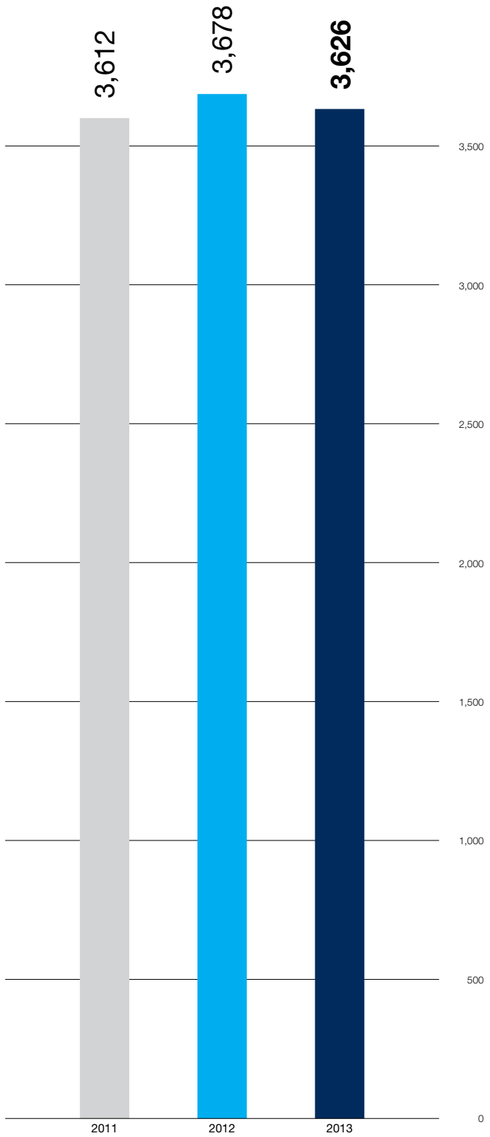
7. Free Assignment Support Project

Proposes free-themed research that is not addressed in the above categories yet promotes research excellence and has powerful social implications

- e.g.) Planning a large-scale research project

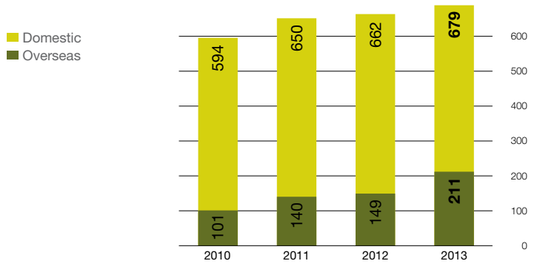
Article Publications

(Unit: Case)



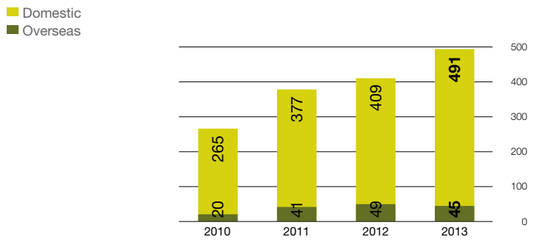
Patent Applications

(Unit: Case)



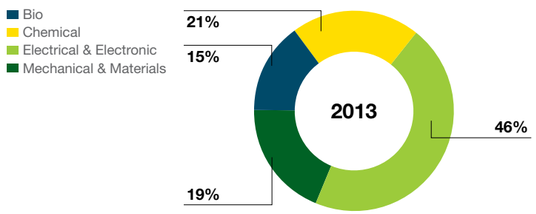
Patent Registrations

(Unit: Case)



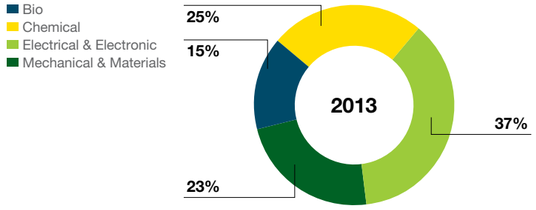
Patent Application Rates of Technology Fields

(Unit: %)



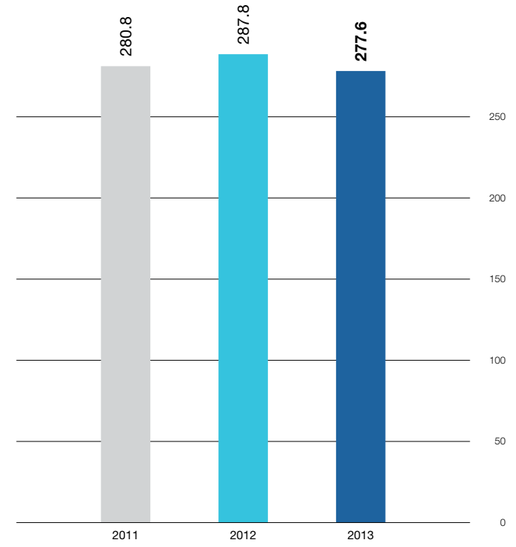
Patent Registration Rates of Technology Fields

(Unit: %)



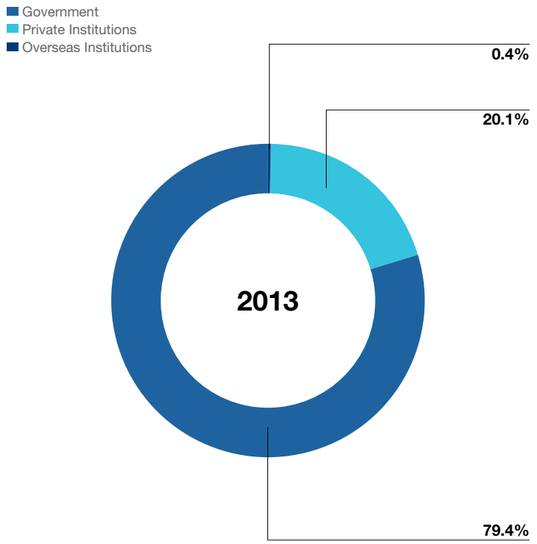
Expenditures

(Unit: million USD)



Expenditures by Funding Source I

(Unit: %)



Expenditures by Funding Source II

(Unit: %)

- Ministry of Science, ICT and Future Planning
- Ministry of Trade, Industry & Energy
- Ministry of Education, Science & Technology
- Ministry of Health & Welfare
- Ministry of Land, Infrastructure and Transport
- Ministry of Environment
- Ministry of National Defense
- Ministry for Food, Agriculture, Forestry & Fisheries
- Other Government Institutions
- Seoul Metropolitan Government
- Ministry of Public Administration and Security
- Ministry of Culture, Sports & Tourism
- Overseas Institutions
- Private Institutions
- Affiliated Organizations of the President's Office
- Local Governments
- NGO
- Korea Communications Commission
- Ministry of Employment & Labor
- Ministry of Justice

* Exclusion: Performance of Part-time Faculty, Large-scale Scholarship/Promotion Programs, Intramural Research Fund

* Source: A Study on Academic Research and Development Activities in Korea (NRF)