



**KOREA
BASIC SCIENCE
INSTITUTE**

**ANNUAL
REPORT
2014**



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Towards the world
beyond Korea!
Korea Basic Science
Institute is
actively running
at the center of
change.

www.kbsi.re.kr

2014

TOP 10 ACHIEVEMENTS OF KBSI IN 2014

Research Area

The world's first development of a human stem cell model to embody dementia brain

Selected as top 10 major science and technology news of the year in 2014 by the Korean Federation of year 2014 by Korean Federation of Science and Technology Societies

Development of an experimental model showing pathological characteristics of brains of Alzheimer's disease patients through 3D differentiation of human neural stem cells

Published in Nature (IF : 42.351)

Dr. Young Hye Kim, Division of Mass Spectrometry Research, Ochang Headquarters (Joint research with the School of Medicine at Harvard University, U.S.)

Research Area

The world's first examination of electrochemical phenomenon on the interface of ferroelectric oxide

Development of an innovative analysis method that simultaneously observes atomic structure and interfacial phenomenon

Published in Nature Materials (IF : 36.425)

Dr. Young Min Kim, Division of Electron Microscope Research, Daedeok Headquarters (Joint research with Oak Ridge National Laboratory, U.S.)

Research Area

Visual examination of stress resilience in depression

Successful measurement of stress resilience of brain by converting molecular biological stress phenomena of brains in rats into images

Published on Molecular Psychiatry (IF : 15.147)

Research Team of Dr. Song Her, Chuncheon Center

Management and Other Areas

Opening ceremony of Western Seoul Center

Convergence research on nano, bio and pharmaceutical technologies (NBPT) / Installed on the campus of Ewha Womans University (Jul. 1)

Management and Other Areas

Completion ceremony of 'MRI Research Building' for brain and bio-image research

15 advanced research equipment for research purposes to be introduced such as 7 T human MRI for research purpose to be introduced

TOP 10

Management and Other Areas

Received Education Donation Award for Youth Science and Culture Industry in 2014

- External awards
 - Received Grand Prize for Institutions at the 3rd Korean Education Donation Awards (hosted by the Ministry of Education)
 - Received an award from the Head of Yuseong-gu for Yuseong-gu Science Mentor Project

Management and Other Areas

Securement of base for facilitation of development and corporate support on domestic research equipment

- Held 'Public hearing for the project on development and commercialization of advanced research equipment'(Oct. 18)
- Obtained new order for 'The project on development and commercialization of advanced research equipment'(5 years, 28 billion Korean won)

Management and Other Areas

Acquisition of ISO 9001 certification for international quality management system to reinforce quality management of analytical support

Division of Mass Spectrometry Research and Jeonju Center

- Establishment of an optimal system for strict calibration and analytical support of equipment
- Increased reliability of support on characteristic analysis of materials and protein medicines, and reinforcement of customer satisfaction management

Management and Other Areas

Establishment of global cooperation system and expansion of infrastructure

- Korea-Singapore BTI glycomics research: Facilitation of research cooperation in Asia (Feb. 12)
- Korea-UAE petroleum and gas research: Preparation of base for mutual research cooperation on petroleum gas and nano catalyst with Petroleum Institute (Sep. 16)
- Hosted the 3rd International Conference on Analytical Science (Nov. 21~21, Daedeok Headquarters of KBSI)
 - 398 participants including scholars from 6 countries around the world and 10 fields of study such as metabolomics

Management and Other Areas

Technology transfer to small and medium businesses

- Representative examples of technology transfer
 - Transfer of optical catalyst mass production technology :
 - Target of transfer: Sentec Co., Ltd. (contract signed on Jan. 27)
 - Transfer of temperature sensor calibration technology using cryogenic freezer :
 - Target of transfer: Yoonseul Co., Ltd. (contract signed on Sep. 22)
 - Transfer of norovirus detection technology :
 - Target of transfer: Solgent Co., Ltd. (contract signed on Dec. 23)

MESSAGE



“ KBSI contributes to the creative economy, and KBSI protects happiness of citizens ”

In 2014, KBSI faithfully played the role of a basic research platform based on advanced research equipment and excellent researchers. With the 4 core values that include customer, communication, creation and integrity, KBSI has achieved many outstanding research outcomes. ‘Development of the world’s first cell model for dementia is the disease of the brain made using human stem cells’ (published in Nature magazine) by Dr. Young Hye Kim was selected as the top research outcome among ‘10 major news of the year on scientific technology’ by the Korean Federation of Science and Technology Societies. Also, ‘the world’s first examination on electrochemical phenomena of ferroelectric oxide surface’ by Dr. Young Min Kim and ‘visual examination on stress recovery in depression’ by Dr. Song Her were published through renowned global academic journals, and there were more excellent research outcomes this year than any other years.

KBSI placed great emphasis on supporting small and medium businesses and on resolving national and social problems with an intent to be faithful to the governmental effort on the economy. It made contribution to safe life of citizens through development and diffusion of analytical technologies to resolve current issues of the nation and society such as biological disasters.

In the analytical service of 2014, 5,632 users analyzed about 140,000 cases, among which 23.4% were requested by small and medium businesses. We had 10 technology transfers to small and medium businesses for a total technology transfer cost of 500 million won, which was increased by about 54% compared to the previous year. Moreover, we conducted various activities to provide our analytical technology and know-how to small and medium businesses such as operation of 25 partners and mentor services small and medium businesses.

In addition, we have established a quality management system for analytical service by obtaining ISO 9001 certification to increase convenience of customers and improve reliability of analysis, focusing on the development of equipment and support of technology. We have developed the USE website, an online analytical service system that allows for searching of equipment, payment of fees and management of analytical service on the internet, and will launch the website during early 2015.

KBSI used its advanced research equipment for the past 26 years to support research efforts of universities and conduct joint research. It is now granted with a new mission to perform independent research and development by extending its capabilities for independent and creative activities.

KBSI will concentrate its capabilities to devote itself to the basic duties, contribute to creative economy, and place utmost efforts for happiness and safety of citizens and society.

Thank you.

January 2015 President of KBSI Kwang Hwa Chung

HISTORY

1988
1999

- 1988.08 ● Korea Basic Science Center (KBSC) established as an affiliate of Korea Science & Engineering Foundation
- 1992. 03/04 ● Four local Centers (Seoul, Busan, Daegu, Gwangju) established
- 1999. 05 ● Established as a corporate body
- 1999. 12 ● Jeonju Center established

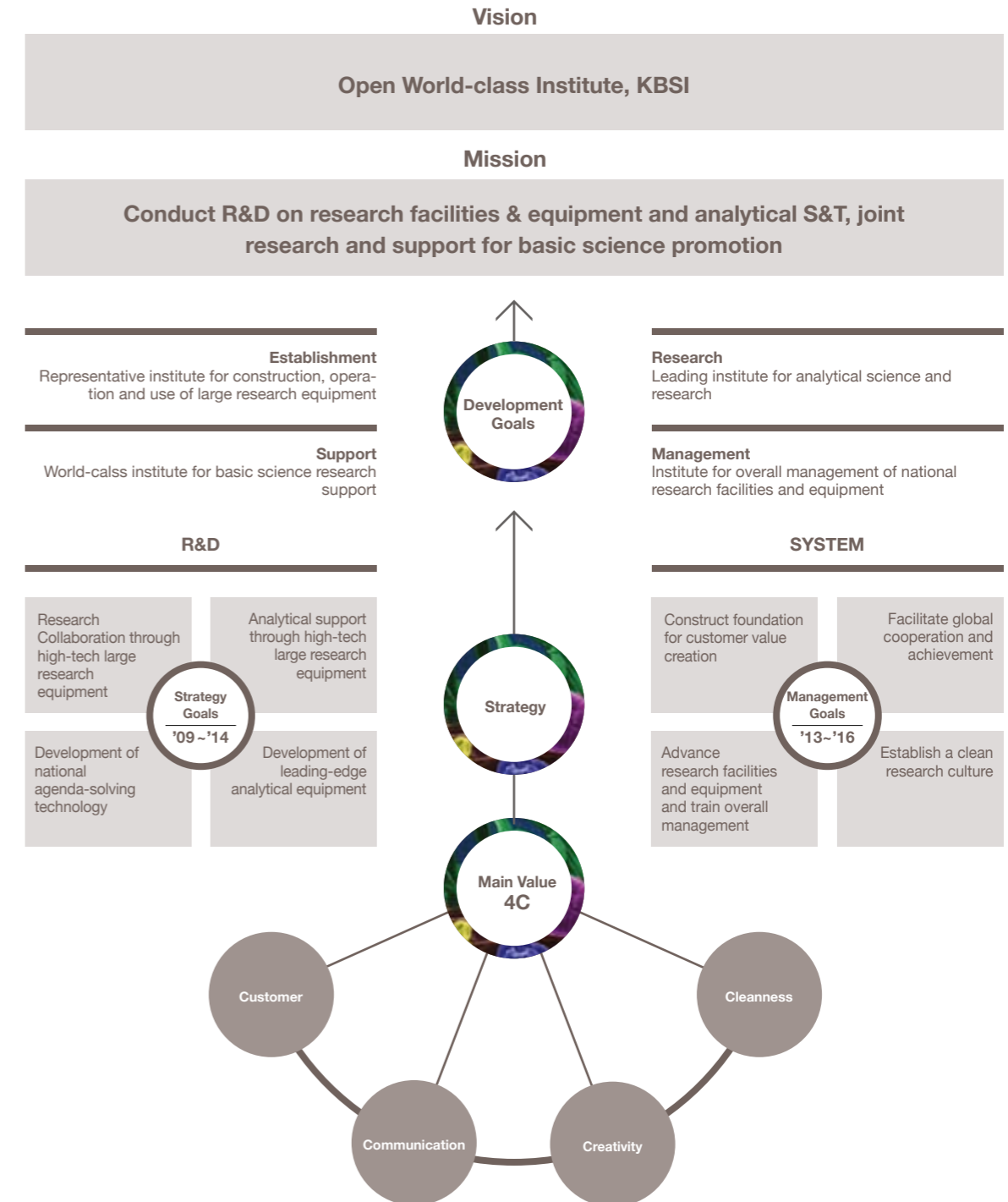
2000
2005

- 2001. 01 ● Name change to Korea Basic Science Institute (KBSI)
- 2001. 11 ● Chuncheon Center established
- 2005. 05 ● Suncheon Center established
- 2005. 10 ● 'National Fusion Research Institute' established affiliated organization

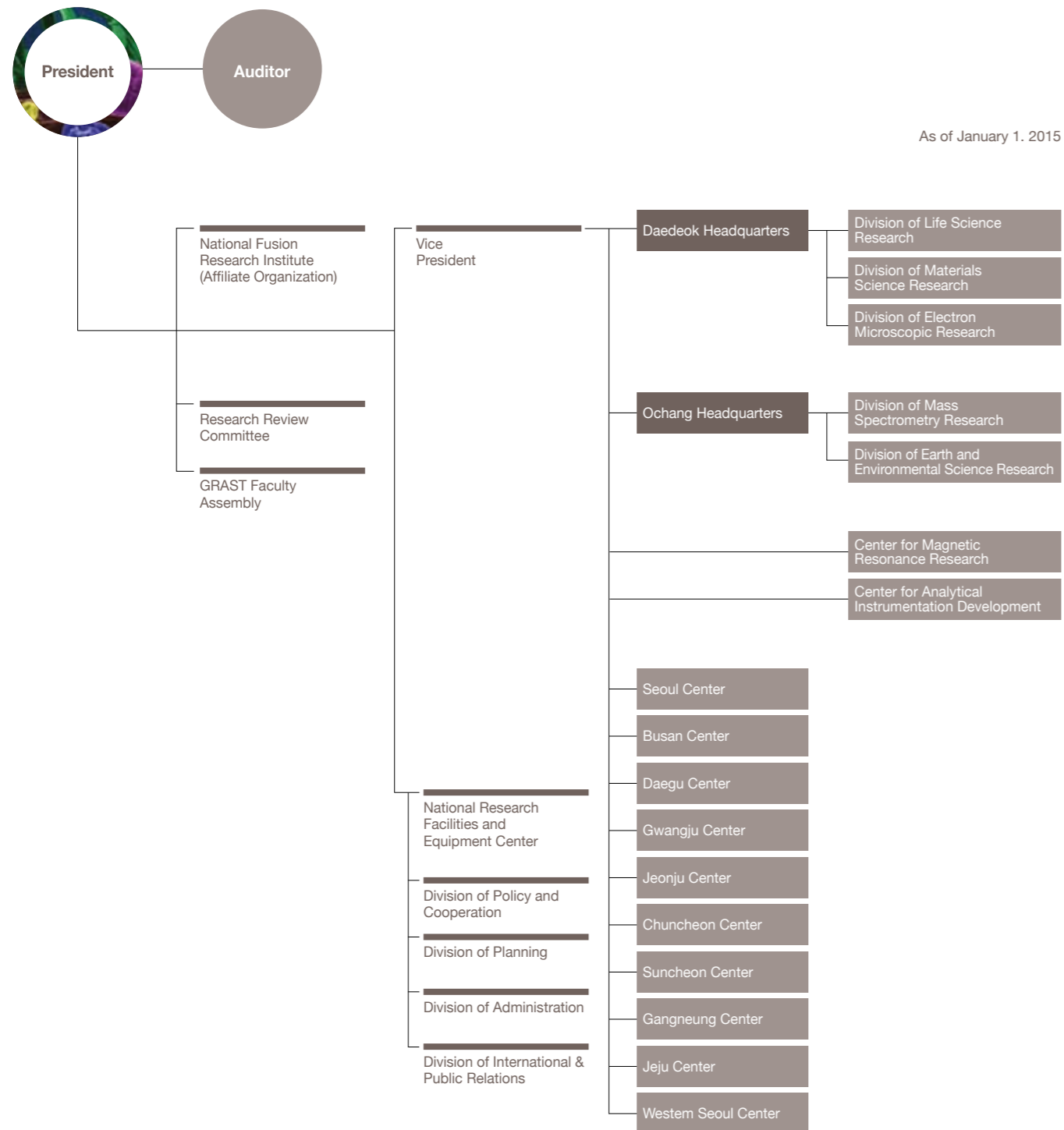
2006
2014

- 2006. 04 ● Ochang Center established
- 2006. 05 ● Gangneung Center established
- 2008. 04 ● Jeju Center established
- 2009. 03 ● Graduate School of Analytical Science and Technology (GRAST) established jointly with Chungnam Univ.
- 2009. 08 ● National Research Facilities Equipment Center (NFEC) established
- 2012. 12 ● Western Seoul Center established

VISION & GOAL



ORGANIZATION



PERSONNEL, EQUIPMENT AND BUDGET

Personnel

Unit : No. of People

Researchers	Engineers	Administrators	Analyst	Total
142	51	47	1	241

※ President included in researchers category

Equipment

Unit : Million won

Category	Daedeok Head quarters	Ochang Head quarters	Local Centers										Total
			Seoul	Busan	Daegu	Gwangju	Jeonju	Chuncheon	Suncheon	Gangneung	Jeju	Western Seoul	
Equipment	155	144	76	59	22	51	22	20	11	16	10	29	615
Amount	53,275	51,966	20,077	17,432	6,207	12,580	6,984	5,797	2,526	3,633	2,795	15,343	198,615

※ President included in researchers category

Budget

Unit : Million won

Operating Revenue	
Category	Budget
Government Contribution	79,542
1. Basic Fund	14,781
2. General R&D Projects	46,661
3. Facilities & Equipment	18,100
4. Loan Payment & Interests	-
Income	23,171
1. Public(government)	15,520
2. Private	222
3. Other R&D projects	-
4. Technology supports	6,519
5. Technical fees	120
6. Others	790
Total	102,713

Operating Expense	
Category	Budget
Wages	17,258
1. Research Personnel	14,791
2. Legal liability amount	1,281
3. Retirement Reserves	1,186
Direct Research Expenses	62,139
1. In-house projects	46,661
2. Government/public projects	11,500
3. Private projects	170
4. Other R&D projects	-
5. Technology supports	3,808
Operating costs	5,096
Facilities and equipment	18,100
Others	120
Total	102,713

KBSI NETWORK

KBSI supports national basic science research and performs and specialized re- search based on regional industrial fields through the institute's 12 bases across the country.

1

Daedeok Headquarters
Biological Disaster Analysis, Drug & Disease Target, Nano-Bio Electron Microscopy, vanced Nano-Surface, Optical Instrumentation Develop- ment, Spin Engineering Physics, Instrumentation Development Sup- port

2

Ochang Headquarters
Protein Structure, Bioimaging, Bio- medical Omics, Geochronology, En- vironmental Monitoring & Research, Mass Spectrometry & Advanced In- strumentation

3

Seoul Center
Environmental Risk & Welfare, Space- Time Resolved Molecular Imaging

4

Busan Center
Advanced Materials, Ion Beam, Molecular Materials

5

Daegu Center
Functional Materials

6

Gwangju Center
Advanced Aging Science

7

Jeonju Center
Carbon-based Materials

8

Chuncheon Center
Disease



9

Suncheon Center
Energy Materials

10

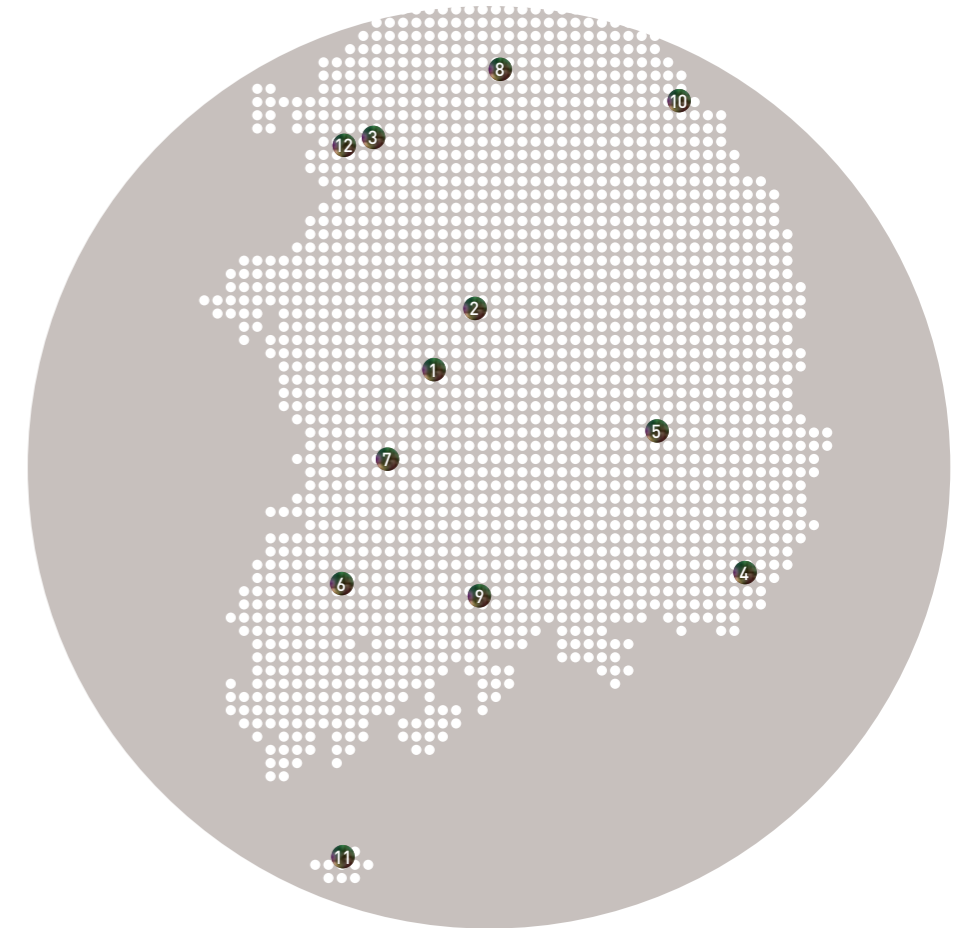
Gangneung Center
Advanced Material Science

11

Jeju Center
Marine Bio

12

Western Seoul Center
Functional Interface Science, Omics System



2014 KBSI NAVIGATION

Cases of Analytical Services
(unit : No. of cases)

17,039

Samples of Analytical Services
(unit : No. of samples)

139,508

Users of Analytical Services
(unit : No. of users)

5,632

Korea Basic Science Institute (KBSI) is a basic research platform that conducts research support and joint research based on advanced research equipment and outstanding researchers.

It provides world class service on analytical support using a network of Daedeok and Ochang and 10 regional centers around the nation. Managing national research equipment and cultivating human resources in analytical science and technology, KBSI plays a pivotal role in development of national scientific technology by making contributions to efficient management and use of basic research infrastructures.

KSBI creates excellent research outcomes through its global infrastructure and plans and develops research equipment with new concepts based on the best analytical science technology to protect the health and happiness of citizens.

KBSI also contributes to the realization of creative economy by providing technological support to small and medium businesses.

Our ceaseless determination and passion exhibited on top of a strong basic research platform are opening up the future of science and technology in Korea.

The 2014 KBSI Yearbook summarizes outcomes of many research efforts and analytical supports, and it is used as basic data to set the direction of future research and to promote new projects.

Please send your encouragement and attention so that KBSI can settle and produce winners of the Nobel Prize as well as play a huge role in the future creative economy.

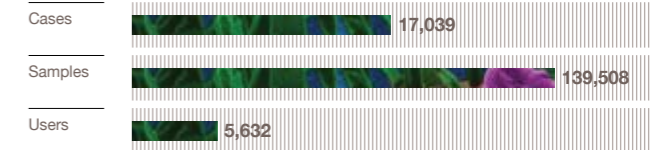
Statistical trends of analytical services

Unit : No. of cases, No. of samples, No. of users

2012



2014

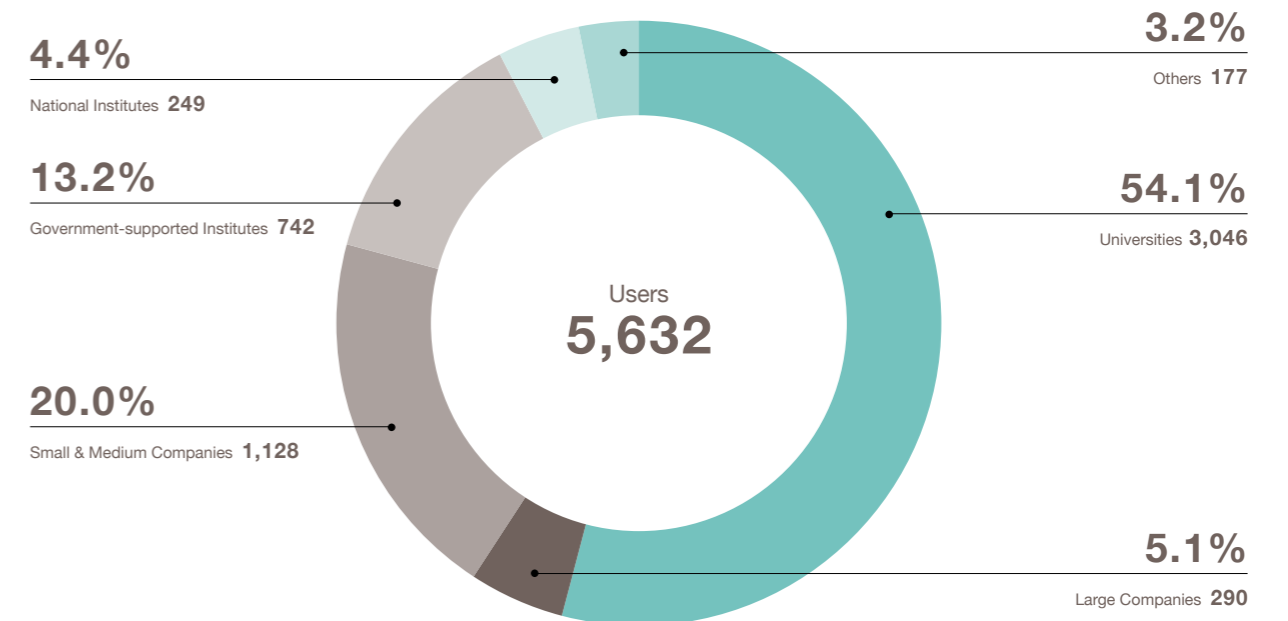


2013



Statistics of analytical service users

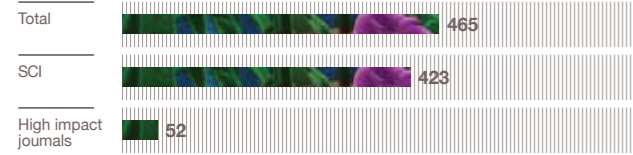
Unit : No. of users



Publications

Unit : No. of papers

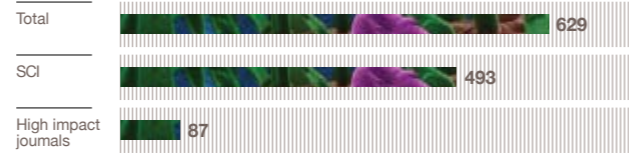
2014



User publications

Unit : No. of papers

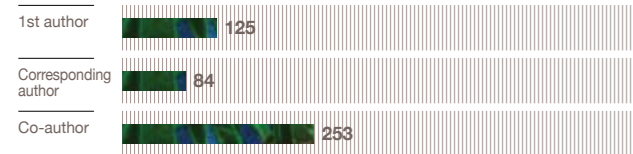
2014



Publication by author type

Unit : No. of papers

2014



Research funds per researcher

Unit : Million won

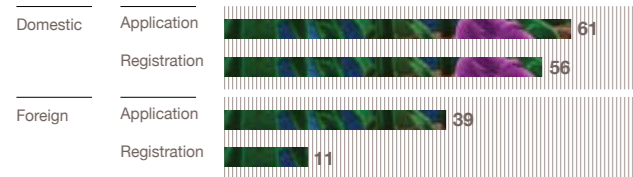
2014



Patents

Unit : No. of cases

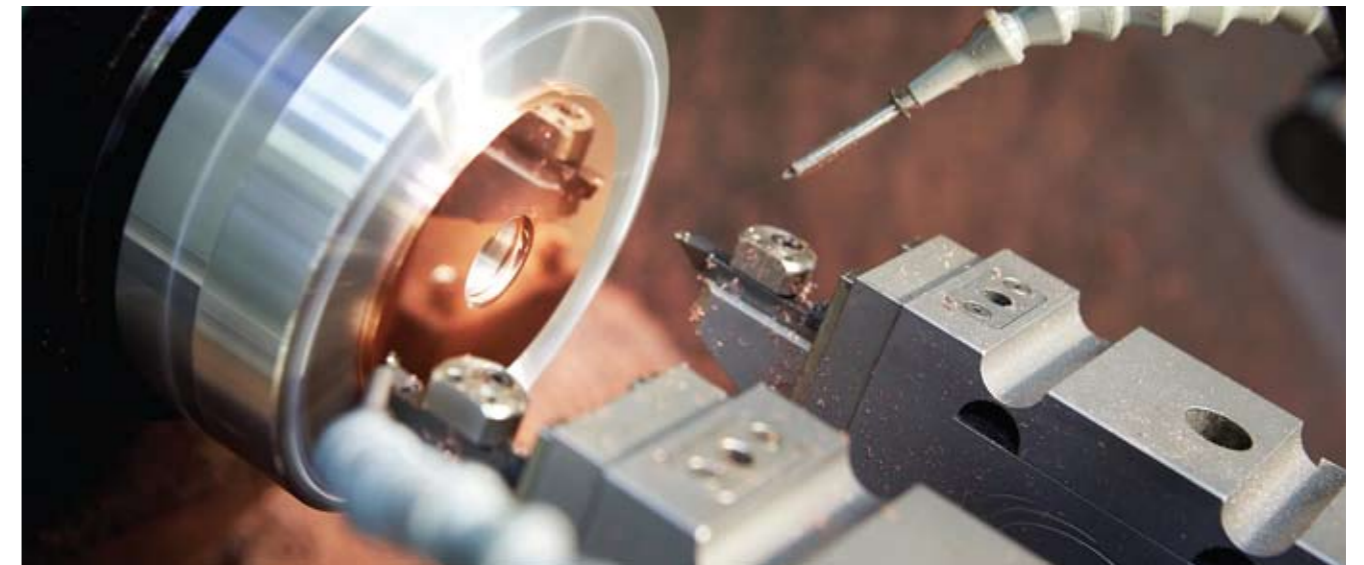
2014



Technology transfers

Unit : No. of cases,
No. of institutes,
Million won

2014



Description of photograph |

Grand prize at the 2014 KBSI Imaging Photo Exhibition,
<A Bug's Life>

Stem of cherry tomato observed at a magnification of
300 using ESEM.



Besides R&D on 5 representative research areas, KBSI, with its state-of-the-art research facilities and equipment, carries out tasks such as analysis services, collaborative research, education and technology transfer & commercialization.

JOINT UTILIZATION OF ADVANCED EQUIPMENT

MEDICINE PHARMACY RESEARCH
INTEGRATIVE BIOSCIENCES RESEARCH
ENVIRONMENTAL AND BIOLOGICAL DISASTER RESEARCH
NANO MATERIALS RESEARCH
DEVELOPMENT OF RESEARCH EQUIPMENT



1
JOINT
UTILIZATION OF
ADVANCED
EQUIPMENT

MEDICINE PHARMACY RESEARCH

Mass Spectrometry Research
Biological imaging Research
Protein Structure Research
Degenerative Disease Research

We develop analytical methods using the largest analytical facilities in Korea to conduct basic research on living substances to understand life phenomena and pharmaceutical research on diagnosis and treatment of diseases. From molecular research using advanced equipment to bio image research for diagnosis and treatment of diseases and efforts for securement of international trust on aged animal infrastructures, we are further developing domestic research on medicine and pharmacy.

Mass Spectrometry Research

● Division of Mass Spectrometry Research

Scientists in support the research of drug discovery, diagnostic and therapeutic technology, and environmental science using high-resolution mass spectrometers, such as the 15 T FT

Main Research Activity

Outstanding publications in post-translational modification analysis of proteins and glycan structure analysis were produced. As for applications research, we supported medical and pharmaceutical science by recombinant protein characterization and by use of early diagnoses technology for cancers using mass spectrometry.

Representative Research Case

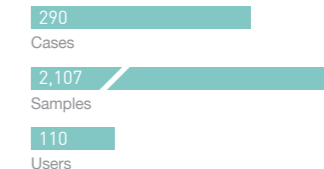
Development of a human neural cell culture model of Alzheimer's disease

A human neural cell model that replicate two hallmarks, amyloid plaques and tau tangles, of Alzheimer's disease (AD) have been developed in a 3-dimensional culture system. This research was done in cooperation with Prof. Rudolph E. Tanzi's group at Harvard Medical School.

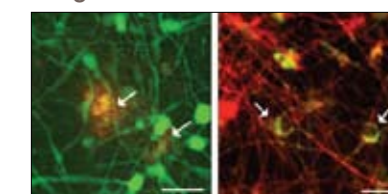
Major Achievements

Category	Achievements		
Research Result	Publications 28 (SCI 25)	Presentations Domestic 33 International 5	Patents Application 13 Registration 6
Analytical Methods	<ul style="list-style-type: none"> · MRM validation of targeted peptides from N-glycoprotein biomarkers using direct trypsin digestion of undepleted human plasma · In-depth analysis of site-specific N-glycosylation in vitronectin from human plasma · Method for laser capture microdissection of mouse hippocampal subregions · Fractionation of aggregated proteins in the brain based on solubility · Development of new ECD gun · Absolute internal mass calibration with carbon soot ions for high resolution MALDI FT-ICR MS · Quadrupole mass filter · High resolution RF Module development · Comparison of lipidomes between wild type strain and ΔchoC mutant of <i>Aspergillus nidulans</i> using UPLC/Q-TOF MS 		
Projects	<ul style="list-style-type: none"> · High throughput biomarker discovery and validation by mass spectrometry · Discovery and functional studies of disease-related proteins from human chromosome 11 · Proteomic study of learning and memory · Analysis of spilled oils and related contaminants · Development of high-throughput quantitative N-glycan analysis · Development of antibody characterization platform technology for antibody-biobetter · High sensitivity portable toxic gas detector development · Study of FAIMS tech. for separation of chemical agent · Development of hazardous air pollution measurement method using an unmanned areal vehicle (UAV) 		
Equipment	Installed <ul style="list-style-type: none"> · 15 T FT-ICR MS · Hybrid FT-ETD Mass Spectrometer (Orbitrap-Elite) · 2D-GC/HR MS (2-dimensional gas chromatography/high resolution mass spectrometer system) · High-speed Q-TOF Mass Spectrometer (5600+, 6600+) · Ion Trap/7 T FT-ICR MS · Triple Quadrupole MS · MALDI Imaging System · MALDI/ESI Hybrid Tandem MS 		

Analysis Service



Image



Aggregates of β -amyloid and phosphorylated tau in a 3D-differentiated human neural cell model of Alzheimer's disease

Equipment



15 T FT-ICR Mass Spectrometer



High-speed Q-TOF Mass Spectrometer



LTQ Orbitrap Elite Mass Spectrometer

Biological Imaging Research

Division of Magnetic Resonance Research, Chuncheon Center

Biological imaging researches are promising approaches to visualize, characterize and measure the biological and pathological processes which occur in living subjects. Bio-imaging techniques will be helpful to understand characteristics of diseases and guide new diagnostic and therapeutic strategies at early stages for the treatment of diseases.

Main Research Activity

Studies on drug mechanism, new drug discovery and screening, development of multifunctional nanobiomaterial-based diagnostic and therapeutic nanomedicine are performed, and their functional studies are examined in cells and disease animal models (i.e., cancer, depression, transgenic obesity, atherosclerosis, stroke, etc.) by using biological imaging techniques. Also, high-resolution imaging studies, cutting-edge equipment analysis, professional technical support and research collaboration are performed for users.

Representative Research Case

Brain-imaging technique development for depression treatment

This study identified evidence for the first time that stress recovery is the important criteria for the treatment of depression using bioluminescence imaging techniques. These findings provide new mechanistic insights for the development of biomarkers and novel antidepressants.

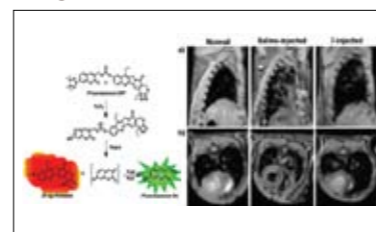
Major Achievements

Category	Achievements						
Research Result	<table border="1"> <thead> <tr> <th>Publications</th> <th>Presentations</th> <th>Patents</th> </tr> </thead> <tbody> <tr> <td>45</td> <td>31</td> <td>10</td> </tr> </tbody> </table>	Publications	Presentations	Patents	45	31	10
Publications	Presentations	Patents					
45	31	10					
Analytical Methods	<ul style="list-style-type: none"> Brain-imaging technique development for depression treatment Biomarker detection of cancer with gene mutation 						
Projects	<ul style="list-style-type: none"> Study on depression mechanism using real-time biological imaging techniques Study on biocompatible nanomedicine-based osteoporosis control Research for stimulating brown adipocyte to prevent obesity Installation and utilization of human research MRI Identification of drug-binding proteins using in vivo imaging technology Test on the SAR measuring instrument for MRI Development of diagnosis probes and treatment agents for tumor targeting Development of MRI image acquiring methods for water and fat analysis 						
Training of Equipment	<ul style="list-style-type: none"> EM (TEM/SEM) user training course Multi-photon CLSM user training course In vivo imaging system 200 user training course Understanding and practice of MRI equipment 						
Equipment	<p>Installed</p> <ul style="list-style-type: none"> Luminescence and Fluorescence Animal Imaging System Intravital Multi-photon Confocal Laser Scanning Microscope Variable Pressure Field Emission Scanning Electron Microscope 4.7 T/9.4 T animal MRI 600 MHz/800 MHz Microimaging System 3 T human MRI Animal PET/CT/SPECT <p>To Be Installed</p> <ul style="list-style-type: none"> Selective Plane Illumination Microscopy (2015) Luminescence and Fluorescence Imaging System with micro-CT in vivo imager (2015) 7 T human MRI(2014) 						

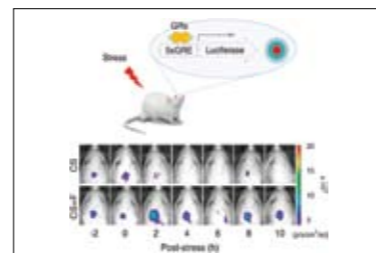
Analysis Service

89	Cases
612	Samples
49	Users

Image



Proposed reaction mechanism of prodrug with H₂O₂. In vivo therapeutic effects of prodrug in experimental lung metastasis



Stress recovery imaging after anti-depressant drug treatment

Equipment



9.4 T animal MRI



Animal PET/CT/SPECT



Luminescence and Fluorescence Animal Imaging System

Protein Structure Research

Division of Magnetic Resonance Research

3-dimensional structures, interactions and dynamics of protein are studied using NMR spectroscopy and X-ray crystallography methods to provide a structural basis for biological phenomena and drug discovery.

Main Research Activity

3-dimensional structures of protein and the molecular dynamics related to the protein function were studied by using X-ray crystallography and various NMR techniques. Various collaborative studies with domestic and foreign scientists resulted in 24 publications and 10 patents.

Representative Research Case

Hetero- and homo-dimeric structures of various SARAH domains

We determined the crystal structures of (i) hetero-dimer and (ii) homo-dimer that are formed by (i) the SARAH domains from MST1 and RASSF5 (NOE1) and (ii) the SARAH domain of MST2, respectively. Comparison of the hetero- and homo-dimeric interactions of the SARAH domain provides structural insights into the mechanism of Hippo signalling.

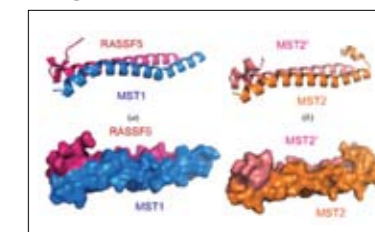
Major Achievements

Category	Achievements						
Research Result	<table border="1"> <thead> <tr> <th>Publications</th> <th>Presentations</th> <th>Patents</th> </tr> </thead> <tbody> <tr> <td>24 (SCI 24)</td> <td>Domestic 4 International 20</td> <td>Application 5 Registration 5</td> </tr> </tbody> </table>	Publications	Presentations	Patents	24 (SCI 24)	Domestic 4 International 20	Application 5 Registration 5
Publications	Presentations	Patents					
24 (SCI 24)	Domestic 4 International 20	Application 5 Registration 5					
Analytical Methods	<ul style="list-style-type: none"> Structural analysis of the SARAH domain complex from MST1 and Rassf5 by using X-ray/NMR techniques NMR analysis of the protein interaction between N-TXNIP and TRX Structure analysis of the antibiotic Lajollamvcins from tropical marine microorganisms Studies on the changed protein folding by the different protonation status of glutamate Structure analysis of the Tyr-rich channel binding compounds with Polo-Box Domain NMR analysis of protein-protein interaction using unfolding and binding mechanism X-ray crystallography analysis of heparin and angiogenin complex 						
Projects	<ul style="list-style-type: none"> Structural analysis of protein-protein interaction and design of inhibitor Systematic quality controls for the maintenance of liquid NMR spectrometers The development of inhibitors targeting Polo-box domain of Polo-like Kinase 1 and their structural analysis using X-ray and NMR 						
Training of Equipment	<ul style="list-style-type: none"> 2014 KBSI Bio-NMR workshop 						
Equipment	<p>Installed</p> <ul style="list-style-type: none"> 900, 800, 700 MHz NMR spectrometer 500, 400 MHz NMR spectrometer Auto Isothermal Titration Calorimeter Macromolecular X-ray Petide Synthesizer Multi-Angle Light Scattering Circular Dichroism Spectropolarimeter <p>To Be Installed</p> <ul style="list-style-type: none"> DynaPro Plate Reader II system 						

Analysis Service

974	Cases
6,081	Samples
195	Users

Image



Structures of hetero- and homo-dimer formed by SARAH domains and the resulting mechanism of Hippo signaling

Equipment



900 MHz nuclear magnetic resonance spectrometer



800 MHz nuclear magnetic resonance spectrometer



Macromolecular X-ray

Degenerative Disease Research

Gwangju Center

Gwangju Center focuses on degenerative diseases research and exerts our best efforts to activate collaborations, such as joint research and analysis support, through operating large cutting-edge research equipment and maintaining of Animal Facility of Aging Science (AFAS).

Main Research Activity

AFAS in Gwangju Center is the only animal facility in the nation who supplies high quality aged animals raised in the individually ventilated cages (IVC) at the specific pathogen free (SPF) facility to prevent cross contamination. Gwangju Center supports researchers in academia, industry and medical fields by providing qualified aged animals (over 28 months old) and through close collaboration. Their supports are not limited to biomedical fields but are also active in physical science and engineering fields by continuously establishing cutting edge researchers equipment and collaboration.

Representative Research Case

Drug development for nonalcoholic fatty liver disease (NAFLD)

Nonalcoholic fatty liver disease (NAFLD) is a worldwide metabolic syndrome defined by an increased accumulation of fat, mainly triglycerides in hepatocytes. Our findings provide novel evidence that PRMT3 regulates hepatic lipogenesis via interaction with LXRA. Targeting of PRMT3 is a potential approach to the treatment of NAFLD and prevention of the side effects of the LXRA agonist.

Study on regulation of steroidogenesis in male reproduction

BiFC assay revealed that TGF- β 1 signaling suppress steroidogenesis through the physical interaction between Nur77 and Smad3 by confocal microscopy

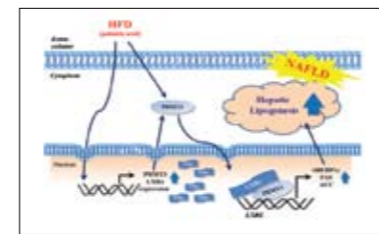
Major Achievements

Category	Achievements		
Research Result	Publications 7 (SCI 7)	Presentations Domestic 2	Patents Application 0
Analytical Methods	<ul style="list-style-type: none"> Therapeutic analysis for nonalcoholic fatty liver disease Identification of biomarker and improvement of egg quality for aged women Molecular mechanism in signaling repression of testicular steroidogenesis 		
Projects	<ul style="list-style-type: none"> NGFI-B and Btg2 are bi-functional proteins; two different organs between nuclear and mitochondria 		
Training of Equipment	<ul style="list-style-type: none"> The basic principle and education of NMR Inorganic elemental analysis by ICP-OES 		
Equipment	Installed <ul style="list-style-type: none"> Laser scanning confocal microscope online LC-NMR/MS Multi-TEM Animal facility of aging science Super-resolution TIRF Microscope Real-time PCR Automatic chemistry analyzer To Be Installed <ul style="list-style-type: none"> Micro-CT(2015) 		

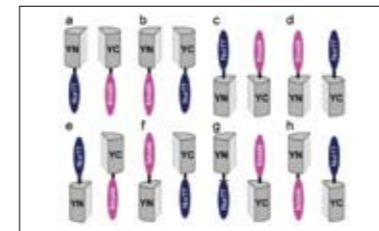
Analysis Service



Image



Regulation of PRMT3 and LXRA expression in non-alcoholic fatty liver disease(NAFLD)

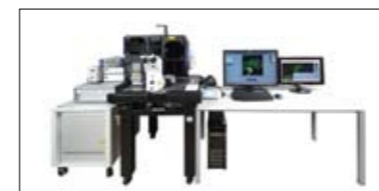


Eight combination for BiFC assay

Equipment



Laser Scanning Confocal Microscope



Super-Resolution TIRF Microscope



Real-Time PCR





2

JOINT UTILIZATION OF ADVANCED EQUIPMENT

INTEGRATIVE BIOSCIENCES RESEARCH

Bio Electron Microscopic Research
Metabolomics Research
Marine Biology Research

Human's quality of life will improve through various research of life. In order to research a biological substance, bio-convergence science research based on biological phenomena based on biological phenomena is needed. That includes comprehensive research on bio electron microscopic application, biological imaging, metabolomics, and marine biology and investigation of the structure of biological substances using high-tech analytical equipment and fusion technology to include identification of in vivo function and control mechanisms.

Bio Electron Microscopic Research

Division of Electronic Microscopic Research

Division of Electron Microscopic Research is devoted to the development and application of technologies for (cryo) specimen preparation, 3D (cryo) electron microscopy, as well as image analysis for nano-bio convergence applications.

Main Research Activity

Scientists in the Division of Electron Microscopic Research have determined the structure and function of protein complexes that are critical to bacterial pathogenicity, and also have conducted collaborative research on brain and neurodegenerative disease for near-atomic resolution 3D electron microscopy and nano-bio convergence.

Representative Research Case

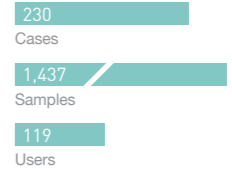
Structural analysis of protein complexes involved in bacterial drug resistance

We employed electron microscopic single particle analysis to determine structure and function of the multi-drug efflux pump found in Gram-negative bacteria, and we expect our noble finding would contribute to the development of drugs against new strains of pathogenic bacteria.

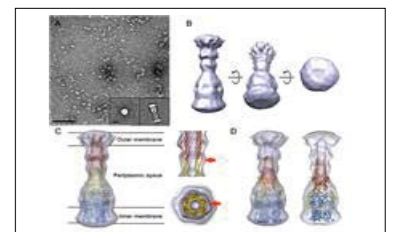
Major Achievements

Category	Achievements		
Research Result	Publications 10 (SCI 10)	Presentations Domestic 19 International 4	Patents Application 5 Registration 2
Analytical Methods	<ul style="list-style-type: none"> Maximum-likelihood image processing method for high resolution single particle analysis of protein structures Adult stem cell detection and analysis technology based on epigenetic biomarker and asymmetric self-renewal Development of correlative microscopy based on 3D cryo-electron tomography Tomography analytical method for 3 dimensional structure analysis of thick specimen Immuno EM analytical method for the discovery of degenerative neuropathy protein of mouse brain. 		
Projects	<ul style="list-style-type: none"> Super Bio-HVEM installation and operation project Application of HVEM for correlative biological 3D imaging, and 6 others 		
Training of Equipment	<ul style="list-style-type: none"> 6 cases of public education programs and imaging equipment training 		
Equipment	Installed <ul style="list-style-type: none"> High Voltage Electron Microscope, HVEM Bio-Transmission Electron Microscope, Bio-TEM Cryo-Transmission Electron Microscope, Cryo-TEM Environmental-Scanning Electron Microscope, E-SEM 		
	To Be Installed <ul style="list-style-type: none"> Super Bio-High Voltage Electron Microscope(2015) 		

Analysis Service



Image



Determination of structure and function of bacterial multi-drug efflux protein complex

Equipment



Bio-TEM (TECNAI G2 Spirit Twin, FEI)



Cryo-TEM (JEM 1400Plus, JEOL)



E-SEM (LEO 1455VP, Carl Zeiss)

Metabolomics Research

Western Seoul Center

Integrative metabolomics research is discovering biomarkers for disease/therapy by profiling metabolites that change depending on the disease.

Main Research Activity

Metabolic profiling was developed based on NMR spectroscopy and Mass Spectrometry. Characteristic metabolites related to cardiovascular disease, obesity and cancer were identified, providing the biomarker for diagnosis.

Representative Research Case

Urinary and tissue metabolic profiling reveals pathways and biomarkers associated with gastric cancer

¹H-NMR and HR-MAS NMR based metabolic profiling of urines and tissues from patients with gastric cancer was applied to elucidate the mechanism underlying gastric cancer. This study demonstrates that urinary and tissue metabolite profiling is useful for the diagnosis of gastric cancer and a further understanding of its pathogenesis.

Major Achievements

Category	Achievements		
Research Result	Publications 15 (SCI 15)	Presentations Domestic 27 International 4	Patents Application 1
Analytical Methods	<ul style="list-style-type: none"> Metabolic characterization of Drosophila models altered in synaptic architectures by HR-MAS NMR spectroscopy Metabolic profiling of dyslipidemia in high fat diet induced rat model using NMR spectroscopy GC-TOF/MS based metabolomics analysis Identification strategy for unknown compounds by unit mass resolution GC/MS Analytical method of derivitized short chain fatty acids by GC-MS Analysis of polar amino acids using simple extraction method by CE-MS Development of the new diagnosis method of gastric cancer by metabolite profiling using urine Development of discrimination method of Curcuma species grown in different regions using metabolic profiling Analysis of dose-dependent metabolic alterations in human cells exposed to gamma irradiation Development of the effective diagnosis method of Alzheimer's disease using NMR/multivariate data analysis 		
Projects	<ul style="list-style-type: none"> Investigation of biological pathway and biomarker discovery for diseases using metabolite profiling approach Development of NMR based metabolomics/chemometrics for diagnosis and treatment of chronic kidney disease Development of country-of-origin or authenticity discrimination techniques for foods Development of multiple diagnostic and therapeutic technology in cardiovascular disease using fusion research of metabolomics and bio-imaging Metabolic profiling studies for prediction and management of the metabolic syndrome 		
Training of Equipment	<ul style="list-style-type: none"> Trace quantitative analysis by Mass Spectrometry Chromatographic separation and qualitative analysis by Mass Spectrometry 		
Equipment	Installed <ul style="list-style-type: none"> 800 MHz Nuclear magnetic resonance - Mass Spectrometer System Online liquid chromatograph/Mass spectrometer/Nuclear Magnetic Resonance spectrometer system 700 MHz High resolution-magic angle spinning Nuclear Magnetic Resonance (HR-MAS NMR) 500 MHz Fourier Transform-Nuclear Magnetic Resonance (500 MHz FT-NMR) Gas Chromatograph-Mass Spectrometer (GC-MS) Triple Quadrupole Liquid Chromatograph-Tandem Mass Spectrometer (TQ LC/MS/MS) Ultra Performance Liquid Chromatograph-Time of Flight Mass Spectrometer (UPLC QTOF MS) Liquid Chromatograph/Capillary Electrophoresis-Mass Spectrometer (LC/CE-MS) Two Dimensional Gas Chromatograph Time of Flight Mass Spectrometer 		

Analysis Service

93

Cases

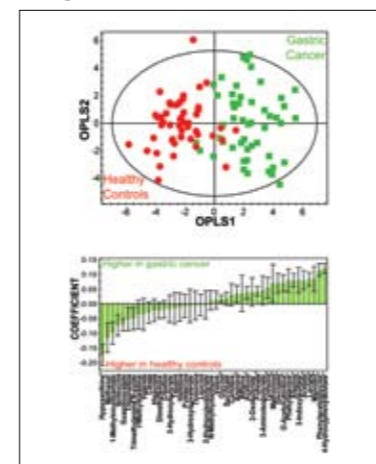
1,942

Samples

32

Users

Image



Score plot and loading plot derived from the metabolite concentrations obtained by metabolite profiling of urine

Equipment



800 MHz NMR-MS System



600 MHz online LC-MS-NMR System



UPLC-TQ MS

Marine Biology Research

Jeju Center

Researches in biomedical manufacturing technology and environment-friendly recovery with marine organisms are carried out.

Main Research Activity

Research for the ichthyotoxic mechanism of the harmful dinoflagellate phytoplankton and the various effects of bio-active substances isolated from marine algae.

Representative Research Case

Phylogenetic analysis of microalgae based on highly abundant proteins using Mass Spectrometry

This research suggested that MALDI-TOF MS method for microalgal proteins was comparable in terms of the rapid identification of microalgae to conventional methods based on genetic information and morphology.

Anti-inflammatory effect of sargachromanol D (SD) isolated from Sargassum siliquastrum

We investigated whether SD isolated from S. siliquastrum inhibited production of inflammatory mediators and pro-inflammatory cytokines by LPS-induced RAW 264.7 cells.

These findings suggest that SD may be a therapeutically useful secondary metabolite for inflammation and related diseases.

Major Achievements

Category	Achievements		
Research Result	Publications 20 (SCI 20)	Presentations Domestic 7 International 3	Patents Registration 2
Projects	<ul style="list-style-type: none"> Genomic study of non-culturable microorganisms in food and human Isolation and bioprospecting of novel species of archaea from extreme environments Culture of microalgae and development of new potential materials Specific analysis in marine biology 		
Training of Equipment	<ul style="list-style-type: none"> Training of Scanning Transmission Electron Microscope Training of GC-MS and ICP-MS 		
Equipment	Installed <ul style="list-style-type: none"> Bio-LC LC/MS System Recycling HPLC Amino Acid Analyzer Bio Imaging Navigator GC-Mass Spectrometer High Sensitivity Spectral Laser Confocal Microscopy System Variable Pressure Field Emission Scanning Electron Microscope with Scanning Transmission Electron Microscope Inductively Coupled Plasma Mass Spectrometer Electron Paramagnetic Resonance Spectrometer 		

Analysis Service

90

Cases

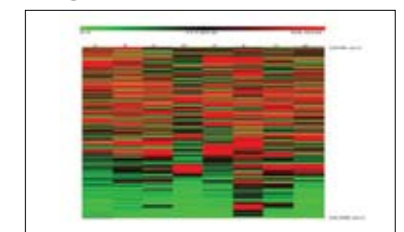
1,048

Samples

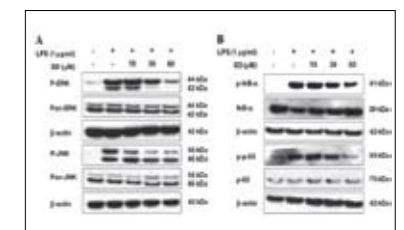
41

Users

Image



Mass spectra for proteins of microalgae



The effect of SD on activation of MAPK (A) and NF-κB (B)

Equipment



Variable Pressure Field Emission scanning Electron Microscope with Scanning Transmission Electron Microscope



Headspace Gas Chromatograph Tandem Mass Spectrometer



High Sensitivity Spectral Laser Confocal Microscopy System



3

JOINT UTILIZATION OF ADVANCED EQUIPMENT

ENVIRONMENTAL AND BIOLOGICAL DISASTER RESEARCH

- Geochronology Research
- Trace Element Analysis Research
- Biological Disaster Research
- Environmental Analysis Research
- Analytical Research for Energy and Environment

Based on world class analytical facilities, Environmental and Biological Disaster Research Group is developing technical and scientific resolutions for issues of national and social concerns such as environmental and biological disasters and criminal investigation.

Geochronology Research

Division of Earth and Environmental Science Research

Various techniques are being developed to determine ages of major geological, environmental and planetary changes, via independent and collaborative researches.

Main Research Activity

New dating techniques were developed for Quaternary based on the multi-collector noble gas mass spectrometer, and for river-generated sediments using a measurement system based on radioactive isotopes and luminescence.

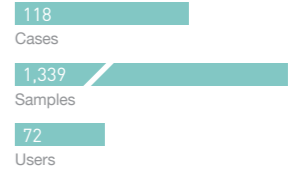
Representative Research Case

Zircon U-Pb age and Hf isotopic constraints on the Precambrian crustal evolution of the North-eastern Yeongnam Massif, Korea
 The Precambrian history of the North-eastern Yeongnam Massif in Korea was revealed by Zircon U-Pb ages: sedimentation at 2.1-1.98 Ga, peraluminous igneous activity at 1.98 Ga and co-magmatic metamorphism at 1.86 Ga. In addition, Hf isotope data suggested recycling of crustal materials for magma generation.

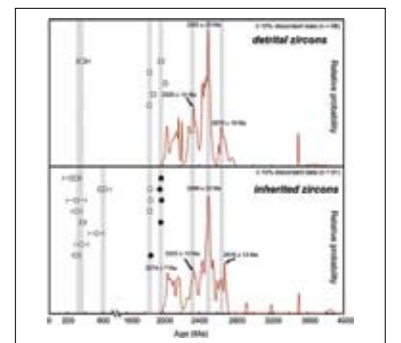
Major Achievements

Category	Achievements	
Research Result	Publications 27 (SCI 18)	Presentations Domestic 25 International 7
Analytical Methods	<ul style="list-style-type: none"> • Age determination of lunar zircon • Single-grain OSL age dating for the sediment layer of the middle stone age • Development of luminescence signal processing for the quartz and feldspar using pulsed OSL • Ar-Ar age dating for the Quaternary volcanics • Correction of Hf isotope measurement using MC ICP-MS • Study for strontium isotope in human bone from Chosun period • Correction of Sr isotope measurement using thermal ionization mass spectrometer • Petrological application of Mg isotope • Correction of SHRIMP age for the high-U zircon mineral • GRM analysis of corrected Sm-Nd isotope measurement using MC ICP-MS 	
Projects	<ul style="list-style-type: none"> • Development of standard analytical protocol of various material using the Secondary Ion Mass Spectrometer • Management procedure of SIMS cluster • Tectonics and origin of Mesozoic granitoids in South Korea • Exploration and development technology of domestic rare metal resources 	
Training of Equipment	<ul style="list-style-type: none"> • School for age determination • SHRIMP User School 	
Equipment	Installed	
	<ul style="list-style-type: none"> • High-Resolution Secondary Ion Mass Spectrometer • Thermal Ionization Mass Spectrometer • Optically Simulated Luminescence Measurement System • Noble Gas Mass Spectrometer 	
	To Be Installed	
	<ul style="list-style-type: none"> • Laser Ablation Multi-collector Inductively Coupled Mass Spectrometer(2015) 	

Analysis Service

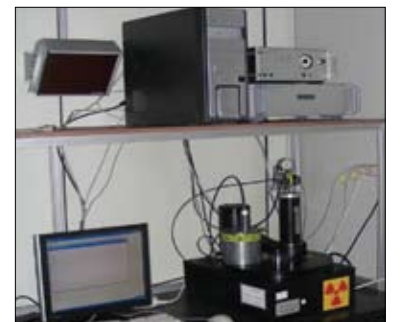


Image



Histogram of the SHRIMP zircon ages from the north-eastern Yeongnam Massif in Korea

Equipment



Automatic luminescence Measurement system



Multi-collector noble Gas Mass Spectrometer



Thermal Ionization Mass Spectrometer

Trace Element Analysis Research

Division of Earth and Environmental Science Research

Scientists in the Division of Earth & Environmental Sciences materials and provide analytical services to scientists in relevant fields as well as conduct various joint researches.

Main Research Activity

Techniques for Mg and Li isotope measurements have been developed for the first time in Asia and applied to the study of climate changes.

Representative Research Case

Application of Li isotopes for paleoclimate studies

Li isotopes of soils were measured to establish a 4 Ma chronosequence in the Hawaiian Islands, which indicated that the non-monotonous evolution of the regolith $\delta^7\text{Li}$ values over 4 Ma was consistent with known climatic variations.

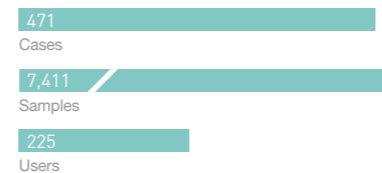
Imaging trace element quantitative distribution by LA-ICP-MS

Development of the technique that visualizes the quantitative distribution of trace elements in heterogeneous samples by LA-ICP-MS. It becomes possible to show two dimensional quantitative distributions of the trace elements in various samples.

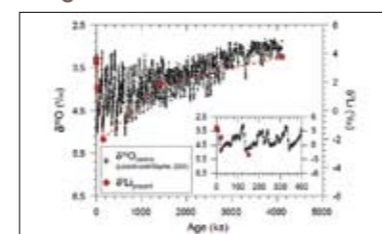
Major Achievements

Category	Achievements									
Research Result	<table border="1"> <tr> <td>Publications</td> <td>Presentations</td> <td>Presentations</td> </tr> <tr> <td>8 (SCI 7)</td> <td>Domestic 9</td> <td>Application 2</td> </tr> <tr> <td></td> <td>International 5</td> <td>Registration 4</td> </tr> </table>	Publications	Presentations	Presentations	8 (SCI 7)	Domestic 9	Application 2		International 5	Registration 4
Publications	Presentations	Presentations								
8 (SCI 7)	Domestic 9	Application 2								
	International 5	Registration 4								
Analytical Methods	<ul style="list-style-type: none"> Trace element analysis of geological samples using glass beads and LA-ICP-MS Quantitative analysis of trace elements based on the line analysis of LA-ICP-MS 									
Projects	<ul style="list-style-type: none"> Development of Reuse Continuous system for LED Precursor using the ICP-MS and NMR analyzer Establishment of Material Flow Statistics for Metals Development of Analysis methods and Purification process for Ga/In metal CO₂ evasion from the Polar Ice Sheet: carbon-climate feedback 									
Training of Equipment	<ul style="list-style-type: none"> Inorganic element analysis using ICP-AES and ICP-MS Trace element analysis using LA-ICP-MS I, II, III 									
Equipment	Installed <ul style="list-style-type: none"> Multi Collector-Inductively Coupled Plasma-Mass Spectrometer, MC-ICP-MS Inductively Coupled Plasma-Mass Spectrometer, ICP-MS Glow Discharge-Mass Spectrometer, GD-MS Inductively Coupled Plasma-Atomic Emission Spectroscopy, ICP-AES Laser Ablation-Inductively Coupled Plasma-Mass Spectrometer, LA-ICP-MS 									

Analysis Service



Image



$\delta^7\text{Li}$ of the present Li (on right axis) and $\delta^{18}\text{O}$ of benthic forams (on left axis) versus age

Equipment



Multi-Collector Inductively Coupled Plasma Mass Spectrometer



Inductively Coupled Plasma Mass Spectrometer



Inductively Coupled Plasma Atomic Emission Spectrometer

Biological Disaster Research

Division of Life Science Research

Biological disaster researches aim at the development of problem-solving techniques for disaster-causing microorganisms in the field of agriculture, animal industry and fishery. Main research areas cover the concentration and detection of foodborne pathogenic virus, the analysis of fish disease and the early screening method of algal bloom bacteria.

Main Research Activity

As a representative highlight of scientific achievement in the field of biological environmental disaster, researchers developed a novel technology to efficiently concentrate norovirus, a major foodborne pathogenic virus, with sword bean lectin protein and succeeded in transferring the technology to small and medium-sized bioventure.

Representative Research Case

Development of rapid concentration method of human norovirus

Human norovirus can not be cultivated in laboratory and a major cause of mass food poisoning. Biological disaster research team developed a novel and rapid concentration method using sword bean lectin protein which can reduce concentration time from 6 hours using the existing method to 15 min by the new method. This technique can be applied for the advanced prevention against food poisoning and will contribute to the public healthcare.

Elucidation of infection mechanism to flatfish by VHSV

When the flatfish is infected by viral hemorrhage septic virus (VHSV) as a major causative fish virus, F-type lectin can regulate the proteome expression in flatfish. This information on VHSV infection mechanism can be applied to develop the therapeutic drug and vaccine.

Major Achievements

Category	Achievements									
Research Result	<table border="1"> <tr> <td>Publications</td> <td>Presentations</td> <td>Presentations</td> </tr> <tr> <td>13 (SCI 13)</td> <td>Domestic 4</td> <td>Application 4</td> </tr> <tr> <td></td> <td>International 2</td> <td></td> </tr> </table>	Publications	Presentations	Presentations	13 (SCI 13)	Domestic 4	Application 4		International 2	
Publications	Presentations	Presentations								
13 (SCI 13)	Domestic 4	Application 4								
	International 2									
Analytical Methods	<ul style="list-style-type: none"> Rapid concentration method of foodborne norovirus Analytical method for fish proteome network by VHSV infection 									
Projects	<ul style="list-style-type: none"> Development of analytical methods for biological environmental disasters (KBSI Research Fund) Development of rapid concentration and detection of human norovirus (Consignment Research Fund) 									
Training of Equipment	<ul style="list-style-type: none"> Education of field-applicable norovirus concentration techniques to the engineers at Solgent Ltd. 									
Equipment	Installed <ul style="list-style-type: none"> LC-MS/MS Next Generation Sequencer 									

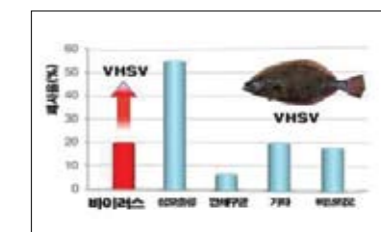
Analysis Service



Image



Scheme of rapid concentration method of foodborne pathogenic norovirus particles contained in Kimchi



Perish of flatfish by viral hemorrhage septic virus and proteome network by VHSV-induced F-type lectin

Equipment



LC-MS/MS Synapt G2



Next Generation Sequencer, MiSeq

Environmental Analysis Research

● Seoul Center

The environmental analysis researches are being conducted to develop analytical methods for various organic and inorganic pollutants, and to establish scientific resolutions for environmental disasters such as chemical leakages.

Main Research Activity

Methods to assess pollutant levels in soils and wastes have been developed, and protocols for contaminated site monitoring were established. A fast and accurate screening technology was developed to detect fluoride concentration in soils. In this officially recognized national test laboratory, scientists conduct dioxin analysis in foods and safety assessment of PCBs for 500 fish and clam samples.

Representative Research Case

Application of wavelength dispersive X-ray fluorescence spectrometry for fluorine analysis in soils

A wavelength dispersive X-ray fluorescence spectrometry was applied for the determination of fluorine in soil samples with high analytical sensitivity. The LOD value of 800 ppm by the existing method was improved to 100 ppm with a new method using polyvinyl alcohol at 9:1 weight ratio.

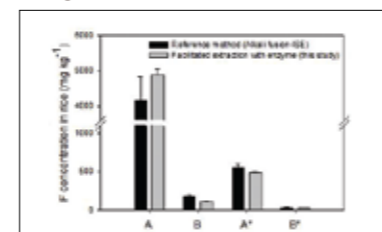
Major Achievements

Category	Achievements		
Research Result	Publications 9 (SCI 7)	Presentations Domestic 26 International 12	Patents 3
Analytical Methods	<ul style="list-style-type: none"> Speciation analysis of selenium in lactic acid bacteria by multidimensional LC-ICP-MS Analysis of the useful component in native plants by HR-GC/TOF Analysis of the efficacy materials in natural extracts (bellflower) according to extraction solvent Method development of metabolites analysis in tissue using imaging mass spectrometry 		
Projects	<ul style="list-style-type: none"> Study on the Marine Biofouling Processes at Seawater Pilot Plant Development of monitoring and management protocols for the hazardous chemical substances in environment Development of Assessment Tools for Measuring Fluoride concentrations in soil and waste for field application Development of Pre-built management systems for contamination spreading in soil and groundwater for the environmental monitoring of hazardous chemicals. Study of safety management of dioxins and PCBs in food Build and Maintain of Reliability Assurance Scheme Method development of PCNs and SCCPs in food A study on method development of pollutants monitoring and tracking sourced of pollutants 		
Training of Equipment	<ul style="list-style-type: none"> Technical training course of Dioxins analysis by using HRGC/HRMS 		
Equipment	<p>Installed</p> <ul style="list-style-type: none"> High Resolution Gas Chromatography/High Resolution Mass Spectrometer, HRGC/HRMS High Performance Liquid Chromatography Inductively Coupled Plasma Mass Spectrometer, HPLC-ICP-MS Inductively Coupled Plasma Atomic Emission Spectrophotometer, ICP-AES Wavelength Dispersive X-ray Fluorescence Spectrometer, WD-XRF Energy Dispersive X-ray Fluorescence Spectrometer, ED-XRF X-ray Diffraction Spectrometer, XRD <p>To Be Installed</p> <ul style="list-style-type: none"> Inductively Coupled Plasma Atomic Emission Spectrophotometer, ICP-AES Gas Chromatography Triple Quadrupole Mass Spectrometer, GC-MS/MS Liquid Chromatography Triple Quadrupole Mass Spectrometer, LC-MS/MS 		

Analysis Service



Image



Sequential strategies for quantitative F analysis using wavelength dispersive X-ray fluorescence spectrometry (Talanta, 2015, IF 3.511, JCR 16.0%)

Equipment



High Performance Liquid Chromatography-Inductively Coupled Plasma Mass Spectrometer



Wavelength Dispersive X-ray Fluorescence Spectrometer



High Resolution Gas Chromatography/High Resolution Mass Spectrometer

Analytical Research for Energy and Environment

● Suncheon Center

We investigate and cooperate to develop the functional materials for rechargeable batteries, fuel cell and rare element absorbents.

Main Research Activity

We developed new electrode materials for rechargeable batteries based on Nb and Ti metals. Also, we optimized their performances by modifying surface morphology and synthetic conditions. The Ca-ion cell was also reported as a new post Li-ion battery. And we investigated the electrical characteristics of metal contact to GaN.

Representative Research Case

Development of the Nb-based anode material for Li-ion batteries
fluorine analysis in soils

Development of the Nb-based anode material for Li-ion batteries

Development of the surface coating technique for enhanced battery performances in Nb-based anode.

Development of the Ti-based sulfide material for Ca-ion batteries

Investigation of GaN Interfaces and Thermal Instability

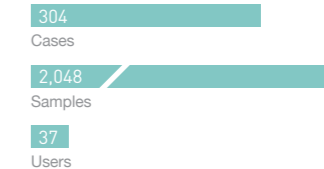
fluorine analysis in soils

We analyzed to inhomogeneous Carrier Transport at Contact/GaN Interfaces and Thermal Instability

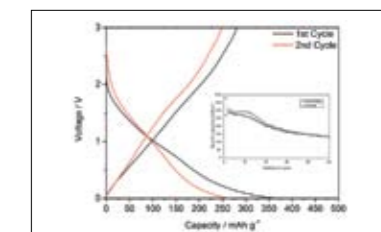
Major Achievements

Category	Achievements		
Research Result	Publications 12 (SCI 10)	Presentations Domestic 10 International 3	Presentations Application 6 Registration 2
Projects	<ul style="list-style-type: none"> Suncheon Center operational project Development of high stability negative electrode materials using metallic oxide 		
Training of Equipment	<ul style="list-style-type: none"> Learning first electronic state calculation World of nanoparticles viewing with an Electron Microscope 		
Equipment	<p>Installed</p> <ul style="list-style-type: none"> Field Emission Transmission Electron Microscope High Resolution Field Emission Scanning Electron Microscope High Power X-ray Diffractometer Differential Scanning Calorimetry X-ray Fluorescence Spectrometry <p>To Be Installed</p> <ul style="list-style-type: none"> In-situ X-ray Diffractometer System TEM Sample Preparation System 		

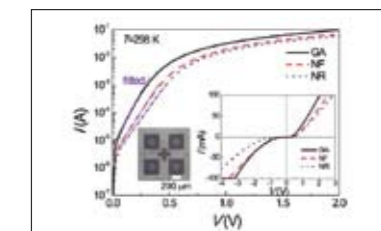
Analysis Service



IMAGE



Electrochemical performances of Nb-based electrode



Semilogarithmic forward I-V curves of Schottky diodes formed on the GA, NF, and NR samples

Equipment



High Resolution Transmission Electron Microscope (HR-TEM)



Field Emission Scanning Electron Microscope (FE-SEM)



X-ray Diffractometer (XRD)



4

JOINT UTILIZATION OF ADVANCED EQUIPMENT

NANO MATERIALS RESEARCH

- Surface Analysis of Nano Materials
- Nano Electron Microscopic Research
- Analytical Research of Energy and Environmental Materials
- Surface Physical Property Research
- Characterization and Analysis of Nanostructures and Carbon-Based Nanomaterials
- High-tech Fusion Materials Research
- Nano Materials Imaging Research

Researching high-tech analytical technology and instruments provide crystal, surface and electronic structure of advanced materials in nano scale to promote progress in national nano science through collaborative research. Furthermore and analytical fusion study for nano-energy and nano-bio is performed to improve efficient utilization of nanomaterials by studying new properties of the materials.

Surface Analysis of Nano Materials

Division of Materials Science Research

The purpose of this system is to provide a total analytical solution to both universities and industries through the the one-line in-situ analytical system.

Main Research Activity

Perform the researches about the introduction and installation of NAP-XPS, the introduced preparation for the LEEM/PEEM (1st test completion), the installation of PE-ALD and the design for the Magnetron sputter

Representative Research Case

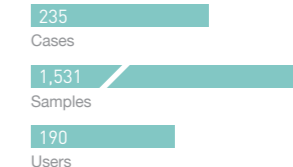
Development of mass production technology of photocatalysts at room temperature

This manufacturing technology is a mass-production of photocatalysts using simple preparing methods at room temperature. It can be used to decompose toxic organics molecules and sterilize microorganisms.

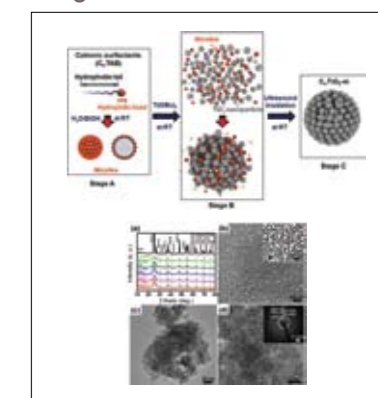
Major Achievements

Category	Achievements		
Research Result	Publications 27 (SCI 27)	Presentations Domestic 7 International 5	Presentations Application 3
Analytical Methods	<ul style="list-style-type: none"> · The analytical method for the chemical stoichiometry on the insulating materials using XPS · The structural analysis for the low-dimensional nano-material for use in Kelvin Probe Microscopy · In-situ NAP-XPS analysis for the growth mechanism on the oxidized-layer 		
Projects	<ul style="list-style-type: none"> · The development of multi-disciplinary in-situ analytical system nanotechnology and related science · The study of synthetic mechanism and selective functionalization for high-quality graphene · The study of structural properties and electron transfer mechanism in organic/inorganic hybrid device interfaces 		
Training of Equipment	<ul style="list-style-type: none"> · 2014' SpectroNanoscopy Workshop · 10th Surface Analysis Symposium 		
Equipment	Installed <ul style="list-style-type: none"> · Micro X-ray/UV Photoelectron Spectrometer · Ultra High Vacuum Scanning Tunneling Microscopy · Near Ambient Pressure X-ray Photoelectron Spectrometer · Plasma-Enhanced Atomic Layer Deposition · Linear Multi-sample Transfer System 		
	To Be Installed <ul style="list-style-type: none"> · Low Energy Electron Microscopy · PhotoEmission Electron Microscopy · Angle-Resolved Ultraviolet Photoelectron Spectrometer · Magnetron Sputterin System 		

Analysis Service



Image



Large-scale preparation of photocatalysts with high photocatalytic performance

Equipment



UHV-SPM



NAP-XPS



LEEM/PEEM

Nano Electron Microscopic Research

Division of Electronic Microscopic Research

Division of Electron Microscopic Research is engaged in structural analysis of nano materials by developing convergence imaging techniques.

Main Research Activity

The construction of an advanced electron microscope specializes in nano convergence analysis has been launched.

Major electron microscopy techniques (spectroscopy, crystallography, tomography and cryo-EM) were established for the advancement in research support.

Devices and methods related to the key imaging technology were developed for the improvements in the performance of electron microscopes.

Representative Research Case

The first atomic-scale observation of ferroelectric field effect in ferroelectric interface

The researchers, from KBSI in Korea in collaboration with the scientists from Norway, Ukraine and the United States, observed for the first time the effect in ferroelectric materials that exhibited switchable electrical polarization.

The new structural identification of a single-wall carbon nanotube

The new structure of a single-wall carbon nanotube was identified by collaborative efforts between KBSI and KIST research groups. The study provided unambiguous evidence that certain single-wall carbon nanotubes are not seamless tubes, but instead adopt a graphene helix that results from the spiral growth of a nano-graphene ribbon.

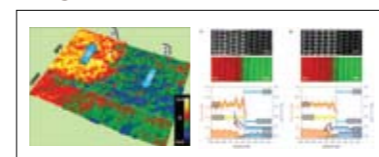
Major Achievements

Category	Achievements		
Research Result	Publications 22 (SCI 21)	Presentations Domestic 17 International 5	Presentations Application 4 Registration 2
Analytical Methods	<ul style="list-style-type: none"> Oxide Interface Analytical Methods Advanced Analytical Methods using UC-EF-TEM and 9 others 		
Projects	<ul style="list-style-type: none"> HVEM operation project Development of NanoBio Convergence SEM/STEM core equipment, and 7 others 		
Training of Equipment	<ul style="list-style-type: none"> 4 cases of public equipment trainings 		
Equipment	Installed <ul style="list-style-type: none"> High Voltage Electron Microscope, HVEM UC-Energy Filter-Transmission Electron Microscope, UC-EF-TEM Field Emission-Transmission Electron Microscope, FE-TEM Energy Filter-Transmission Electron Microscope, EF-TEM UHA Field Emission-Scanning Electron Microscope, UHA FE-SEM Electron Probe Micro-Analyzer, EPMA High Temperature X-ray Diffractometer, HT-XRD Focused Ion Beam, FIB To Be Installed <ul style="list-style-type: none"> Multi Purpose XRD, 2015 		

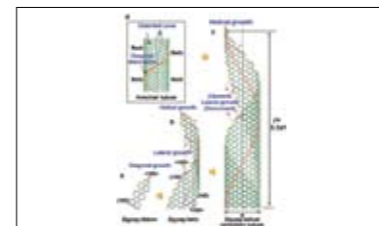
Analysis Service

615
Cases
3,328
Samples
153
Users

Image



(Left) Unit-cell-wise polarization mapping based on quantitative aberration-corrected EM and (Right) atomic scale EELS analysis at the interface in BiFeO₃ ferroelectric thin film



The growth model of a SWNT identified by using high resolution electron microscopy and energy calculation method

Equipment



UC-Energy Filtered Transmission Electron Microscope



Ultra High Analytical Scanning Electron Microscope



Temperature Control Multi Source Ion Miller (Ar, Xe, Kr)

Analytical Research Energy and Environmental Materials

Western Seoul Center

Characterization of energy conversion materials/systems using solid-state nuclear magnetic resonance spectroscopy, electron paramagnetic resonance spectroscopy investigation on bio/nano-materials, and development of highly efficient nanocatalysts for environmental remediation were carried out.

Main Research Activity

We analyzed structure of amyloid peptides as the major cause of Alzheimer's disease and structure of water-splitting molecules and developed environmental purification technology using photo-catalyst based on porous silica and AgX (X=Cl or Br), and developed an on-line NMR system to analyze chemical compounds in exhausts of direct alcohol fuel cells.

Representative Research Case

Environmental remediation application using highly efficient mesoporous silica nanoparticles

The removal/adsorption properties of mesoporous silica nanoparticles with respect to pollutants, such as heavy metals, organic toxic reagents and microcystins was investigated. The mesoporous silica nanoparticles can be applied in environmental remediation.

Multifrequency, multitechnique pulsed electron paramagnetic resonance spectroscopic investigation on copper-murine amyloid peptide

Copper-amyloid peptides are proposed to be the cause of Alzheimer's disease. However, mice do not produce amyloid plaques and thus do not suffer from Alzheimer's disease. This paper shows the first detailed structural characterization of the copper-binding mode in murine amyloid b peptides.

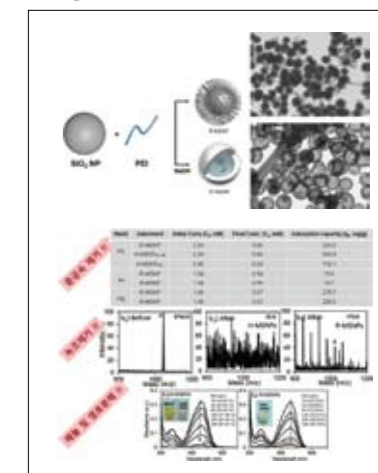
Major Achievements

Category	Achievements		
Research Result	Publications 13 (SCI 12)	Presentations Domestic 14 International 6	Presentations Application 2 Registration 3
Analytical Methods	<ul style="list-style-type: none"> Quantitative analysis of 5- and 6-coordinated Y in Y substituted BaZrO₃ Measurement of powder resistivity of carbon nanotubes Measurement of water contents in Nafion using ²H NMR spectroscopy 		
Projects	<ul style="list-style-type: none"> Development and application of nuclear magnetic resonance techniques for investigation of electrochemical reaction and ionic behavior Environmental Remediation using multi-dimensional hierarchical nanostructures Fibrilization of amyloid peptide in Alzheimer's disease using EPR spectroscopy Multifrequency, multitechnique EPR study on bio/energy related materials 		
Training of Equipment	<ul style="list-style-type: none"> 4 cases of public equipment trainings 		
Equipment	Installed <ul style="list-style-type: none"> Single Crystal X-ray Diffractometer 600 MHz Solid State FT-NMR Spectrometer 400 MHz Solid State FT-NMR Spectrometer(A) 400 MHz Solid State FT-NMR Spectrometer(B) 200 MHz Solid State FT-NMR Spectrometer 500 MHz FT-NMR Spectrometer CW/Pulse EPR System To Be Installed <ul style="list-style-type: none"> 400 MHz Solid State FT-NMR Spectrometer(C) 		

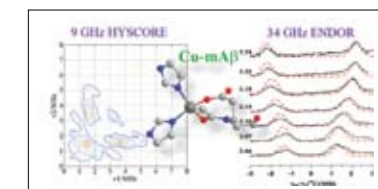
Analysis Service

301
Cases
1,427
Samples
146
Users

Image



Synthesis of mesoporous silica nanoparticles using hydrogen bond of polyelectrolytes (left) and their data of possible environmental remediation applications (right)



The structure of copper-murine amyloid b peptide revealed by multi-frequency, multi-technique pulsed electron paramagnetic resonance spectroscopy

Equipment



CW/Pulse EPR System

Surface Physical Property Research

● Busan Center

Perform the researches to identify the compositions, the chemical structures and physical properties on of surfaces using state of the art surface analysis instruments.

Main Research Activity

Perform the researches about the structural characteristics, band gaps, and optical properties of semiconductor nano-materials for solar cells and secondary batteries with the doped amount of elements. In addition, metal surface treatment and analysis of basic research into metal-plastic adhesion components were developed. MgB2 superconducting wire electricity with thermal properties helped developed a breakthrough technology to improve the process.

Representative Research Case

Metal-polymer resin bonding component development for Lithium ion secondary batteries

Al metal and copper was obtained as well as the surface roughness measured over a range of surface treatment of metal. PPS and PPE resin can be used for a metal taip lithium ion secondary battery for an electric vehicle, so a one piece plastic bonded electrode terminal part was developed. The battery has undergone commercialization in the areas of surface analysis techniques and analytical support.

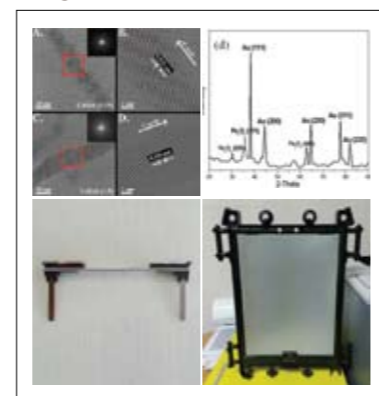
Major Achievements

Category	Achievements						
Research Result	<table border="1"> <thead> <tr> <th>Publications</th> <th>Presentations</th> <th>Presentations</th> </tr> </thead> <tbody> <tr> <td>36 (SCI 36)</td> <td>Domestic 13 International 4</td> <td>Application 4 Registration 1</td> </tr> </tbody> </table>	Publications	Presentations	Presentations	36 (SCI 36)	Domestic 13 International 4	Application 4 Registration 1
Publications	Presentations	Presentations					
36 (SCI 36)	Domestic 13 International 4	Application 4 Registration 1					
Analytical Methods	<ul style="list-style-type: none"> Surface treatment and analysis for improved tensile strength of plastics-maetal Al chemical etching for PPE plastic adhesion its surface analysis Synthesis of semiconductor nano-material and structural phase change analysis of by doping 						
Projects	<ul style="list-style-type: none"> Research and application of bonding technology between metal and organic polymer for energy container Development of cost components developed by the lightweight chemical bonds between the polymer and metal 						
Training of Equipment	<ul style="list-style-type: none"> 25 training courses including exploring surface properties using a microscope The 2nd Dynamic SIMS Workshop 						
Equipment	<p>Installed</p> <ul style="list-style-type: none"> Nano Secondary Ion Mass Spectrometer Angle-Resolved X-ray Photoelectron Spectrometer Time of Flight Secondary Ion Mass Spectrometry Liquid Chromatography Mass Spectrometer Mass Spectrometer Nductively Coupled Plasma Atomic Emission Spectrophotometer <p>To Be Installed</p> <ul style="list-style-type: none"> X-ray Photospectrometer(2015) 						

Analysis Service



Image



Development of the one-piece metal-polymer bonded electrode terminals for the middle/large-sized can-type lithium ion secondary batteries

Equipment



Nano Secondary Ion Mass Spectrometer



Time of Flight Secondary Ion Mass Spectrometry



Angle-Resolved X-ray Photoelectron Spectrometer

Characterization and Analysis of Nanostructures and Carbon-Based Nanomaterials

● Jeonju Center

Jeonju center is performing research support and collaborations to improve nano and carbon-based materials science.

Main Research Activity

Jeonju Center acquired the ISO 9001 Quality Management System certification and can provide reliable analysis of data for creative economy developments.

Representative Research Case

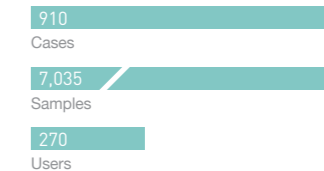
In situ probing of doping- and stress-mediated phase transitions in a single-crystalline VO₂ nanobeam

We demonstrate an experimental in situ observation of the temperature- dependent evolution of doping and stress-mediated structural phase transitions in an individual single-crystalline VO₂ nanobeam on a Au-coated substrate using spatially resolved Raman spectroscopy.

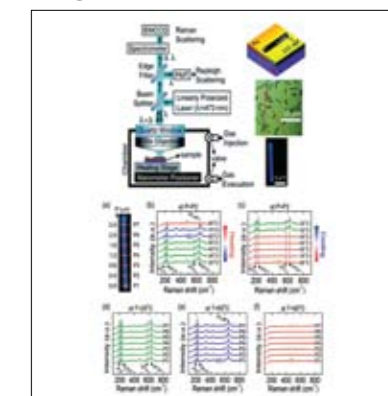
Major Achievements

Category	Achievements						
Research Result	<table border="1"> <thead> <tr> <th>Publications</th> <th>Presentations</th> <th>Presentations</th> </tr> </thead> <tbody> <tr> <td>21(SCI 19)</td> <td>Domestic 21 International 2</td> <td>Application 1 Registration 3</td> </tr> </tbody> </table>	Publications	Presentations	Presentations	21(SCI 19)	Domestic 21 International 2	Application 1 Registration 3
Publications	Presentations	Presentations					
21(SCI 19)	Domestic 21 International 2	Application 1 Registration 3					
Analytical Methods	<ul style="list-style-type: none"> In-situ probing of the evolution of structural phase transition using Raman spectroscopy Using an EPMA analysis to determine igneous rock weathering ratio Porosity analysis of sandstone by using mercury SEM image analysis of nano-layer without edge effect AFM image development method for a electrostatic force generated substance 						
Projects	<ul style="list-style-type: none"> ISO 9001 qualified analysis center of carbon composite materials for support of small and medium businesses Modification of OsO₄ coater gas chamber for enhancing the reproducibility Preparation of porous carbon electrode for bio-sensor Real-time observation and nanoscale analysis of low-dimensional nanostructures and their properties-coupling behaviors by mechanical strain A development of in-situ multi-disciplinary characterization system for oxide electronics using ultrafast phase transitions Development of analysis/synthesis for functional construction materials of carbon-based industry 						
Training of Equipment	<ul style="list-style-type: none"> 25 training courses including exploring surface properties using a microscope The 2nd Dynamic SIMS Workshop 						
Equipment	<p>Installed</p> <ul style="list-style-type: none"> The application and principle of MALDI-TOF MS The application and principle of PSA System Sample Preparation for High Resolution SEM Image Analysis EPMA professional operator training EPMA general operator training Electron interaction and image formation for Transmission Electron Microscopy Principle and application of PSA System Principle and application of Scanning Probe Microscopy Principle and application of Raman System The latest technique of SEM Analysis Principle and application of MALDI-TOF MS 						

Analysis Service



Image



In situ probing of doping- and stress-mediated phase transitions in a single-crystalline VO₂ nanobeam by spatially resolved Raman spectroscopy

Equipment



Micro Raman Spectroscopy



FE-SEM



FE-EF-TEM

High-tech Function Materials Research

Daegu Center

Multidimensional characterization and physicochemical molecular analysis was performed on smart materials and nano complex agents.

Main Research Activity

User-oriented analytical methods were developed for High-Resolution Mass Spectrometer, Multi-Function X-ray Diffractometer and the Field Emission Scanning Electron Microscope.

Representative Research Case

Novel oxynitrides with perovskite structure

A new synthetic route to novel complex perovskite-type oxynitrides was developed and the crystal structure was characterized by neutron diffraction and multinuclear NMR analysis, opening up various materials applications for integrated optics, data storage media, sensor and switches.

Ni-doped novel soft-magnetic alloy materials

Magneto-caloric effects in Nanoperm-type amorphous materials were enhanced by Ni-doping and the Curie temperature was increased as well, providing better materials at low costs for magnetic refrigerators.

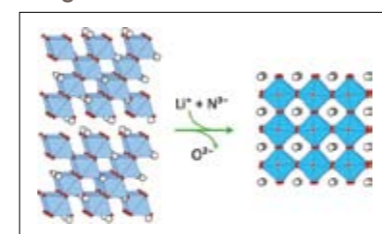
Major Achievements

Category	Achievements						
Research Result	<table border="1"> <thead> <tr> <th>Publications</th> <th>Presentations</th> <th>Presentations</th> </tr> </thead> <tbody> <tr> <td>13 (SCI 13)</td> <td>Domestic 5</td> <td>Registration 1</td> </tr> </tbody> </table>	Publications	Presentations	Presentations	13 (SCI 13)	Domestic 5	Registration 1
Publications	Presentations	Presentations					
13 (SCI 13)	Domestic 5	Registration 1					
Analytical Methods	<ul style="list-style-type: none"> ^7Li MAS NMR analysis of olivine-type structure cathode materials for rechargeable batteries 						
Projects	<ul style="list-style-type: none"> ^2H(^{19}F) REDOR NMR Spectroscopy for the 3D bioactive structure of epothilone anticancer drugs Time-dependent ^{31}P NMR study on GTP hydrolysis in taxol-stabilized microtubules Installation and Operation of Customized Support Systems for Small and Medium Enterprises in Daegu 						
Training of Equipment	<ul style="list-style-type: none"> Equipment Operation Education for Genral Users : 5 programs Equipment Education for Users in Small and Medium Enterprises: 2 programs Youth Education Support Programs with Scientific Instruments : 15 programs 						
Equipment	<p>Installed</p> <ul style="list-style-type: none"> X-ray/High Resolution X-ray/Multi-purpose X-ray/Multi-Function X-ray Diffractometer High Resolution Mass Spectromter High Resolution Field Emission Scanning Electron Microscope Field Emission Scanning Electron Microscope 200 kV Field Emission Transmission Electron Microscope X-ray Fluorescence Spectrometer <p>To Be Installed</p> <ul style="list-style-type: none"> Focused Ion Beam(2015) 						

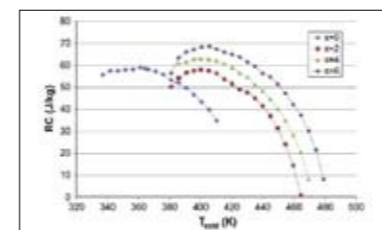
Analysis Service



Image



Structural evolution scheme of novel oxynitride-type complex perovskites



Refrigeration capacity of Ni-doped SOMT alloys

Equipment



High Resolution Mass Spectrometer(HR-MS)



Multi-Function X-ray Diffractometer(MF-XRD)



200 kV Field Emission Transmission Electron Microscope(FE-TEM)

Nano Materials Imaging Research

Gangneung Center

We mainly investigate physical and chemical properties such as fluorescence and structural properties of nonferrous metal materials.

Main Research Activity

Researches on advanced imaging of physical and chemical properties of materials from various metal oxide nano materials, nanohybrid materials and fluorophore based cell imaging.

Representative Research Case

Precise evaluation of energetic interactions via lifetime imaging of semiconductor quantum dot superlattices

Researchers in Gangneung Center report time-resolved photoluminescence (PL) properties on semiconductor quantum dot (QD) superlattices (SLs) using PL lifetime imaging microscopy at a single particle level.

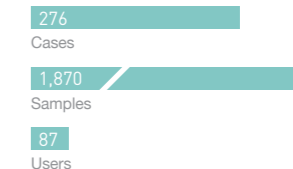
Evaluation of local viscosity and polarity change in cell based on time-resolved fluorescence imaging technique

We evaluated local viscosity and polarity change in cell using a dual functional fluorescence probe molecule based on lifetime imaging technique in the pico-nanosecond time regime.

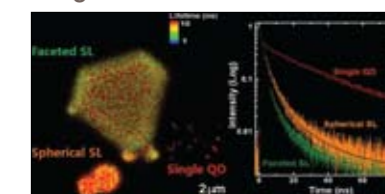
Major Achievements

Category	Achievements						
Research Result	<table border="1"> <thead> <tr> <th>Publications</th> <th>Presentations</th> <th>Presentations</th> </tr> </thead> <tbody> <tr> <td>6 (SCI 5)</td> <td>Domestic 5 International 4</td> <td>Registration 1</td> </tr> </tbody> </table>	Publications	Presentations	Presentations	6 (SCI 5)	Domestic 5 International 4	Registration 1
Publications	Presentations	Presentations					
6 (SCI 5)	Domestic 5 International 4	Registration 1					
Projects	<ul style="list-style-type: none"> Smart nanoporous materials for stimuli-responsive controlled release Functional control of nanoparticle-superlattice structures 						
Training of Equipment	<ul style="list-style-type: none"> Advanced user training of transmission electron microscope Advanced user training of multi-purpose X-ray diffractometer 						
Equipment	<p>Installed</p> <ul style="list-style-type: none"> Field Emission Transmission Electron Microscope Field Emission Scanning Electron Microscope Multi Purpose X-ray Diffractometer Time-resolved Fluorescence Confocal Microscope FT-UV-VIS-IR Spectroscopic Imaging Microscope Wavelength Dispersive X-ray Fluorescence Spectrometer 						

Analysis Service



Image



Lifetime image of semiconductor QD superlattices presenting different fluorescence lifetimes depending on microcrystal shapes, which is governed by packing fraction of component QDs.



Fluorescence lifetime imaging of cell for the detection of local viscosity and polarity change using dual functional fluorescence probe molecule

Equipment



Field-Emission Transmission Electron Microscope



Multi-Purpose X-Ray Diffractometer



Time-Resolved Fluorescence Confocal Microscope



5

JOINT UTILIZATION OF ADVANCED EQUIPMENT

DEVELOPMENT OF RESEARCH EQUIPMENT

Technical Support for Research Equipment
Machining Systems for Fabricating and Measuring Aspherical Freeform Optical Surfaces
New Physical Phenomena of New Materials under Extreme Conditions

To meet the demands of cutting-edge research, analytical equipment (whole product or key parts) and ambient systems are remodeled and developed through core technology development of the analytical equipment.

Technical Support for Research Equipment

Center for Analytical Instrumentation Development

To maintain the performance of large-scale research equipment in industries, universities and research institutes, the maintenance and the design of research equipment is supported, which encourages the utilization of national research equipment.

Main Research Activity

We performed technical assistance for the maintenance and settlement of complaints on all research equipment and supported the design and production on the development and modification of research equipment as well as supported the utilization of electronic instrumentation and mechanical processing equipment.

Representative Research Case

Medical center of research equipment for small and medium sized enterprise (SME) support

Professional engineers in the medical center of research equipment have taken charge of the maintenance of state-of-the-art research, which is located in 10 KBSI regional centers as well as in the Daejeon Headquarters. After the medical center launched to support research equipment in SMEs, universities and public institutions in 2014, it accomplished 23 of troubleshooting support, 4 of technical guidance, 2 of equipment rental, 2 of equipment modification, 2 of operator training, respectively.

Technical support tasks for the installation of equipments or the repair of the research equipments or the manufacturing of electronics device

In 2014, We performed 312 cases of technical support tasks of equipment or the repair of the research equipment or the manufacturing of electronics devices. And then we are making efforts into effective maintenance and improvement of technical ability in order to decrease break time and to extend the lifetime of research equipment.

Major Achievements

Category	Achievements						
Service Results	<table border="1"> <thead> <tr> <th>Equipment Owned</th> <th>Small and Medium Businesses</th> <th>Universities and Public Institutions</th> </tr> </thead> <tbody> <tr> <td>Maintenance (205) installation (29) manufacture of machineries (74) research (4)</td> <td>Failure repair (20) technical guide (4) equipment rental (2) equipment remodeling (2) education on operation (2)</td> <td>Failure repair (3)</td> </tr> </tbody> </table>	Equipment Owned	Small and Medium Businesses	Universities and Public Institutions	Maintenance (205) installation (29) manufacture of machineries (74) research (4)	Failure repair (20) technical guide (4) equipment rental (2) equipment remodeling (2) education on operation (2)	Failure repair (3)
Equipment Owned	Small and Medium Businesses	Universities and Public Institutions					
Maintenance (205) installation (29) manufacture of machineries (74) research (4)	Failure repair (20) technical guide (4) equipment rental (2) equipment remodeling (2) education on operation (2)	Failure repair (3)					
Projects	<ul style="list-style-type: none"> Operation and improvement on the life-cycle system of research equipment Operation of call center for external support Construction of technical support website for external support 						
Training of Equipment	<ul style="list-style-type: none"> Ultra Precision Machine Tool(Free from 700 A) 						
Equipment	<p>Installed</p> <ul style="list-style-type: none"> Oscilloscope(500 MHz, 11402A) Spectrum Analyzer(PSAE4443A) Network Analyzer(R&S ZVL) 5-Axis CNC Machine(HSC600/5) 3-D Coordinate Measuring(CONTURA-G2) <p>To Be Installed</p> <ul style="list-style-type: none"> Ultra-Precision Polishing Machine 						

Technical Service



Image



The introduction of the medical center for Research Equipment in KBSI

Equipment



Support for the modification of LED lamp for a inverted microscope installed at a SME



Utilization of Research Instruments for Development of a new product of a SME



Corrective maintenance of a Gasometer for SMEs

Machining Systems for Fabricating and Measuring Aspherical Freeform Optical Surfaces

Center for Analytical Instrumentation Development

We established high-precision instruments for fabricating and measuring aspherical/freeform optical surfaces with nanometer-order precision and have dedicated research to state-of-the-art optical systems such as infrared microscopes, space observation telescopes and satellite payloads.

Main Research Activity

We developed an ultra-precision machining process for fabricating aluminium alloy based on primary and secondary reflectors, which are the key elements of the space cryogenic infrared 30 cm telescope.

Representative Research Case

Development of ultra-precision machining process for the space cryogenic infrared 30 cm telescope

The research on machining process of the aluminium alloy reflectors was performed in order to acquire the key technology for manufacturing the space cryogenic infrared telescope, and the metrology of large-apertured reflectors was also developed by configuration of a null-correcting system.

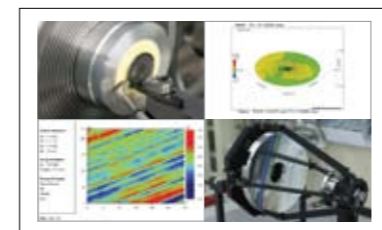
Major Achievements

Category	Achievements						
Research Result	<table border="1"> <tr> <th>Publications</th> <th>Presentations</th> <th>Presentations</th> </tr> <tr> <td>4 (SCI 2)</td> <td>Domestic 4 International 4</td> <td>Application 4 Registration 6</td> </tr> </table>	Publications	Presentations	Presentations	4 (SCI 2)	Domestic 4 International 4	Application 4 Registration 6
Publications	Presentations	Presentations					
4 (SCI 2)	Domestic 4 International 4	Application 4 Registration 6					
Analytical Methods	<ul style="list-style-type: none"> Measurement technology for a large-apertured aspherical reflector using a Null-correcting system Development of ultra-precision machining technology for oxygen-free copper disks 						
Projects	<ul style="list-style-type: none"> Development of ultra-precision machining process technology for infrared optics Development of a high-resolution thermal imaging camera used for temperature measurement Development of high-resolution infrared optics and LIT modules Development of high-speed cooling system for 200 mm deformable mirror 						
Training of Equipment	<ul style="list-style-type: none"> Educations about ultra-precision machining and measuring instruments (9.17) 						
Equipment	<p>Installed</p> <ul style="list-style-type: none"> 5-Axis Ultra Precision Freeform Machine Tool : Freeform700A Ultra Precision Machine Tool (Nanotech 450UPL) Ultra Precision 3D Profiler (UA3P) Laser Interferometer (WYLKO6000) High Speed Machine Tool (HSC600) Aspheric 3D Profiler (Formtalysurf II) <p>To Be Installed</p> <ul style="list-style-type: none"> MRF Polishing Machine Tool (Q-flex300) Sub-Aperture Sticking Laser Interferometer (ASI) 						

Analysis Service

29 Cases
147 Samples
19 Users

Image



Development of Germanium based infrared lenses and 30 cm telescope optics

Equipment



Ultra Precision Machine Tool (Freeform700A)



Ultra Precision Machine Tool (Nanotech 450UPL)



Ultra Precision 3D Profiler (UA3P)

New Physical Phenomena of New Materials under Extreme Conditions

Division of Materials Science Research

New measurement tools and related technologies are developed for investigating new physical phenomena of new materials and functional devices under extreme conditions.

Main Research Activity

We have developed a new cryo-free probe station using low temperature refrigerators and made a tuneable world smallest linear magnetic sensor by investigating the electronic transport properties of functional spin devices.

Representative Research Case

Tunable world smallest high sensitive linear magnetic sensor

We have improved the sensitivity of magnetic field sensing with spin controlling techniques applied to a bipolar pulse. We have successfully developed the world's smallest high sensitive tuneable linear magnetic sensor without an external field using DC bias.

Cryogen-Free Probe Station using two-stage cryocooler

We have designed the thermal conductor of probe of probe stations physical property measurements using cryocooler and developed a low temperature cooling technique and a high vacuum cryogenic probe station. From these, we can make 2 patents and 1 SCI paper.

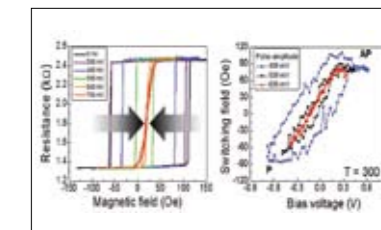
Major Achievements

Category	Achievements						
Research Result	<table border="1"> <tr> <th>Publications</th> <th>Presentations</th> <th>Presentations</th> </tr> <tr> <td>11 (SCI 11)</td> <td>Domestic 9 International 5</td> <td>Application 11 Registration 4</td> </tr> </table>	Publications	Presentations	Presentations	11 (SCI 11)	Domestic 9 International 5	Application 11 Registration 4
Publications	Presentations	Presentations					
11 (SCI 11)	Domestic 9 International 5	Application 11 Registration 4					
Analytical Methods	<ul style="list-style-type: none"> Damping constant measurement technique Cryogenic closed loop technology showing natural circulation and stage control 						
Projects	<ul style="list-style-type: none"> Development of Spin Device Measurement Technique Functional Spin Device Transport Analysis Spin-Orbit Measurement Technique Low Temperature Vector Field SPM Cryo-Free Temperature Sensor Development Low Temperature Probe Station Development 						
Training of Equipment	<ul style="list-style-type: none"> Electronic Magnetic Property Measurement Magnetic Materials and Application Magnetic Property : Principle and Application 						
Equipment	<p>Installed</p> <ul style="list-style-type: none"> 16 T Physical Property Measurement System Magnetic Property Measurement System Scanning Probe Microscope Cryogenic Probe Station High Magnetic Field System <p>To Be Installed</p> <ul style="list-style-type: none"> High Field Scanning Probe Microscope 						

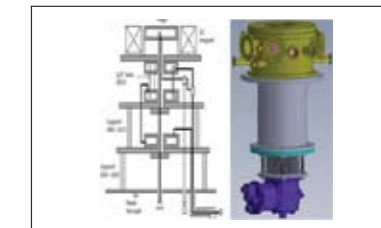
Analysis Service

81 Cases
485 Samples
50 Users

Image



By applying bipolar pulse, removing coercivity and obtain high sensitivity

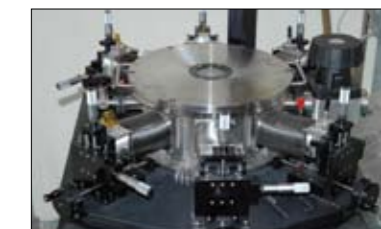


Design of cryogenic probe station using two-stage cryocooler.

Equipment



7 T Magnetic Property Measurement System



Cryo-Probe Station



16 T Physical Property Measurement System

Description of photograph |

Silver prize at the 2014 KBSI Imaging Photo Exhibition,
<Nano Puffer-Fish>

Red blood cells inside blood vessel of a mouse observed at
a magnification of 10,000 using scanning electron microscope

2

To support research and perform joint research, KBSI has established and operated national large-scale research equipment such as HVEM, 15 T FT-ICR MS, HR-SIMS, 900 MHz NMR, Human 7 T MRI, in situ, SuperBio EM and 28 GHz ECR Ion Source.

INSTALLATION & OPERATION OF NATIONAL LARGE-SCALE RESEARCH EQUIPMENT

HIGH VOLTAGE ELECTRON MICROSCOPE (HVEM),
15 T FOURIER TRANSFORM ION CYCLOTRON RESONANCE MASS SPECTROMETER
HIGH FIELD-NUCLEAR MAGNETIC RESONANCE
HIGH RESOLUTION-SECONDARY ION MASS SPECTROMETER
HUMAN 7 T MRI SYSTEM
MULTI DISCIPLINARY IN SITU ANALYTICAL SYSTEM
SUPER BIO HVEM
HEAVY, ION ACCELERATORS EMPLOYING 28 GHZ SUPERCONDUCTING ECR ION SOURCE

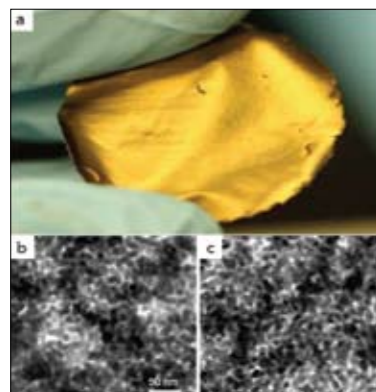
HVEM

High Voltage Electron Microscope

The High Voltage Electron Microscope (HVEM) utilizes high accelerating voltage for structural analysis at atomic-resolution. The HVEM is employed in basic and applied sciences, such as structural analysis of new materials, structure determination of small proteins and development of infinitesimal materials. (Open in April 2004)



Image



(a) Newly developed stretchable conductor image
(b) Gold nanoparticles without strain
(c) Self-organized gold nanoparticles under strain

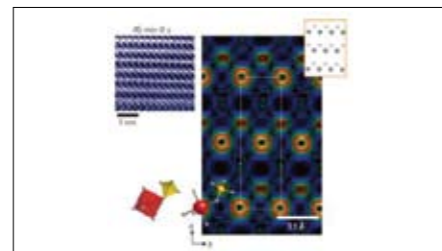
Characteristics of Equipment

- Observation of three-dimensional (3D) atomic structure of materials by concurrently implementing its atomic resolution (0.12nm) and high tilting specimen angle ($\pm 60^\circ$)
- Chemical signal detection with high collection rate using the advanced energy filtering system (HV-GIF) that utilizes the relativity effect
- In-situ and Cryo-EM analysis with customized specimen holder

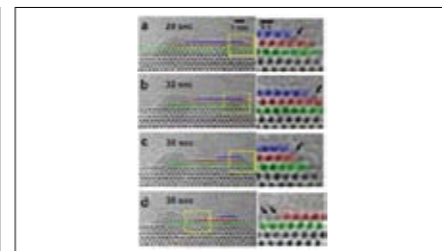
Representative Research Case

The world's first development of stretchable nanoparticle conductors
The shortcomings of the existing elastic conductor led to the development of a flexible, elastic and excellent conductor, made of polyurethane and filled with gold nanoparticles. It's development may contribute to the world's first development of such kind. The self-assembled gold nanoparticles help to visualize the data, taking advantage of the HVEM and its penetration of the extension and contraction.

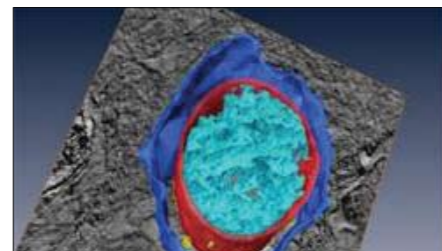
Major Achievements



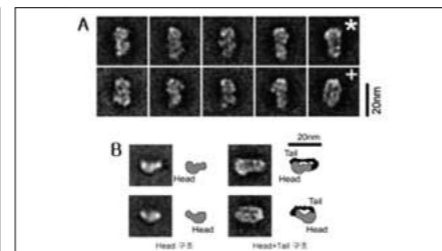
Atomic structure analysis of nanostructured materials



Real-time structure analysis



3D analysis of subcellular structures



Structural analysis of functional protein

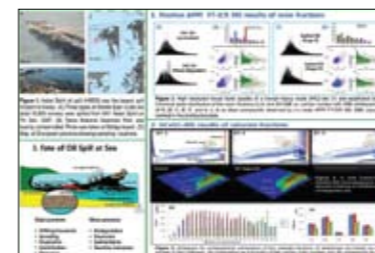
FT-ICR MS

15 T Fourier Transform Ion Cyclotron Resonance Mass Spectrometer

The world's first 15 T FT-ICR MS was developed to build up the infrastructure of a world-class level Mass Spectrometry in Ochang Headquarters. The profiles of proteome, metabolome, petroleome, and natural product materials are produced with the Ultra-High Resolution Mass Spectrometry.



Image



After oil spill accident from the Hebei Spirit near the ocean of Taean on December 7, 2007, the comparison of naturally weathered oil and artificially photo-degraded oil at the molecular level by a combination of SARA fractionation and FT-ICR MS.

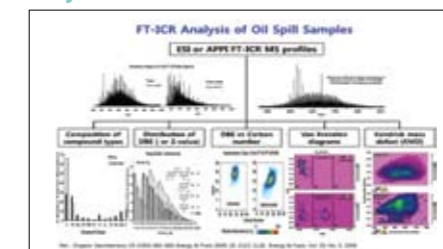
Characteristics of Equipment

- The world best mass resolution : > 10,000,000
- Dual ion source : ESI/MALDI
- Applicable methods: MALDI Imaging, APCI, APPI, LC/MS/MS
- Various MS/MS techniques: CID, ECD, ETD, IS-CAD

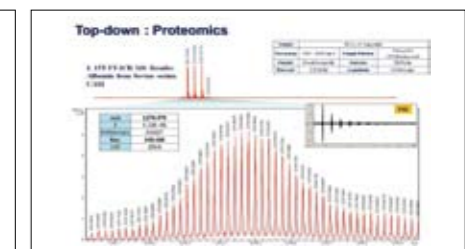
Representative Research Case

Analysis of spilled oils and related pollutants using UHR MS
The FT-ICR MS coupled with SARA fractionations is an improved technique for complete characterization of chemical compounds in spilled oil at molecular level. This technique was used to analyze the spilled oils and related pollutants. Spilled oils obtained from different weathering stages of the oil spill site and photo-degraded oils are separated by SARA (saturate, aromatic, resin, and asphaltene) fractionations. The compositions and abundance of compounds in spilled oil is compared at the molecular level by 15 T FT-ICR MS.

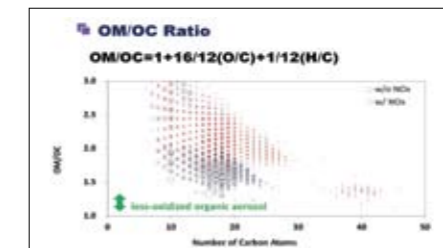
Major Achievements



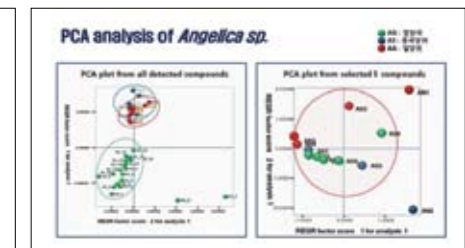
The FT-ICR MS can be used to investigate the polar molecules in spilled oils. Weathered oils and photo-degraded oils are compared at the molecular level by 15 T FT-ICR MS.



The ultrahigh-resolving power (i.e. over 1,000,000 FWHM) of the 15 T FT-ICR MS enables to obtain high-accuracy information from intact proteins without proteolytic digestion (Top-Down Proteomics).



Understanding of NOx effects on biogenic SOA formation is improved by comprehensive elemental composition determination of SOA with the ultra-high resolution 15 T FT-ICR MS. OM/OC ratios of SOA were slightly increased in the presence of NOx.



Principal component analysis(PCA) of 33 samples categorized into 3 groups. From a PCA and HCA of the metabolite profiles, we can find the characteristic marker compounds to distinguish the regional and species difference and classify the samples into different groups with those makers.

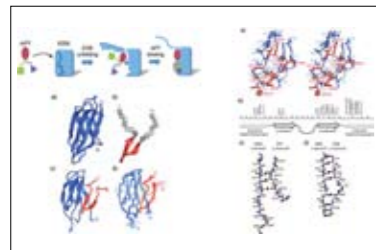
HF-NMR

High Field-Nuclear Magnetic Resonance

The 900 and 800 MHz Nuclear magnetic resonance (NMR) spectrometers, and 4.7 T and 9.4 T Magnetic resonance imaging (MRI) animal scanners were installed in Ochang Headquarters as the core equipment for researches in molecular structure determination and drug discovery.



Image



An Unusual Protein-Protein Interaction through Coupled Unfolding and Binding

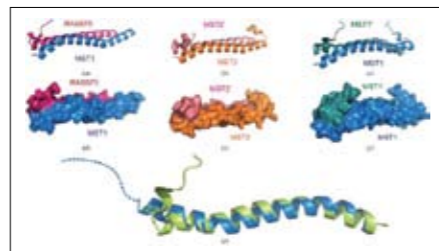
Characteristics of Equipment

- 900 MHz & 800 MHz NMR : The ¹H sensitivity of the cryoprobe is over 4 times higher than that of the room temperature probe, which reduces the experimental time to 1/16 and ¹³C spectra can be taken with 1mg or less samples.
- 9.4 T and 4.7 T MRI: Animal MRI scanners with 21 cm and 40 cm bore sizes respectively

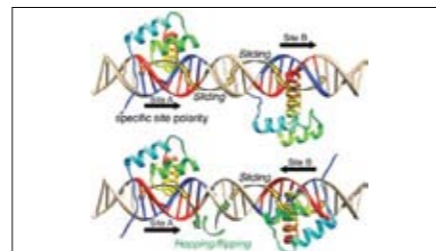
Representative Research Case

An unusual protein-protein interaction through coupled unfolding and binding
 Aptides, a novel class of high-affinity peptides, recognizes diverse molecular targets with high affinity and specificity. The solution structure of the aptide APT specifically bound to fibronectin extradomain B (EDB), which represents an unusual protein-protein interaction that involves coupled unfolding and binding, is reported. APT binding is accompanied by unfolding of the C-terminal β strand of EDB, thereby permitting APT to interact with the freshly exposed hydrophobic interior surfaces of EDB.

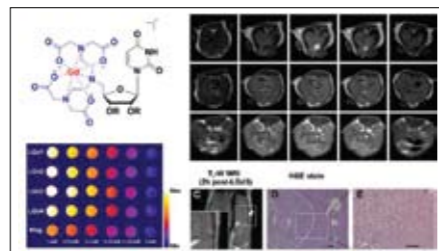
Major Achievements



Research on protein structure and natural product structure



Research on protein-protein interactions and dynamics



Molecular imaging and therapeutic effect monitoring



Brain function study

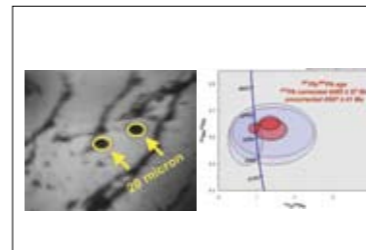
HR-SIMS

High Resolution-Secondary Ion Mass Spectrometer

High Resolution Secondary Ionization Mass Spectrometer(HR-SIMS, SHRIMP-IIe/MC), which can measure the isotope ratio for microscopic areas of surface in solid materials, has been operated as a core-research instrument for age determination, stable isotope research and nuclide analysis.



Image



U-bearing Merrillite from Jinju meteorite (left) and concordia diagram of its age dating by SHRIMP (right)

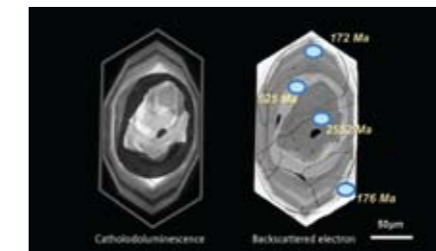
Characteristics of Equipment

- KBSI SHRIMP is the first high resolution secondary ion Mass Spectrometry in Korea.
- KBSI SHRIMP has low detection limit (~1 ppm) with 10,000 mass resolution and 50 % transmission.
- Multi-collection system with charge-mode electrometers can measure Pu isotopes simultaneously

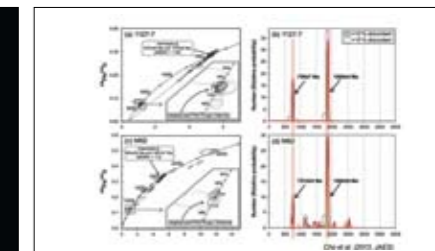
Representative Research Case

Age dating of Jinju meteorite
 In situ U-Pb geochronology of Merrillite in thinsections from Jinju meteorite yields its age as 4.57 to 4.48 as shown by collaboration research with Prof. B.G. Choi (SNU).

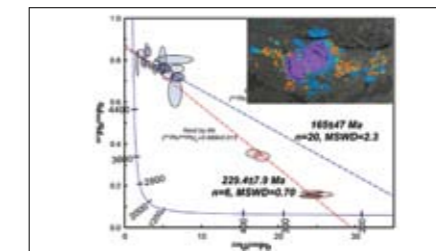
Major Achievements



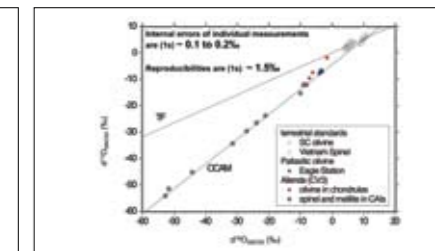
U-Pb geochronology



Reconstruction on geotectonic development and history



in situ isotopic measurement of microtexture



Micro- isotope ratios and age determination of meteorite

Human 7 T MRI system

Philips Achieva 7 T MRI research system provides ultra high field strength for advanced clinical research in a stable, optimized platform. In particular, it shares the proven technology platform of the 3 T clinical system for reproducible results to support research needs. (To be installed in May, 2015)



Characteristics of Equipment

- Actively shielded superconductive 7 T magnet
- Actively shield gradient system and 8 channels RF system
- ^1H , ^{13}C , ^{23}Na , and ^{31}P image and spectroscopy
- Ultra-high resolution, enhanced fMRI and spectroscopy

Representative Research Case

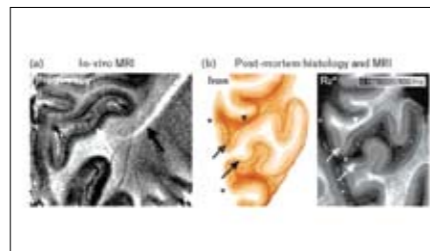
Asia's First Actively Shielded 7 T MRI system

Asia's first ultra high-field 7 T magnetic resonance imaging (MRI) of KBSI could be installed in a smaller place than before using a technique known as 'actively shielded'. Compared to the existing commercial 1.5T or 3 T MRI, our 7 T MRI provided shorter scan time and showed excellent MR images with high-resolution (~0.2 mm), so it was much more accurate for the early diagnosis of encephalopathy. It also raised the potential to provide new information.

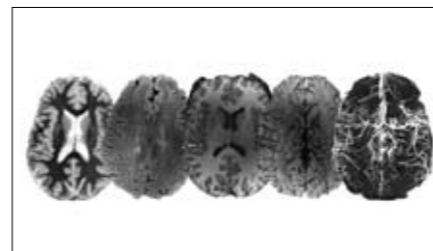
Functional MRI with an Ultra High Resolution

Compared to the existing 7 T Magnetic Resonance Imaging (MRI), ultra high-field 7 T MRI of KBSI was provided with parallel multi-channel transmit systems and receiver channels (8ch-TX / 32Ch-RX) for RF coil. It could also be optimized for system performance to enable the image acquisition of multinuclear species (^1H , ^{13}C , ^{31}P , etc.). Based on the techniques, the overall brain network and functional connectivity could be analyzed with resting state-fMRI with an ultra high resolution.

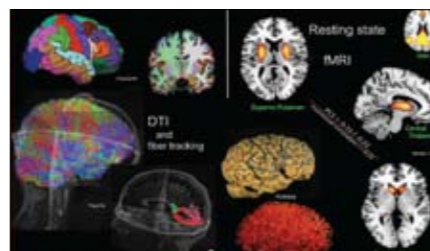
Major Achievements



Ultra-high resolution brain MRI, resolution 200 x 200 x 1000 μm , (image: NIH, Maryland, USA)



Same brain, different MR contrasts, advanced clinical research, (image: CFMM, Ontario, Canada)



High resolution functional MRI, Structural/functional connectivity, (image: NIH, Maryland, USA)



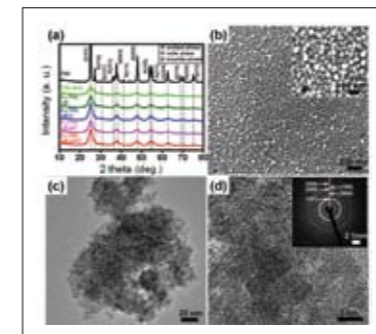
Multi-channel transmit/receive RF coil built, Tx/Rx = 8/32 channels, (image: CFMM, Ontario, Canada)

Multi Disciplinary in situ Analytical System

The purpose of this system is to provide a total analytical solution to both universities and industries by means of establishing the one-line in-situ analytical system consisting of high-end leading analysis instruments and device fabrication process. (To be installed by December, 2016)



Image



Large-scale preparation of photocatalysts with high photocatalytic performance

Characteristics of Equipment

- Combination of the process and the analysis provide the essential information on basic science
- Support nano-technology and other complex science with qualified data and information on basic knowledge on the new-forthcoming materials for the future

Representative Research Case

Development of mass production technology of photocatalysts at room temperature

This manufacturing technology is a mass-production of photocatalysts using simple preparing methods at room temperature. It can be used to decompose toxic organics molecules and sterilize microorganisms. These manufacturing technologies were transferred (the technology) to related company (Sentech Korea Inc.; Technology transfer amount: 130,000,000 won).

Major Achievements



the measurement of AFM, STM, KPFM images related signals such as tunneling current, force and force gradient.



Atomic scale ultrathin films growth



NAP-XPS analysis under pressure (up to 25 mbar) and humidities similar to those encountered in natural environments



Surface material and structure Local work function difference Element specific study

Super Bio HVEM

A high voltage electron microscope with state-of-the-art auxiliary functions, which is optimized for 3D analysis of bio-molecules, is scheduled to be installed. It will be the lead National User Research Equipment for nano-bio fusion research fields (to be installed in 2015 - Deadeok Headquarters - Division of Electron Microscopic Research).

Characteristics of Equipment

- Advanced cryo-EM function at cryogenic temperature (< 98°K) for the structural analysis protein complexes
- Enhanced auto-high tilt function ($\pm 70^\circ$) for the 3D structure analysis
- Reinforced performance with STEM, in-column Ω -filter, and high resolution DDD camera (4 kx4 k)

Representative Research Case

1 Development of anti-contaminator for Super Bio-HVEM

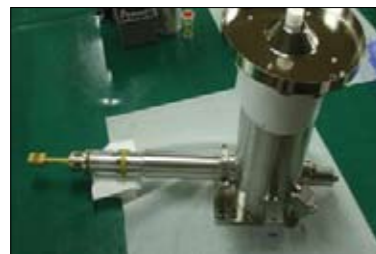
Anti-contaminator device was developed for the optimal cryogenic imaging environment of the Super Bio-HVEM. The design and function of the anti-contaminator was developed by the researcher at KBSI, which helped the manufacturer to produce a new-concept device that is fully functional for the world's first HVEM dedicated to cryo-EM studies.

2 Development of Cryo-EM stabilization system for Super Bio-HVEM

It took over 40 minutes for a normal HVEM to regain high vacuum condition after the loading of a specimen. This was problematic for cryo-EM studies because a vitrified sample is prone to the exposure to room temperature. Researchers at KBSI developed a brand new pumping & shielding system for HVEM to facilitate vacuum recovery within 60 seconds, and also to maintain cryogenic temperature of the chamber during the experiments.

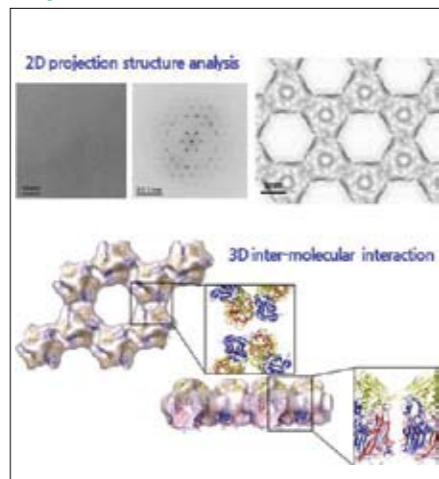


Image

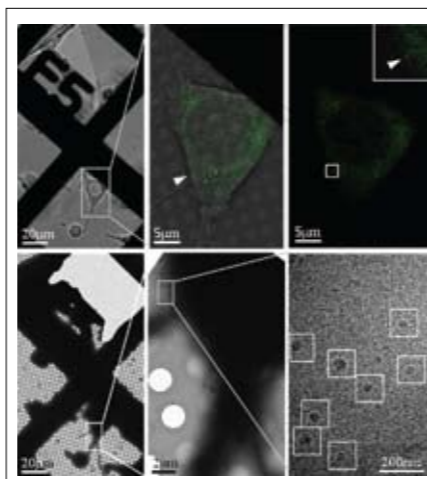


New developed anti-contaminator

Major Achievements



Characteristic structures of biological macromolecules visualized by high resolution imaging of HVEM



In-vivo ultrastructural imaging of intracellular organelles using correlative cryo-light and Electron Microscopy

Heavy, Ion Accelerators Employing 28 GHz Superconducting ECR(Electron Cyclotron Resonance) Ion Source

28 GHz Superconducting Electron Cyclotron Resonance (ECR) ion source is composed of a high power microwave system, high field superconducting magnets and a large bore vacuum plasma chamber. After ECR plasma ignition, the extracted ion beam is delivered through the Low Energy Beam Transport (LEBT) system and Radio-Frequency Quadrupole (RFQ) linear accelerator for beam acceleration.



Image



28 GHz superconducting ECR ion source and heavy ion linear accelerator

Characteristics of Equipment

- 28 GHz Electron Cyclotron Resonance (ECR) superconducting ion source has successfully been developed.
- The beam extraction and transportation system based on high voltage and magnetic field apparatuses is used to optimize and transport an ion beam without any loss.
- A ion beam diagnosis tools such as particle analysing magnet, wire scanner, view screen, x-y slits and faraday up are fabricated.
- The development of radio-frequency quadrupole (RFQ) linear accelerator and 100 kW RF power source for a heavy ion acceleration has been carried out.

Representative Research Case

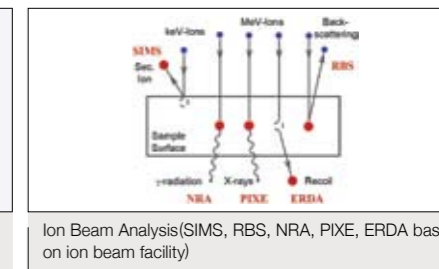
The development of cutting-edge technology for 28 GHz ECR ion source and linear accelerator system of heavy ion

The 28 GHz superconducting ECR ion source, which is the first in Korea and the third in the world, has been developed in Busan center of KBSI. The ECR plasma ignition has been successfully carried out. The extracted ion beam is delivered to heavy ion accelerator through LEBT system. The diagnostic devices were prepared to analyze the ion beam status. The in-house developed RFQ linear accelerator operated with 100 kW RF power and is able to accelerate the heavy ion up to 500 keV/u.

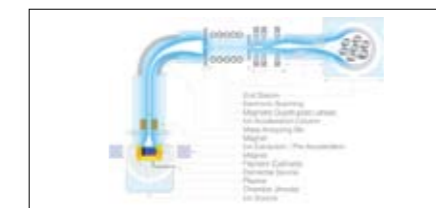
Major Achievements



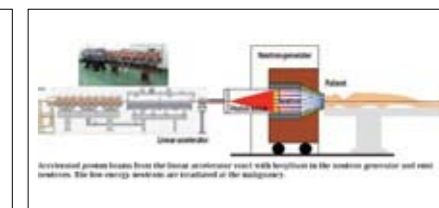
Neutron radiography



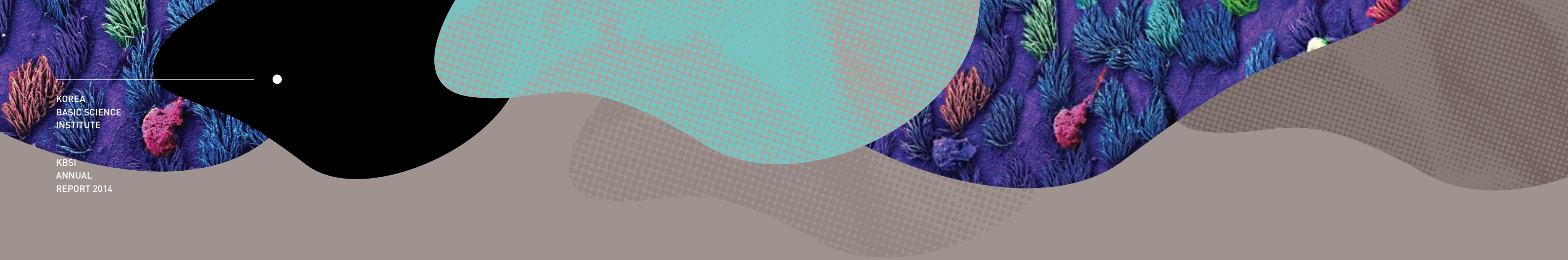
Ion Beam Analysis(SIMS, RBS, NRA, PIXE, ERDA based on ion beam facility)



Ion Implantation



Boron Neutron Capture Therapy(BNCT) of cancer

A scanning electron microscope (SEM) image of a mouse air duct, showing a complex, branching, and porous structure. The image is rendered in a vibrant, multi-colored palette of blues, purples, and reds. The background is dark, making the intricate details of the air duct stand out. The image is partially obscured by a large, stylized graphic element consisting of overlapping shapes in teal, black, and grey with a halftone dot pattern.

KOREA
BASIC SCIENCE
INSTITUTE

KBSI
ANNUAL
REPORT 2014

Description of photograph |

Gold prize at the 2014 KBSI Imaging Photo Exhibition,
<Under the Deep Sea>
Photograph of air duct of a mouse taken using SEM

3

KBSI develops cutting edge analytical technology to extend capability of analytical services and develops and develops high-tech research equipment and related elementary technology to secure national competitiveness.

ADVANCED ANALYTICAL SCIENCE RESEARCH

DEVELOPMENT OF NATIONAL AGENDA-SOLVING TECHNOLOGY

STANDARDIZED TECHNOLOGY FOR DISCRIMINATING THE GEOGRAPHICAL ORIGIN
ANALYTICAL TECHNOLOGY IN DISASTER SCIENCE
BIO-IMAGING TECHNOLOGY FOR EARLY DISEASE DIAGNOSIS
CULTURE PROPERTY PRESERVATION AND ANALYSIS TECHNOLOGY
ANALYTICAL TECHNIQUES USING BIOCHEMICAL FORENSIC BIOMARKERS

DEVELOPMENT OF LEADING-EDGE ANALYTICAL EQUIPMENT

FEMTOSECOND MULTI-DIMENSIONAL SPECTROMETER
HIGH-PRECISION THERMAL-IMAGING MICROSCOPE SYSTEM
CONDUCTION COOLING TYPE 15 T HIGH MAGNETIC FIELD MATERIAL RESEARCH SYSTEM
PORTABLE MASS SPECTROSCOPY

Development of National Agenda-Solving Technology

1

We develop state-of-the-art analytical technology to resolve national difficulties such as diseases and natural disasters and global issues such as environmental pollution, energy, climate change, etc.



Standardized Technology for Discriminating the Geographical Origin

Western Seoul Center
Division of Earth and Environmental Science Research

Introduction

Integrated analysis technology of agri-livestock products circulated in Korean markets is developed for establishment of order in the circulation, and standardized technology for discriminating the geographical origin is being established for systematic control of imported agri-livestock products.

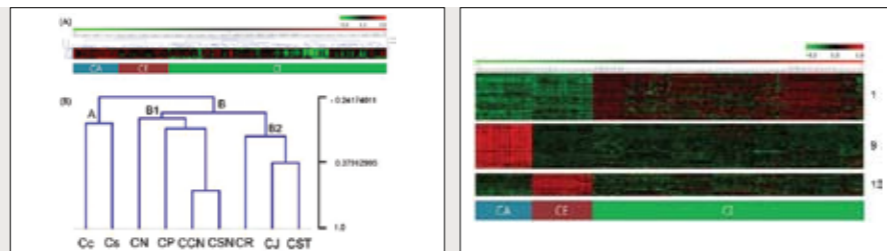
Main Research Activity

The technology for discriminating the thistle species was developed using metabolic profiling based on UPLC-QTOF MS analysis combined chemometrics. This technology was confirmed that it can predict unknown species of thistles with 100% accuracy.

Future Plans Research

An integrated classification system for discriminating the geographical origin/species or quality of various agri-livestock products circulated in Korean markets will be developed.

Image



Dendrogram generated using hierarchical clustering analysis of thistles of nine species

Heat map of 178 extracted metabolites using K-means clustering of thistles of nine species

Analytical Technology in disaster science

Division of Earth and Environmental Science Research

Introduction

In 2012, we have begun a new research project, entitled "Analytical Research in Disaster Science", aiming at establishing analytical protocols promptly applied in case of national disasters. By performing this project, we are to provide expeditious analytical protocols for national disasters, utilizing the state-of-the-art facilities in KBSI.

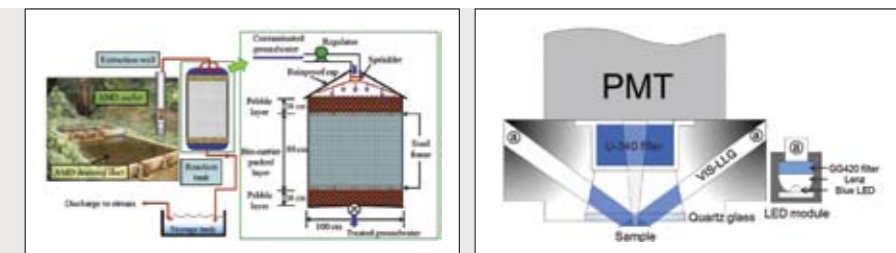
Main Research Activity

We performed a series of pilot tests to remove heavy metals in groundwater using dead *Bacillus drentensis* sp. in polysulfone polymer. The results revealed that 1 kg of bio-carrier can clean up at least 1098 L of groundwater in the field.

Future Plans Research

By 2015, in terms of analysing (1) environmental radioactivities, (2) natural hazardous materials and (3) forensic science materials, we are planning to enlarge the analytical items, and to improve the reliability of analytical protocols, along with the development of new instrumentations.

Image



A facility to test the removal of heavy metals in groundwater using bio-carrier

Development of luminescence measurement system for retrospective dosimetry

Bio-imaging Technology for Early Disease Diagnosis

Division of Magnetic Resonance Research

Introduction

Research interests are focused on the development of multi-modal imaging contrast agents to be used for early diagnosis and therapy monitoring with small-animal in vivo imaging facilities such as magnetic resonance imaging (MRI) and near infra-red (NIR) imaging.

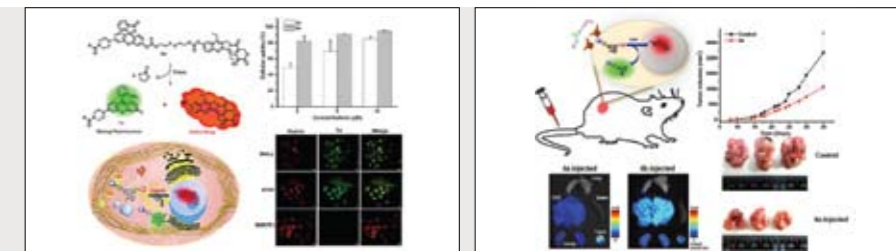
Main Research Activity

A new theranostic agent, which contains a biotinylated rhodol subunit connected to a potent anti-cancer drug, SN-38, was developed and evaluated for targeted cancer therapeutic effect in the mice xenograft tumor model.

Future Plans Research

Novel multi-modal (MR/NIR/PET) imaging probe platform with specific targeting functions to immune (monocyte/macrophages) and cancer cells will be developed and used for the translational study from animal to bed on in vivo diagnosis and therapy.

Image



Development of an activatable theranostic for targeted cancer therapy and imaging

Evaluation of diagnosis and therapeutic effect in the mice xenograft tumor model

Culture Property Preservation and Analysis Technology

●
Division of Earth and Environmental Science Research

Introduction

Development of the lead isotope analysis technology and distribution of zoning for provenance of excavated bronze artifacts from the Korean peninsula.

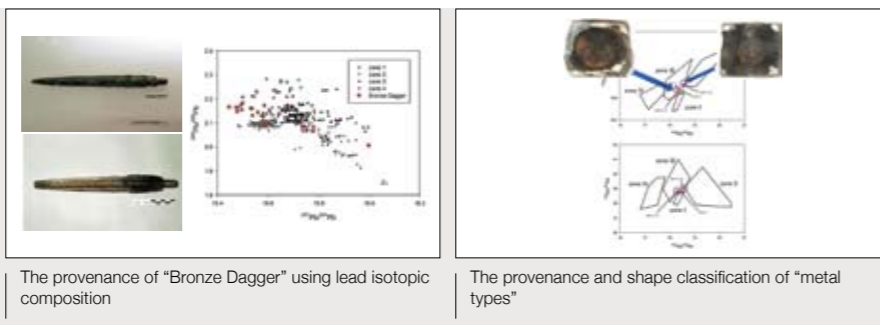
Main Research Activity

Using lead isotope distribution map, we carried out the provenance study for the bronze artifacts of "Bronze Dagger" and "metal types".

Future Plans Research

We will produce the database system for the estimation system for provenance of excavated bronze artifacts from the Korean peninsula.

Image



The provenance of "Bronze Dagger" using lead isotopic composition

The provenance and shape classification of "metal types"

Analytical Techniques using Biochemical Forensic Biomarkers

●
Division of Life Science Research / Division of Earth and Environmental Science Research

Introduction

Scene-applicable analytical techniques using biochemical forensic biomarkers are developing for fast, accurate and portable crime scene investigation. [Division of Life Science Research/Division of Earth and Environmental Research]

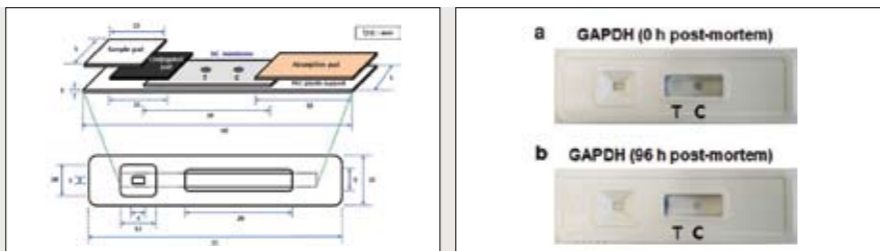
Main Research Activity

The post-mortem interval (PMI) protein markers were identified to assess the time of death using rat kidney and the determination of PMI was performed by lateral flow assay (LFA).

Future Plans Research

An integrated smart forensic phone system for determining the PMI and real-time information transfer at a crime scene will be developed.

Image



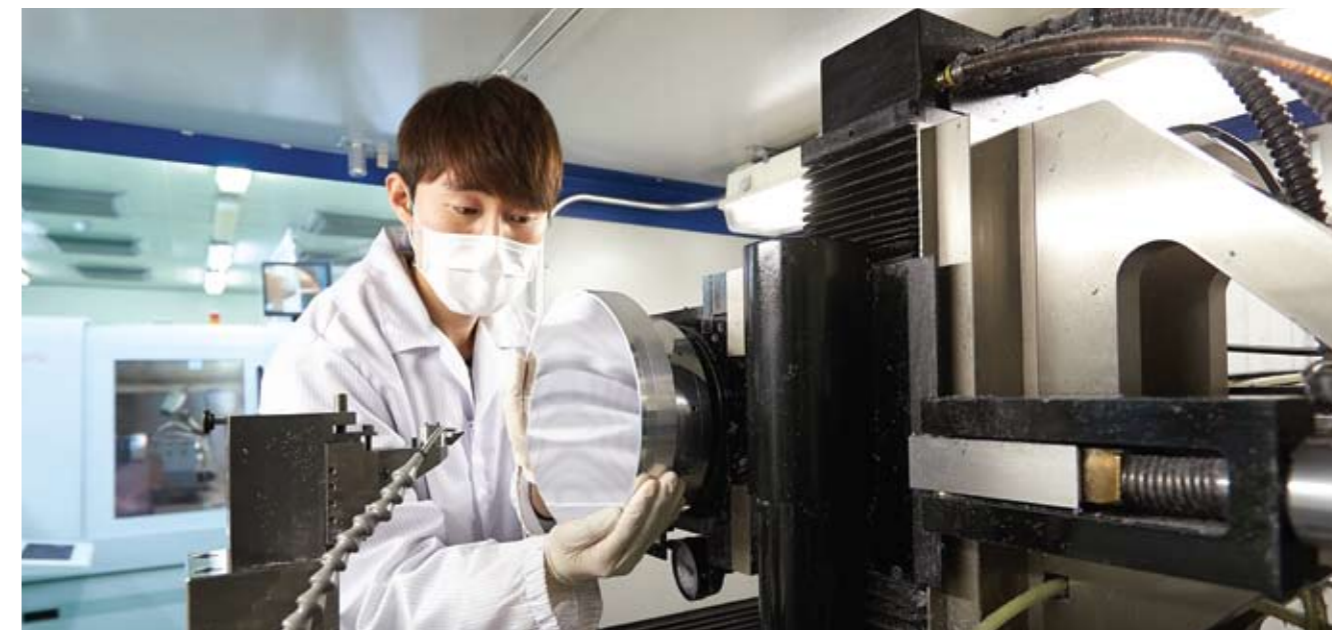
The LFA platform for detecting PMI-indicating proteins

Detection of GAPDH as a PMI marker for rat kidney by LFA

Development of Leading-Edge Analytical Equipment

2

To meet the demands of cutting-edge research, analytical equipment (whole product of key parts) and ambient systems are remodeled and developed through core technology development of analytical equipment.



Femtosecond Multi-dimensional Spectrometer

●
Seoul Center

Introduction

Scientists in Seoul Center are developing the world's first chiroptical measurement system that enables real-time measurements of stereochemical structure and dynamics of chiral biomolecules under an femtosecond time scale.

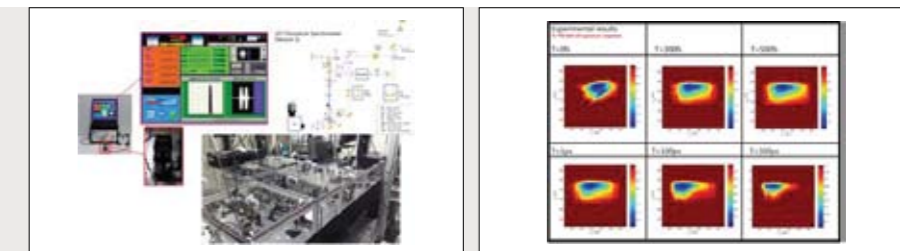
Main Research Activity

A two-dimensional (2D) electronic spectrometer using a high-speed optical pulse shaper and various coherent Raman scattering measurement systems were built up for future developments of 2D chiroptical spectrometer and chiroptical microscope.

Future Plans Research

The world's first space-time resolved chiroptical measurement system will be developed for researches on ultrafast reaction dynamics and stereochemical imaging of chiral molecules.

Image



Two-dimensional(2D) electronic spectrometer

Femtosecond time-resolved 2D electronic spectra

High-precision Thermal-imaging Microscope System

Center for Analytical Instrumentation Development

Introduction

Research on the development of a high-precision thermal imaging microscope is under progress, which can image an absolute temperature distribution and analyze thermal characteristics of micro-scale electronic devices and bio-samples.

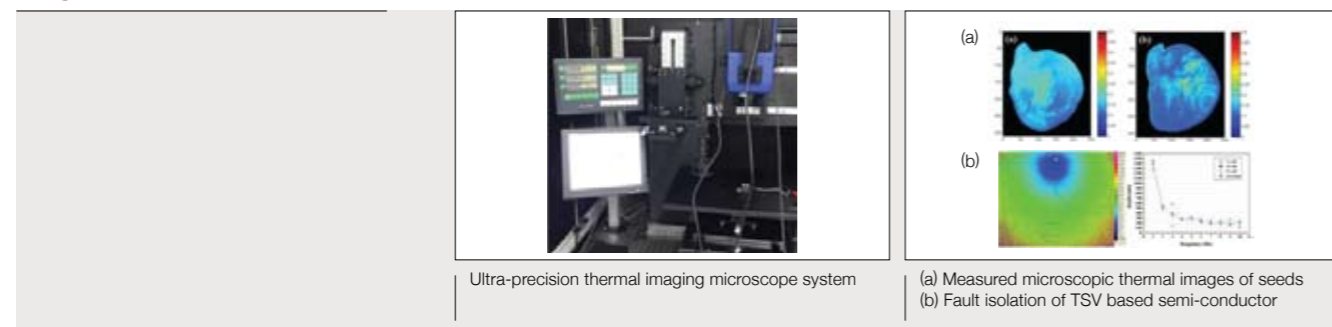
Main Research Activity

High resolution infrared optical lens, ultra-precision thermal imaging microscope systems and the related algorithms were developed. Also, the precise temperature imaging and thermal analysis methods of semiconductor devices and nano-bio samples were developed, as application technologies of the thermal imaging microscope.

Future Plans Research

For the utilization of thermal imaging microscope as a joint research equipment in various fields, the future research will be focused on the development of ultra-precision thermal imaging microscope systems and IT/BT/NT application technologies.

Image



Conduction Cooling Type 15 T High Magnetic Field Material Research System

Division of Materials Science Research

Introduction

With the cryogen-free type 15 T superconducting magnet system, measurement of various materials properties, evaluation of the critical current (I_c -B) of LTS and HTS superconducting wire and magnet test conducted under 15 T high magnetic field and low temperature.

Main Research Activity

With the 2 KA high current power supply and cryogen-free 15 T SC magnet, characterization of critical current (I_c) under high magnetic field of the HTS 2 G GdBCO tape have been done at 4.2 K.

Future Plans Research

Various materials property measurements under high magnetic field and low temperature, evaluation of superconducting wire and magnet by installed high current power supply, magnetic separation, material synthesis and crystal growth will be done.

Image



Portable Mass Spectroscopy

Division of Mass Spectrometry Research

Introduction

For real time onsite detection and identification of trace chemicals, a pocket portable mass spectrometer (PPMS) is under development. The PPMS can be applied to monitor environmental pollutions and to inspect the restricted materials such as drugs, explosives, chemical warfare agents, and nuclear materials onsite.

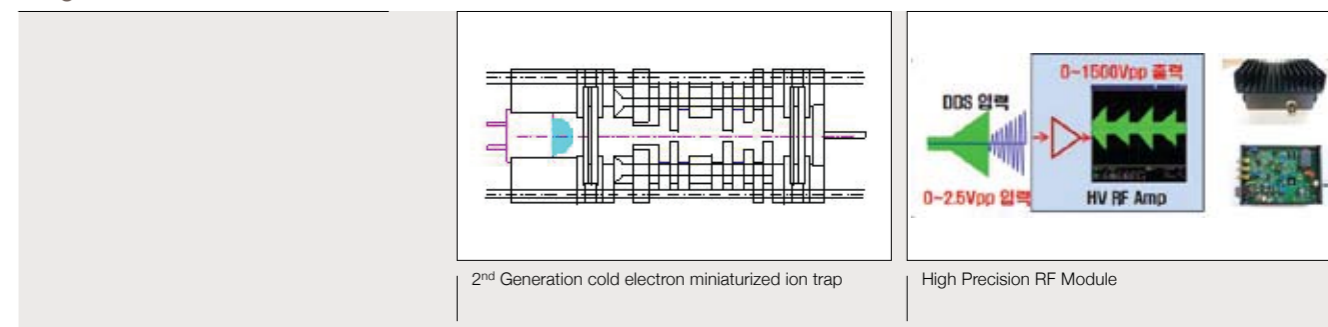
Main Research Activity

The 2nd generation low power consuming cold electron ion trap was designed to reduce the size, but ion storing volume was increased up to 8 times to increase the dynamic range of ion detection. High precision radio frequency power modules was developed and being tested for its performance. Through the collaboration with Bioneer corporation, a gas concentrator was developed to increase the sensitivity.

Future Plans Research

Through the collaboration with Korea Research Institute of Standards and Science (KRISS) and Bioneer corporation, a prototype of the world's smallest PPMS will be fabricated soon and its performance to detect gas samples will be test in the field.

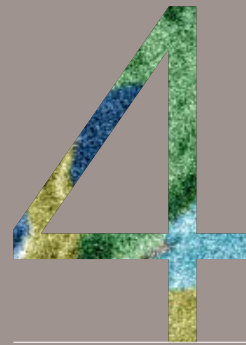
Image



Description of photograph |

Silver prize at the 2014 KBSI Imaging Photo Exhibition,
<Parrot in the Sea>

Brain tissues of a mouse genetically modified with Parkinson's disease were freeze-fixed, freeze-substituted, ultra-thin amputated, double stained, and observed with a 120 kv transmission electron microscope



KBSI provides SMEs requiring R&D resources with various technical supports such as analytical services, collaborative research, training, technology transfer & commercialization.

VALUE CREATION FOR SMEs TO REALIZE CREATIVE ECONOMY

STRENGTHENING SMEs SUPPORT AND COOPERATION INDUSTRY-RESEARCH INSTITUTIONS
REGIONAL BASIC RESEARCH PROGRAM
TECHNOLOGY TRANSFER PROMOTION

Small and medium enterprise support and industry-research cooperation promotion

1

Technology counselling center for SMEs and membership discount program

Introduction

HBSI has conducted various substantial SME support programs for relieving the difficulties of SMEs and promoting technological competitiveness.

Main Research Activity

HBSI has provided the specified support to 25 selected partner enterprises through its equipments, human resource and collaboration in order to respond the "open collaborative ecosystem promotion plan" of the government funded research institutes. HBSI operated the Integrated SME Support Center Chungcheong division fortifying the network between the government funded research institutes and SMEs and conducted 463 cases of the technological counselling about analysis support through technology counselling center for SMEs. In addition, technology mentoring program for SMEs (5 enterprises) and the SME membership discount program (56 enterprises) have contributed to the enhancement of the technology innovation competence.

Future Plans Research

HBSI will conduct the core role in the SME technology innovation system through establishing SME support system and close cooperation with SMEs so that SMEs can be a protagonist in the creative economy.

Image



Counseling procedure of Center for Technical Counseling on Small and Medium Businesses



Technical mentoring matching day between institution and small and medium businesses



2014 KBSI Workshop for Support on Small and Medium Businesses and Exchange of Results



Business agreement for technical support of the institution on small and medium businesses in Chungcheong

SME technological innovation support

Introduction

KBSI has supported creative invention of new technology and products through the enhancement of the technology development competence of innovative SMEs and the activation of the open research and development by conducting joint technology development projects with SMEs.

Main Research Activity

KBSI conducted demand-driven collaborative research and development on 5 projects with 5 SMEs including Yurim Industrial Co., Ltd. and DyneChemTech Corp. through the industrial technology development program of the Small and Medium Business Administration in 2014.

Representative Research Results

Industry-research collaboration with Modoo tek Co., Ltd.

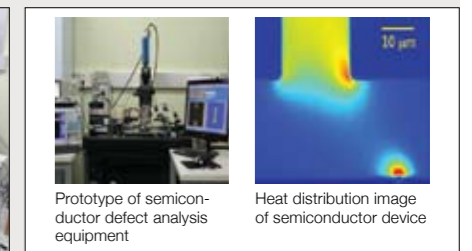
KBSI contributed to the technology transfer and commercialization of the high-resolution system (400 nm) resulting in the sales of 10 billion won a year through the collaboration with Modoo tek Co., Ltd.

Future Plans Research

KBSI will encourage startup and commercialization of innovative technology utilizing research and development infrastructure of KBSI and promote the technology innovation competence of SMEs which need to establish technological basis.

Image

Industry-research cooperation with Modoo Tek Co., Ltd.



Prototype of semiconductor defect analysis equipment

Heat distribution image of semiconductor device

Regional Basic Research Support

2

Introduction

KBSI has supported the basic research based on the knowhow about operating equipment and analytic technology and promoted the product development and commercialization of SMEs through establishing demand responding analysis environment.

Main Research Activity

KBSI provided the on-site analysis infrastructure of SMEs, secured sustainable SME growth system through technology deployment and development promotion, pursued the collaborative research for SME basic research, and developed the devices for the enhancement of utilizing analysis equipment.

Representative Research Results

- Support for the maintenance of research equipment
- Integrated nano-bio SEM/STEM function unit development
- Establishment of the collaborative research system for surface analysis
- Development of the technology of measuring atmospheric toxic chemicals using unmanned aircraft

Future Plans Research

KBSI will support sustainable development through securing the SME basic research infrastructure, pursue efficient utilization of national analysis equipment through better maintenance, develop analysis equipment, and expand KBSI analysis support system into broader SME analysis support.

Image



Daegu and Gyeongbuk Small Businesses Support Center



Opening ceremony of Southeast Small Businesses R&D Support Center



Certificate of Registration ISO 9001



A prototype of OsO₄ coater for improving image data of nano-size sample

Technology Transfer Achievement

3

Introduction

KBSI has conducted the commercialization programs through assessing technologies, finding advanced technology, marketing technology, and technology transfer agreement in order to expand the achievement of the main research and development into industry centering on the Technology Licensing Office

Main Research Activity

KBSI obtained 500 million won in royalties in 2014, which is a 54% increase compared to 330 million won in the prior year, through 10 cases of the technology transfer to SME including the technology of concentration and detection of norovirus.

Future Plans Research

KBSI will expand the technology transfer of research and development into private enterprise, fortify the support for utilizing the transferred technology in industry, and reinforce the supporting basis for the startup by the researcher who participated in the technology development.

Image



Agreement Ceremony(Yoon Seul)



Agreement Ceremony(Solgent)

KOREA
BASIC SCIENCE
INSTITUTE

KBSI
ANNUAL
REPORT 2014

Description of photograph |

Grand prize at the 2014 KBSI Imaging
Special prize at the 2014 KBSI Imaging Photo Exhibition,
<Is it a Son or Daughter?>
Wings of a butterfly observed at a magnification of
2.63 K X using VP=FE-SEM (Variable Pressure Field
Emission Scanning Electron Microscope)

5

KBSI comprehensively manages national research facilities and equipment for the advance of national S&T infrastructure, and trains future core specialists to secure the competency of world-class analytical technology. KBSI operates a public understanding program for S&T to enhance the interest of adolescents in S&T and contribute to the expansion of science culture.

REINFORCEMENT & PROMOTION OF NATIONAL BASIC SCIENCE SUPPORT SYSTEMS

OPERATION OF NATIONAL RESEARCH FACILITIES & EQUIPMENT CENTER
ONLINE RESEARCH SERVICE SYSTEM
OPERATING GRADUATE SCHOOL OF ANALYTICAL SCIENCE & TECHNOLOGY
JOURNAL OF ANALYTICAL SCIENCE & TECHNOLOGY
PUBLIC UNDERSTANDING PROGRAM FOR SCIENCE & TECHNOLOGY
NATIONAL-INTERNATIONAL NETWORKS

Operation of National Research Facilities & Equipment Center

1

NFEC is established by the Framework Act on Science and Technology to provide a systematic support of research facilities and equipment for the development of science and technology. NFEC, as the entity exclusively responsible for research facilities and equipment, will endeavor to maximize the R&D productivity by conducting the following tasks systematically: strategic investment for the research facilities and equipment, promotion of co-utilization, training of high-skilled specialists, and the overall management of research facilities and equipment.



Organization and management of the 'Deliberative Council on Research Facilities and Equipment Budget'

Introduction

We are improving the efficiency of national research facilities and equipment investment by preventing the unnecessary purchase of redundant equipment and excessive investment via deliberation on equipment introduction discussing validity of construction, redundancy, and necessity of introduction of expensive research equipment.

Main Research Activity

In 2015, we reduced 61.3 billion KRW from the budget via the organization and operation of Deliberative Council on Research Facilities and Equipment Budget (plenary session, twice). We also enhanced the action from the changing demand of the introduced equipment from the change of research equipment and the efficiency of R&D budget execution via Deliberative Council on Research Facilities and Equipment Budget (addition/alteration deliberation session, 6 times).

Future Plans Research

We plan to construct the full-cycle management system of research equipment deliberation from on-line deliberation to final fulfilled result and to enhance the support service for exclusive equipment deliberation such as reviewing the redundancy of the equipment, analyzing a reasonable price, recommending the deliberation committee member, and adopting the agent service for introduction deliberation by upgrading the RED (Research Equipment Deliberation).

Image



Deliberative Council on Research Facilities and Equipment Budget

'Deliberative Council on Research Facilities and Equipment Budget' contents related'

Operation of national research facilities and equipment management service

Introduction

We are providing major information and national statistical information, necessary for establishing effective infrastructure policy by comprehensively collecting and managing the research facilities and equipment information constructed with the government R&D budget and upgrading the distribution system.

Main Research Activity

In order to register the NTIS information regarding the research facilities and equipment constructed from the '13 government R&D project and to keep it up to date, we requested 2,432 research institutes in possession of the equipment to register and manage the information. In addition, we developed information linking API to link the information between the research institutes in order to secure the convenience of registration and the recency of the information.

Future Plans Research

We plan to expand the facilities and equipment database to keep the National Research Facilities and Equipment Management Service advanced. We also plan to reinforce the function of equipment management service of the management body and promote the information link between equipment management systems of research institutes and specialized organizations in order to effectively achieve the administrative control of research facilities and equipment.

Image



The Main Screens of NTIS National Research Facilities and Equipment Management Service

The Major Screens of NTIS National Research Facilities and Equipment Management Service

Cultivation of Equipment Engineer and Support program for Expensive Equipment Engineer

Introduction

We systematically train and produce research equipment engineers, manpower of technology specializing in equipment capable of operation and management of research equipment. We also strive to enhance the equipment utilization, with the support program for the operational manpower of costly research equipment.

Main Research Activity

In order to support research equipment engineering systematically, we established a research equipment manpower nurturing system by opening an additional curriculum regarding not only operation of the equipment but also maintenance and analytical science. We are nurturing a total of 120 engineers (third year) from 10 specialized education institutes. In addition, we are providing financial support for the operational manpower of 26 units of costly research equipment for the stable operation and the promotion of co-utilization.

Future Plans Research

We will hold the Strategy Forum for Research Equipment for Research Equipment Engineer (SFREE) and foster the qualifications certification for research equipment experts to augment the expertise of the research equipment engineer. We will also facilitate co-utilization by improving the productivity and the satisfaction of management support for costly research equipment.

Image



Strategy Forum for Research Equipment Engineer

Strategy Education for Research Equipment Engineer

Online Research Service System

2

Introduction

Online research service (OCS) utilizes the most advanced cutting-edge IT technologies for increasing research support easiness/ease. Users can join simultaneously in the analysis process through OCS' technologies in the headquarters and local center. On OCS' web service, to share their opinion for sample analysis, users can communicate with the KBSI's operator through the video conference system. OCS' web service provide various fields of research support (data analysis(S/W), Q&A etc.).

Main Research Activity

In 2014, a total of 51 analysis equipment is working under OCS. In the research support service area, 585 analysis cases were processed based on OCS. Especially OCS expanded new state-of-the-art media streaming technologies for transferring analysis image data to users. For retaining the best operational condition, OCS has been continuously improved.

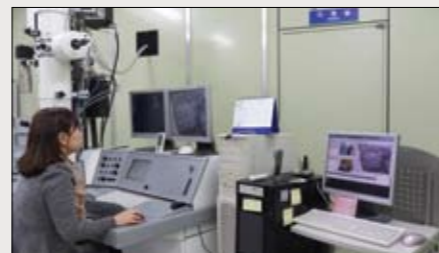
Future Plans Research

Improving the intelligent OCS for promotion of share-use of research facilities. Upgrading OCS's performance for R&D utilization improvement. Contributing to the public understanding of science & technology.

Image



2014 Korea Science Festival



Remote analytical service joint Research



Operation of smart analysis support system



Real-time monitoring of SEM screen using smart analysis support service

Operating Graduate School of Analytical Science and Technology

3

Introduction

Graduate School of Analytical Science and Technology [GRAST] was jointly established with Chungnam National University [CNU] as a new university-institute cooperation model to combine education and S&T research. Contributing to national S&T development and securing global research competitiveness, it aims to become the world's leading graduate school in the field of analytical S&T.

Main Research Activity

In 2014, there were 22 faculties in GRAST, 11 researchers belonging to KBSI and 11 professors belonging to CNU. In the same year, 27 master courses and Ph.D course students entered GRAST and 22 students graduated. In order to cultivate students of executive ability in the field of analytical equipment, GRAST operates expert certification programs. So 10 students got a license in the field of Electromicroscope, Mass Spectrometry and MRI etc.

Future Plans Research

GRAST will foster specialists required in the field of research and industry through various programs, including industrial visits, training and commissioned education.

Image



Strengthening of ability program
(Jan. 17, 2014)



Singapore-Korea Glycomics Joint symposium
(Feb. 10~14, 2014)



Seminar with the UK Ambassador
(Mar. 12, 2014)



4th Grast International Workshop
(Sep. 29, 2014)

Journal of Analytical Science and Technology

4

General Introduction

The Journal of Analytical Science and Technology (JAST) is a fully open access peer-reviewed scientific journal launched by KBSI in 2010. JAST publishes original research and review articles on analytical principles, techniques, methods, procedures and equipment in the fields of physics, material science, earth & environmental science, chemistry, biomedical science, etc. From 2013, JAST is publishing articles through Springer to improve the journal quality.

2014 Publication Status

JAST publishes peer-reviewed articles in English. The electronic version (e-ISSN: 2093-3371) is available at www.jast-journal.com immediately upon publication and the printed edition (p-ISSN: 2093-3134) is issued biannually in June and December. All articles published in JAST are open and freely-accessible. The previous issue published in June, 2014 contains 15 articles, and the latest issue published in December, 2014 contains 7 articles.

Future Plans

The purpose of JAST is to inform the researchers in the world of the significant professional achievements in science by providing unlimited access to the latest advances of analytical science. The goal of JAST is to be an internationally influential and widely-read analytical science journal. To improve the quality of the articles, JAST has worked with Springer since 2013. JAST aims to be indexed in major international databases, such as SCI, SCOPUS, and Medline/PubMed.

Image



Main page of JAST's website



JAST (volume 5, number 1)

Public Understanding Program for Science and Technology

5

Introduction

The purpose of this project is to improve the public awareness of national R&D activities. KBSI provided various outreach programs to students who are utilizing R&D infrastructures such as equipment and researchers.

Main Research Activity

In 2014, KBSI provided students and the public with 'X-Science' and 'Junior Doctor' to improve public understanding of science and technology. A total number of 11,377 youths and the public participated in those programs.

'X-Science' : 4 kinds of courses from beginning level to intensive level were run at 8 sites of KBSI across the country.

'Junior Doctor' : KBSI planned and arranged the 'Junior Doctor' with 29 institutes in Dae-deok research complex and 8 KBSI local branches. As a result, 7,209 students and the public participated and 440 participants received honorary degrees.

Category	Course	Number of programs	Number of participants
X-Science	Lab tour	28	670
	School visit Program	9	2,695
	Research & Education Program	3	7
	Career Guidance Program	7	244
Junior Doctor		298	7,209
Yuseong-gu Science Mentor		15	552
Total		360	11,377

Future Plans Research

KBSI has provided various outreach programs since 2004. X-Science and Junior Doctor are now acknowledged for outstanding creative experience activities for youth and the public. By improving the quality of the programs, KBSI will continue to make effort for X-Science and Junior Doctor to be representative scientific outreach programs in Korea.

Image



X-Science 'Career Guidance Program'



X-Science 'Lab tour'



Yuseong-gu Science Mentor



2014 Junior Doctor Open Ceremony



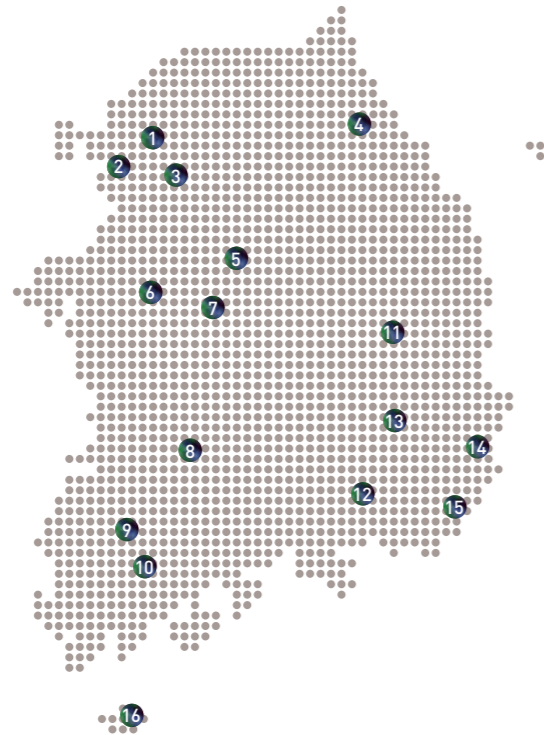
2014 Junior Doctor



2014 Junior Doctor

National · International Networks

6



National Networks

KBSI is building a cooperative network with various national industries, universities, and institutes to promote the sharing of reserch facilities and equipment, research collaborations, and exchange of academic knowledge and researchers.

- 1 Seoul**
 - Sungkyunkwan University (KUMC)
 - Korea University
 - Hongik University
 - Seoul National University
 - Sejong University
 - LG Sangnam Library
 - Kwangwoon University
 - Mine reclamation Corp. (MIRECO)
 - Korea Foundation for the Advancement of Science & Creativity
 - National Institute of Scientific Investigation
 - SEM Technology Co.,Ltd
 - Poongsan Corp.
 - Ewha Womens University
 - Korea Conformity Laboratories
 - Ahnse Law Offices
 - Gwacheon National Science Museum
 - Center for Women in Science, Engineering and Technology
 - Korea Foundation for the Advancement of Science and Creativity (KOFAC)
 - Hanyang University Industry Academic Cooperation Foundation
 - Kyunghee University Medical-Bio-New Materials Convergence Research Corporation
 - Nuclear Safety Evaluation
 - Samsung Hospital
 - Transparency International Korea
 - Seoul Seodaemun-gu office
 - Wips
- 2 Incheon**
 - Korea Polar Research Institute (KOPRI)
 - National Institute of Environmental Research (NIER)
- 3 Gyeonggi-do Seongnam**
 - D. A. K Korea
- 4 Gangwon-do Gangneung**
 - Gangneung-Wonju National University Marine
 - Bio Advanced Material Cluster Center
- 5 Chungcheongbuk-do**
 - Osong Medical Innovation Foundation
 - WISER Regional Agency of Chungbuk
- 6 Chungcheongnam-do Geumsan**
 - International Ginseng and Herb Research Institute
- 7 Daejeon**
 - Korea Advanced Institute of Science&Technology [KAIST]
 - Chungnam National University
 - Daejeon Technopark
 - Hannam University
 - University of Science&Technology [UST]
 - Korea Research Institute of Bioscience and Biotechnology
 - National Science Museum
 - Korea Institute of Geoscience and Mineral Resources
 - Daejeon Metropolitan City
- 8 Jeollabuk-do Jeonju**
 - Chonbuk National University
- 9 Gwangju**
 - Chosun University
 - Honam University
 - Chonnam National University
 - Gwangju Metropolitan City
 - Gwangju Technopark
- 10 Jeollanam-do Jeonnam**
 - Jeonnam Bioindustry Foundation (JBF)
- 11 Gyeongsangbuk-do Pohang**
 - Pohang Accelerator Laboratory
 - Gyeongsangbukdo Institute of Science Education
 - National Institute for Nanomaterials Technology
 - Biology Research Information Center
- 12 Gyeongsangnam-do Changwon**
 - Korea Electrotechnology Research Institute
- 13 Daegu**
 - Kyungpook National University
 - Daegu Metropolitan City
 - Daegu Gyeongbuk Medical Innovation Foundation
 - Daegu National Science Museum (DNSM)
- 14 Ulsan**
 - Dodam Food
- 15 Busan**
 - Dong-Eui University
 - Pusan National University
 - Federation of Busan Science and Technology
 - Dowtechwin Corp.
 - Macrochemtech Corp.
 - Busan Metropolitan City Dongnae Office of Education
 - Taesungpolitech Corp.
 - Silla University
 - Korea Industrial Complex Corp. in Dongnam area
 - Busan Metropolitan City Bukbu Office of Education
 - Korea Electrotechnology Research Institute
- 16 Jeju**
 - Jeju National University
 - Jeju Free International City Development Center
- 1 Hanbat National University**
- 2 Mediscov Inc.**
- 3 Bioneer Corp.**
- 4 National Plastic Co., Ltd.**
- 5 DaedeokNet**
- 6 Institute for Basic Science**
- 7 OVIUS**
- 8 Health & Environment Research Institute**



International Networks

KBSI is building a network with overseas advanced institutes to reinforce world-class collaboration.

- 1 Slovenia**
 - Jozef Stefan Institute [JSI]
- 2 Greece**
 - National Center for Scientific Research Demokritos (Demokritos)
- 3 Poland**
 - Adam Mickiewicz University (AMU)
- 4 UAE**
 - Petroleum Institute (PI)
- 5 Russia**
 - Kazan State University [KSU]
- 6 JAPAN**
 - Osaka University
 - Kyoto University New Energy Research Institute (IAE Kyo Univ.)
 - National Institute for Basic Biol-ogy [NIBB]
 - National Institute for Physiological Sciences [NIPS]
 - National Institute for Material Sciences [NIMS]
 - RIKEN Yokohama Institute
 - Nagoya University Bioscience and Biotechnology Center
 - High Energy Accelerator Research Organization (KEK)
- 7 Singapore**
 - Bioprocessing Technology Institute (BTI)
- 8 Vietnam**
 - Institute of Marine Biochemistry (IMBC)
 - Institute of Materials Science (IMS)
- 9 China**
 - Pecking University Institute of Heavy Ion Physics (IHIP PKU)
 - MMC at Shanghai Jiao Tong University State Key Lab of Metal Matrix Composites
- 10 USA**
 - Lawrence Livermore National Laboratory [LLNL]
 - University of California, San Diego [UCSD]
 - Salk Institute for Biological Studies [SI]
 - National High Magnetic Field Laboratory [NHMFL], University of Florida
 - University of Massachusetts Medical School [UMMS]
 - Havard Medical School / Messachusetts General Hospital Martino Center
 - University of Texas University of Texas Health Science Center at Tyler
 - University of Arizona (UOA)
- 11 Australia**
 - University of Wollongong (UOW)

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ANNUAL
REPORT 2014

Description of photograph |

Special prize at the 2014 KBSI Imaging Photo Exhibition,
<Prejudice>

Observation on a portion of cell wall and starch of
convallaria using confocal STED microscopy equipment

6

APPENDIX

REPRESENTATIVE RESEARCH PUBLICATIONS IN YEAR 2014
RESEARCH PROJECTS IN 2014

Representative
Research
Public in Year
2014

1 Development of a Human Neural Cell Culture Model of Alzheimer's Disease

Young Hye Kim (Co-1st Author), Division of Mass Spectrometry Research

Title

A three-dimensional human neural cell culture model of Alzheimer's disease (IF:42.351)

Journal

Nature (2014. 11. 13.)

Authors

Se Hoon Choi (Co-1st Author, Harvard Medical School-MGH), Young Hye Kim (Co-1st Author, KBSI), Rudolph E. Tanzi (Corresponding Author, Harvard Medical School-MGH) & Doo Yeon Kim (Corresponding Author, Harvard Medical School-MGH)

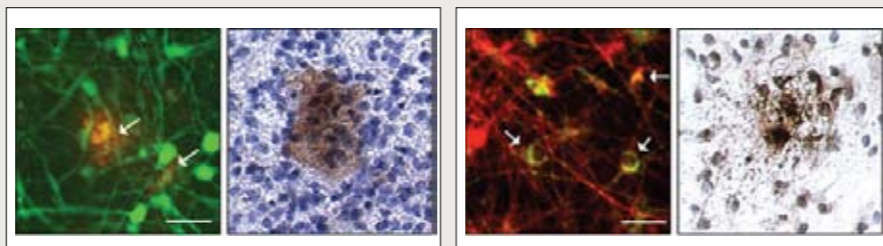
Abstract

Alzheimer's disease (AD) is the most common form of dementia, characterized by two pathological hallmarks: β -amyloid plaques and neurofibrillary tangles. The amyloid hypothesis of AD posits that excessive accumulation of β -amyloid peptide ($A\beta$) leads to neurofibrillary tangles. However, to date, no single disease model has linked these two pathological events using human neuronal cells. We genetically modified human neural stem cells (hNSCs) with FAD mutations in the amyloid- β precursor protein (APP) and presenilin (PS) 1 genes. The hNSCs with FAD mutations are able to induce robust extracellular deposition of β -amyloid plaques and p-tau aggregates in a human neural stem cell-derived three-dimensional (3D) culture system. We also have successfully recapitulated $A\beta$ -driven tau pathology in a single 3D human neural cell culture system for the first time.

Expected Contribution to Science & Technology

This model can be used as a platform for studying AD pathogenic mechanisms, biomarker discovery and drug screening.

Image



β -amyloid plaques of human neural cell AD model

Phosphorylated tau aggregates of human neural cell AD model

Representative
Research
Public in Year
2014

2 Interface Surprises May Motivate Novel Oxide Electronic Devices

Young-Min Kim(1st Author), Division of Electron Microscopic Research

Title

Direct observation of ferroelectric field effect and vacancy-controlled screening at the $\text{BiFeO}_3\text{-La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$ interface (IF : 36.425)

Journal

Nature Materials (2014. 08. 17.)

Authors

Young-Min Kim (1st Author, KBSI), Albina Y. Borisevich (Corresponding Author, ORNL)

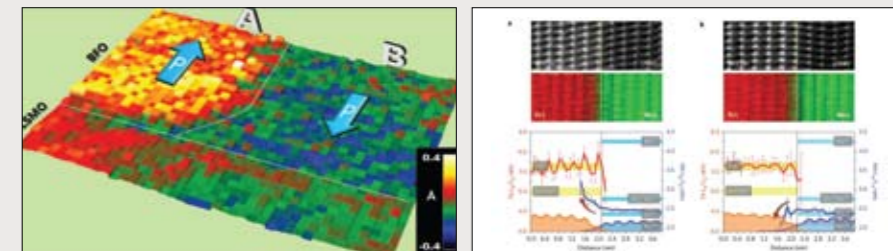
Abstract

The surprising discovery that intrinsic electric fields can drive oxygen diffusion at interfaces of complex oxides may serve as a basis for design of new electronic devices utilizing both electrons and ions. The researchers, from Korea, Norway, Ukraine and the United States, observed the effect in ferroelectrics, materials that exhibit switchable electrical polarization, or asymmetric distribution of positive and negative electrical charges. Ferroelectrics usually have regions, or domains, that can be as small as several nanometers, with different directions of polarization. Their properties are used in some memory devices, where domains with positive and negative polarization serve as "bits" that encode information. However, the longevity of these devices and the power required to "write" information is determined by what is happening at interfaces between the positively or negatively polarized ferroelectric domains and their metallic substrates.

Expected Contribution to Science & Technology

The exact nature of the compensating species at ferroelectric interfaces can have a significant effect on switching behavior because not only electrons but also ions need to move at the interface when the polarization charge is switched. The study therefore suggests a promising role for electrochemical phenomena at oxide interfaces, opening possibilities for fine-tuning switching by engineering local oxygen concentration.

Image



Unit-cell-wise polarization mapping of ferroelectric BFO thin film

Atomic-scale EELS analysis of BFO interface

Representative
Research
Public in Year
2014

3 Imaging of the Therapeutic Action of Antidepressant

Mi-Sook Lee (1st Author) and Song Her (Corresponding Author),
Chuncheon Center

Title

Temporal variability of glucocorticoid receptor activity is functionally important for the therapeutic action of fluoxetine in the hippocampus (IF : 15.147)

Journal

Molecular Psychiatry (2014. 10. 21.)

Authors

Mi-Sook Lee (1st Author, KBSI), Young-Han Kim (KBSI), Wan-Soon Park (KBSI), Ok-Kyu Park (KBSI), Seung-Hae Kwon (KBSI), Kwan-Su Hongs (KBSI), Hyewhon Rhim (KIST), Insop Shim (Kyung Hee Univ), Kyoji Morita (Shikoku Univ), Dona L. Wong (Harvard Univ), Paresh D. Patel (Univ of Michigan), David M. Lyons (Stanford Univ), Alan F. Schatzberg (Stanford Univ), Song Her (Corresponding Author, KBSI)

Abstract

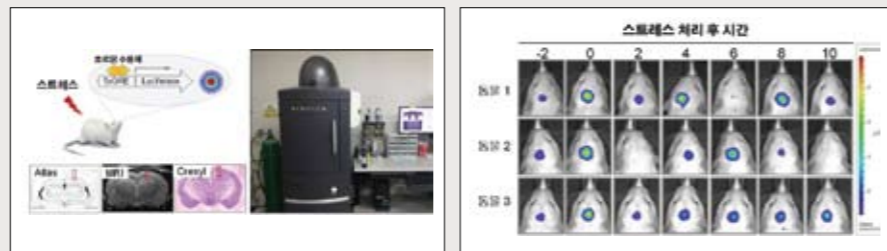
Previous studies have shown inconsistent results regarding the actions of antidepressants on glucocorticoid receptor

(GR) signalling. To resolve these inconsistencies, we used a lentiviral-based reporter system to directly monitor rat hippocampal GR activity during stress adaptation. Temporal GR activation was induced significantly by acute stress, as demonstrated by an increase in the intra-individual variability of the acute stress group compared with the variability of the non-stress group. However, the increased intra-individual variability was dampened by exposure to chronic stress, which was partly restored by fluoxetine treatment without affecting glucocorticoid secretion. Immobility in the forced-swim test was negatively correlated with the intra-individual variability, but was not correlated with the quantitative GR activity during fluoxetine therapy; this highlights the temporal variability in the neurobiological links between GR signalling and the therapeutic action of fluoxetine.

Expected Contribution to Science & Technology

These findings provide new mechanistic insights for the development of biomarkers and novel antidepressants.

Image



Schematic illustration of stress-induced GR activation in a living rat (Left panel) and in vivo Luminescence and Fluorescence Imaging System (Right panel)

Representative in vivo bioluminescent images (BLIs) in the hippocampal CA1 region of acutely stressed, showing an individual variation pattern

Representative
Research
Public in Year
2014

4 Identification of Novel Therapeutic Target of Type 2 Diabetes

Gun-Hwa Kim (Corresponding Author), Division of Life Science

Title

Inhibition of Cyp4a Reduces Hepatic Endoplasmic Reticulum Stress and Features of Diabetes in Mice (IF : 13.926)

Journal

Gastroenterology (2014. 10.)

Authors

Edmond Changkyun Park (Co-1st Author, KBSI), Seung Il Kim (Co-1st Author, KBSI), Yeonhee Hong (Co Author, KBSI), Jeong Won Hwang (Co Author, KBSI), Gun-Sik Cho (Co Author, POSTECH), Hye-Na Cha (Co Author, YU), Jin-Kwan Han (Co Author, POSTECH), Chul-Ho Yun (Co Author, JNU), So-Young Park (Co Author, YU), Ik-Soon Jang (Co Author, KBSI), Zee-Won Lee (Co Author, KBSI), Jong-Soon Cho (Co-Corresponding Author, KBSI), Soohyun Kim (Co Author, Biofabula), Gun-Hwa Kim (Corresponding Author, KBSI)

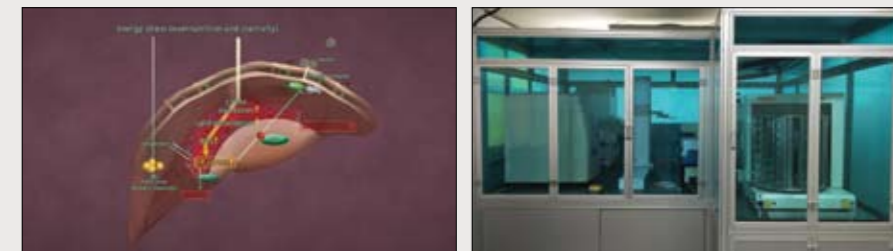
Abstract

We found drastically the expression of Cytochrome P450 4A (Cyp4a) proteins are highly increased in the type 2 diabetic mouse liver by extensive comparison of the mass spectrometric protein profiles of normal and type 2 diabetic mouse liver. Inhibition of Cyp4a protein expression or activity in type 2 diabetic mouse significantly ameliorates the diabetic physiology by reducing ER stress-induced hepatic insulin resistance. These results demonstrate the importance of Cyp4a in the remission of diabetes and suggest that the reduction of Cyp4a activity represents a promising strategy for treating type 2 diabetes.

Expected Contribution to Science & Technology

We found a novel therapeutic target protein of type 2 diabetes and investigated its functional mechanism in the development of type 2 diabetes. This study will be of interest in developing novel therapeutic drug for type 2 diabetes. Therefore, we are going to discover novel drug candidates for type 2 diabetes, which inhibit Cyp4a function by using automated high contents screening system.

Image



Schematic mechanism of hepatic insulin resistance by Cyp4a

Automated high content screening system for drug discovery

Representative
Research
Public in Year
2014

5 Development of Tumor-Targeted Theranostic Prodrug

Eun-Joong Kim (1st Author), Kwan Soo Hong (Corresponding Author),
Division of Magnetic Resonance Research

Title

An activatable Theranostic for Targeted Cancer Therapy and Imaging (IF : 13.734)

Journal

Angewandte Chemie International Edition (2014. 4. 22.)

Authors

S. Bhuniya (KBSI), S. Maiti (Korea Univ.), Eun-Joong Kim (1st Author, KBSI), Hyun Seung Lee (KBSI), J. L. Sessler (Univ. Texas), Kwan Soo Hong (Corresponding Author, KBSI), J. S. Kim (Korea Univ.)

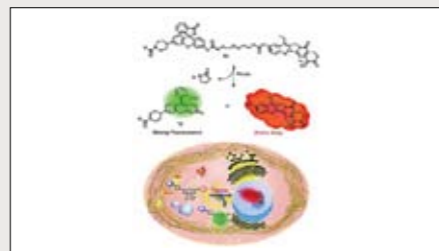
Abstract

A new theranostic strategy is described to be based on the use of an “all in one” prodrug. This prodrug, which incorporates the anticancer drug SN-38, undergoes self-immolative cleavage when exposed to biological thiols. This leads to the tumor-targeted release of the active SN-38 payload along with fluorophore. This release is made selective as the result of the biotin functionality. Fluorophore is 32-fold more fluorescent than prodrug. It permits the delivery and release of the SN-38 payload to be monitored easily *in vitro* and *in vivo*, as inferred from cell studies and *ex vivo* analyses of mice xenografts derived from HeLa cells, respectively. Prodrug also displays anticancer activity in the HeLa cell murine xenograft tumor model. On the basis of these findings we suggest that the present strategy, which combines within a single agent the key functions of targeting, release, imaging, and treatment, may have a role to play in cancer diagnosis and therapy.

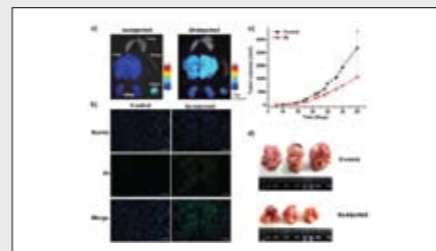
Expected Contribution to Science & Technology

This prodrug and analogues represent a potentially useful new approach to theranostic design and represent species that could provide new tools for tumor-targeted drug delivery and concomitant monitoring of uptake and function *via* fluorescent imaging. To our knowledge, this is the first time these design principles have been successfully demonstrated both *in vitro* and *in vivo*.

Image



Chemical structure of prodrug and schematic representation of activation



Ex vivo biodistribution of prodrug and its therapeutic efficacy

Representative
Research
Public in Year
2014

6 New Materials for Next Generation Thin Film Memory Devices

Young-Min Kim (Co-1st Author), Division of Electron Microscopic Research

Title

Oxygen-vacancy-induced polar behavior in $(\text{LaFeO}_3)_2/(\text{SrFeO}_3)$ superlattices (IF : 12.940)

Journal

Nano Letters (2014. 04. 15.)

Authors

Young-Min Kim (Co-1st Author, KBSI), Rohan Mishra (Co-1st Author, ORNL), Albina Y. Borisevich (Corresponding Author, ORNL)

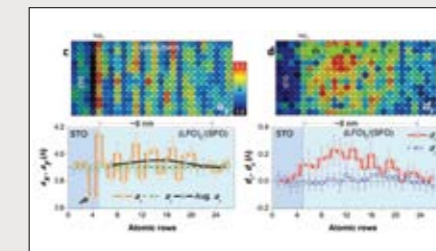
Abstract

A combination of Scanning Transmission Electron Microscopy (STEM), Electron Energy Loss Spectroscopy (EELS) and Density Functional Theory (DFT) calculations show that it is possible to achieve polar order in a superlattice made up of two non-polar oxides by means of oxygen vacancy ordering. While complex oxide films often have finite concentrations of oxygen vacancies that are commonly thought to be detrimental, this work shows that vacancies can instead lead to new functionalities and possibly new applications.

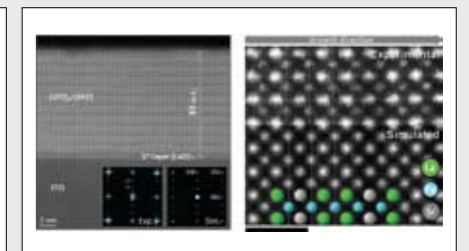
Expected Contribution to Science & Technology

By embracing and manipulating an imperfection of iron-containing oxide materials, we are taking a page from the playbook of the semiconductor industry, which exploits trace impurities called dopants. An added dopant can alter a substance's electrical or optical properties. Dopant atoms commonly take the place of elements in the crystal lattices that make up silicon semiconductors used in solid-state electronics. In fact, diodes cannot be made of pure silicon; a dopant must be added.

Image



Atomic-scale characterization of polar properties



Atomic resolution images of superlattice oxide thin film

Representative
Research
Public in Year
2014

7 Characterizing the 1-Dimensional (1D) Motions of a Transcription Factor on the Same DNA Molecule with Two Specific Sites

Kyoung-Seok Ryu (1st Author), Division of Magnetic Resonance Research

Title

Probing the rate-limiting step for intramolecular transfer of a transcription factor between specific sites on the same DNA molecule by ^{15}N -Exchange NMR Spectroscopy (IF : 11.444)

Journal

Journal of the American Chemical Society (2014. 09. 25.)

Authors

Kyoung-Seok Ryu (1st Author, KBSI), Vitali Tugarinov (NIH), G. Marius Clore (Corresponding Author, NIH)

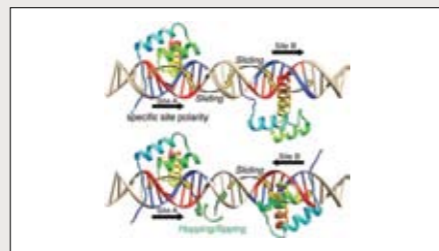
Abstract

The translocation of HoxD9 protein (homeodomain transcription factor) between two specific sites of the same or opposite polarities on the same DNA molecule have been monitored by ^{15}N -exchange NMR Spectroscopy. The results represent that the rate-limiting step is a one-base-pair shift of HoxD9 from the specific site to the immediately adjacent nonspecific site, and indicate the presence of the asymmetric 1D displacement of HoxD9 from the specific-binding site.

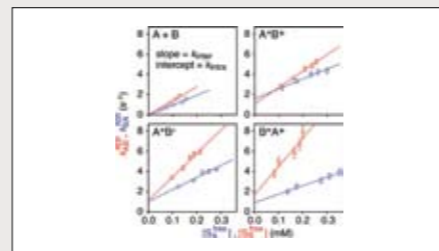
Expected Contribution to Science & Technology

Understanding of detailed 1D motions mediated by a DNA-binding protein on DNA surface

Image



The kinetics of the HoxD9 translocation between two specific sites of the same or opposite polarities on the same DNA molecule



Dependence of apparent k_{AB} and k_{BA} exchange rates of HoxD9 on the concentration of free DNA specific sites

Representative
Research
Public in Year
2014

8 The Studies on Amyloid β Peptide Fibrilization Relevant to Alzheimer's Disease

Sun Hee Kim (Corresponding Author), Western Seoul Center

Title

Multi-frequency, multi-technique pulsed EPR investigation of the copper binding site of murine amyloid β peptide (IF : 11.336)

Journal

Angewandte Chemie International Edition (2014.12.10.)

Authors

Donghun Kim (KBSI), Jeong Kyu Bang (KBSI), Sun Hee Kim (Corresponding Author, KBSI)

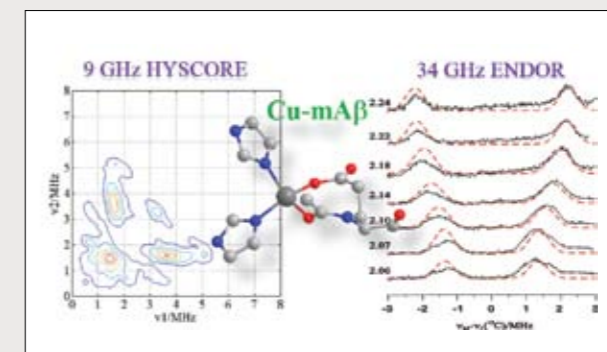
Abstract

Copper-amyloid peptides are proposed to be the cause of Alzheimer's disease. However, mice do not produce amyloid plaques and thus do not suffer from Alzheimer's disease. This paper shows the first detailed structural characterization of the copper-binding mode in murine amyloid β peptides by using multifrequency, multi-technique pulsed EPR Spectroscopy in conjunction with specific isotope labeling.

Expected Contribution to Science & Technology

This work may help elucidate the molecular mechanism underlying amyloid fibrilization, and advance the knowledge required for developing inhibitors of Alzheimer's disease.

Image



9 GHz HYSCORE (left), 34 GHz ENDOR (right) and the active site structure of the copper bound murine amyloid peptide. (center)

Representative
Research
Public in Year
2014

9

Zircon U-Pb Geochronology and Hf Isotope Geochemistry of Paleoproterozoic Basement Rocks from the North-eastern Yeongnam Massif

Chang-sik Cheong (Corresponding Author), Division of Earth and Environmental Sciences

Title

Zircon U-Pb geochronological and Hf isotopic constraints on the Precambrian crustal evolution of the north-eastern Yeongnam Massif, Korea (IF : 6.023)

Journal

Precambrian Research (2014. 03. 01.)

Authors

Namhoon Kim (1st Author, KBSI), Keewook Yi (KBSI), Yong-Sun Song (Pukyong National University), Kye-Hun Park (Pukyong National University), Jian-zhen Geng (Tianjin Institute of Geology and Mineral Resources), Huai-kun Li (Tianjin Institute of Geology and Mineral Resources), Chang-sik Cheong (Corresponding Author, KBSI)

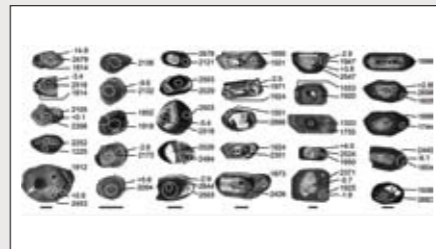
Abstract

This study presents SHRIMP U-Pb dating results and LA-ICPMS Hf isotopic data of zircons extracted from metasedimentary and (meta) granitoid rocks in the north-eastern Yeongnam Massif, Korea. Using these data, we refined the geochronologic scheme of crustal evolution and constrained the timing of crustal growth and recycling, and source characteristics of the granitoids. Also, the zircon ages determined here provided some implications for the correlation with Paleoproterozoic terranes in eastern China.

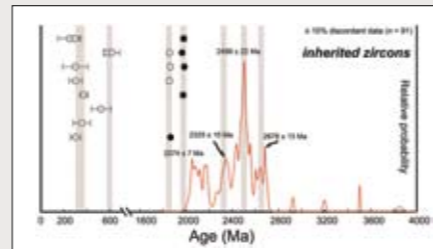
Expected Contribution to Science & Technology

The Hf model ages narrowly constrained by magmatic and inherited zircons from group I and III (meta)granitoids, and the high- ϵ_{Hf} zircons from the metasedimentary rocks and group II metagranitoids suggest that the Neoproterozoic Era (ca. 2.75-2.62 Ga) marks the most important stage of crustal formation in the north-eastern Yeongnam Massif. The Paleoproterozoic (ca. 2.50-1.98 Ga) magmas were derived principally by crustal recycling. These Hf isotopic features generally agree with those reported for zircons from the NCC and eastern Cathaysia Block, but the zircon ages determined here leave uncertainties regarding the correlation of the north-eastern Yeongnam Massif with Paleoproterozoic terranes in eastern China.

Image



CL images of zircons with analysis results



Summary of inherited zircon ages

Representative
Research
Public in Year
2014

10

Li Isotope Geochemistry in Hawaiian Soils

Jong-Sik Ryu (1st Author/Corresponding Author), Division of Earth and Environmental Sciences

Title

Lithium isotope geochemistry during basalt weathering and secondary mineral transformations in Hawaii (IF : 4.25)

Journal

Geochimica et Cosmochimica Acta (2014. 11. 15.)

Authors

Jong-Sik Ryu (1st Author/Corresponding Author, KBSI), Nathalie Vigier (LOV, CNRS, UPMC, UMR 7093), Sin-Woo Lee (KBSI), Kwang-Sik Lee (KBSI), Oliver A. Chadwick (UCSB)

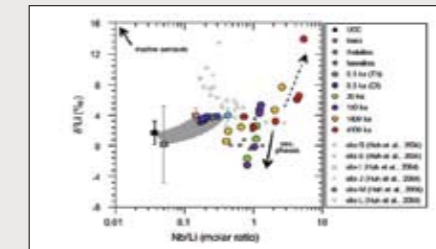
Abstract

Lithium isotopes are a potential tracer of silicate weathering but the relationship between lithium isotope compositions and weathering state still need to be established with precision. Here, we report Li concentrations and Li isotope compositions of soils developed along a 4 million year humid-environment chronosequence in the Hawaiian Islands. Results highlight significant Li isotope fractionation during secondary mineral formation and in particular during Li uptake by kaolinite. Finally, we suggest that the non-monotonous evolution of the regolith $\delta^7\text{Li}$ value over the last 4 Ma is consistent with climatic variations, where congruent release of Li isotopes occurs during warmer periods.

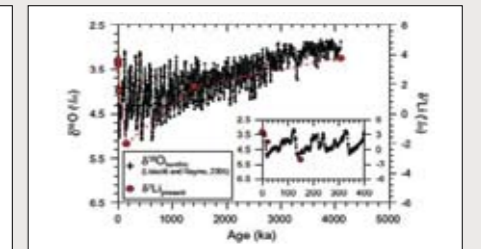
Expected Contribution to Science & Technology

Although this would need to be investigated with more data, the co-variation between $\delta^7\text{Li}$ and $\delta^{18}\text{O}$ indicates a possible control of climatic conditions on the soil $\delta^7\text{Li}$, and therefore on the water $\delta^7\text{Li}$ values. The soil $\delta^7\text{Li}$ is close to the value of the parent basalt at periods of time characterized by low $\delta^{18}\text{O}$ value, i.e., when global temperature was higher.

Image



Lithium isotope geochemistry in Hawaiian soils



Relationship between $\delta^7\text{Li}$ and past climate

Research Projects in 2014

Main Projects

Unit : Million won

Project	Title	Subtitle	Principal Researcher	Research Fund	
General Mission-oriented R&D Projects	Operation & Joint Utilization of Advanced Equipment	Support of analytical research	Seungil Kim	5,360	
		Operation of Advanced Multipurpose Mass Spectrometers	Hyun Sik Kim	1,125	
		Operation of Sensitive High Resolution Ion Microprobe	Kee Wook Yi	1,035	
		Establishment management of analytical system for national disaster response	Kwang-Sik Lee	1,500	
		Establishment and operation of Western Seoul Center	Geum Sook Hwang	1,000	
		Expanded use of research outcomes	Kyung-Hoon Kwon	230	
		Promotion of basic research in the region and facilitation of technology development	Kyung-Hoon Kwon	2,000	
	Operation & Research of fusion imaging equipment	Operation of High Voltage Electron Microscope(HVEM)	Operation of High Voltage Electron Microscope(HVEM)	Jin Gyu Kim	1,089
			Operation of Magnetic Resonance Equipment	Kwan Soo Hong	1,200
			Installation and utilization of human MRI Research System	Gyunggoo Cho	300
			Installation and utilization of Super Bio-HVEM	Hee Seok Kweon	5,865
	Development of high-tech equipment & Analytical Technology	Technology support of research equipment	Technology support of research equipment	Jeong Min Lee	327
			Installation of small and medium accelerators utilizing the ECR Ion	Mi-Sook Won	1,235
			Development & research of analytical Technology	Seungil Kim	3,338
			Identification of drug-binding proteins using in vivo imaging technology	Kwan Soo Hong	3,000
			Development of the state-of-the-art optical analysis equipments for the creative industries	Geon-hee Kim	3,200
	Installation of Research Facilities and Equipment	Installation of research equipment	Installation of research equipment	Kwang-Sik Lee	5,718
			Establishment of joint-use equipment for degenerative disease research	Won Jin Moon	765
			Operation support of platform technology and construction of analytical instruments for fusion science	Hye On Yoon	1,350
			Development of Multi-disciplinary In situ Analytical System for nanotechnology and related science	Jouhahn Lee	2,400
	Promotion of Research Facilities and Equipment	National Research Facilities & Equipment Center operation program	National Research Facilities & Equipment Center operation program	Kyungman Yoo	1,550
Joint utilization & operator support of expensive special research equipment			Kyungman Yoo	600	
Creative R&D Projects	Strengthening Future Research Competence	Strategic research for future	Jong Soon Choi	1,045	
		Creative basic research	Jin Bae Lee	1,463	

In-house Projects

Unit : Million won

Project	Subtitle	Principal Researcher	Research Fund	
Development & Research of Analytical Technology	Protein-protein interaction structure analysis and design of inhibitor	Hae Kap Cheong	252	
	Study of amyloid peptide fibrillation in Alzheimer's Disease using EPR System	Sun Hee Kim	135	
	Development of cryogenic scanned Probe Tera Hz MRI Nanoscope	Sang Gap Lee	135	
	Development of original technology for bio-analysis of the mechanism of infectious disease	Seungil Kim	200	
	Developing correlative fusion techniques of bio-imaging using High Voltage Electron Microscope	Hyun Suk Jung	240	
	Metaproteome analysis for elucidating oil degradation pathway	Young Ho Chung	80	
	The development of inhibitors targeting Polo-box-domain of polo-like kinase 1 and its structural analysis using NMR/X-ray	Jeongkyu Bang	240	
	The development and application of nuclear magnetic resonance analysis techniques for electrochemical reactions and ion behavior research	Oc Hee Han	140	
	Development of High Sensitivity Portable Mass Spectrometer	Hyun Sik Kim	167	
	Study of features and production of OMV nano particle for commercialization	Seungil Kim	20	
	Development of cryogenic high-sensitive analysis and detection equipment	Yeon Suk Choi	27	
	Development of the inspection equipment of the semiconductor devices using high-resolution infrared optical systems	Geon-hee Kim	64	
	Development of space-time resolved laser optical analysis equipment (for future leading technology)	Hanju Rhee	150	
	Development of SARP2 direct imaging technique	Young-Min Kim	125	
	Technical developments of correlative microscopy to visualize membrane-permeable nano particles passing into cell	Sangmi Jun	125	
	Development of analysis/synthesis for functional construction materials of carbon-based industry	Tae Sung Bae	150	
	Development of MRI technology for characteristic analysis of polymer absorber	Chul Hyun Lee	14	
	Development of efficient thermal-cut films	Hyun Gyu Kim	150	
	Multi-frequency, multi-technique EPR studies on bio/energy related materials	Sun Hee Kim	125	
	Explore the fatty liver suppressor gene and drug development	Young-Wook Cho	150	
	Spin-orbit measurement technique	Seung Young Par	11	
	Establishment of infra for degenerative disease research	Won Jin Moon	550	
	Development of blue wavelength blocking materials	Hyun Gyu Kim	24	
	Base research on the environmental toxicology of chemicals	Hye On Yoon	36	
	Development of the metal powders pretreatment equipment for GD-MS analysis	Jaesik Yoon	29	
	Seed Type National Agenda Project	Development of scientific forensic technologies using cutting-edge high-tech analytical equipment	Jong Soon Choi	250
		Development of isotope technology for country-of-origin or authenticity discrimination for foods	Kwang-Sik Lee	90
Development of country-of-origin or authenticity discrimination techniques for foods		Geum Sook Hwang	90	
Hierarchically nanostructured materials for developing environmental remediation technology		Ha Jin Lee	120	
Mass Spectrometry based disease screening for improving the quality of life		Jin Young Kim	76	
Development of monitoring and management protocols for the hazardous chemical substances in environment	Hye On Yoon	114		

In-house Projects

Unit : Million won

Project	Subtitle	Principal Researcher	Research Fund
Development of Auxiliary Systems	Development of sample orientation navigator for 3D EM imaging	Jin Gyu Kim	45
	Microfabricated comprehensive 2-dimensional chromatographic chips	Hye On Yoon	105
	Development of wet-cell holder auxiliary technology wet-cell holder	Yoon Jung Kim	80
	Development of cryogenic high-sensitive analysis and detection equipment	Yeon Suk Choi	30
	Development of new materials for high capacity negative materials for Li 2nd battery	Yang Soo Kim	45
International Research Collaboration Project	Development of high efficient energy storage based on 3D macroporous graphene film	Jin Bae Lee	91
	Geochemical study of basaltic soils along a Hawaiian chronosequence : understanding change of the critical zone	Jong Sik Ryu	72
Support for Collaborations between KBSI and Universities	Tectonics and origin of mesozoic granitoids in South Korea	Kee Wook Yi	56
	Examination on changes in the proteome of learning and memory	Young Hye Kim	56
	Navigation of plant immune system and research of mechanisms of control parameters	Myung Hee Nam	63
	Development of high-throughput quantitative N-glycan analysis system	Young Hwan Kim	49
	Development of high sensitive porous-carbon-based electrode for biosensor	Tae Sung Bae	58
	Synthesis of nanomaterials on graphene or atomic layered material as a substrate and their characterizations in atomic level	Hwanuk Guim	45
	Time-dependent ³¹ P NMR study on GTP hydrolysis in taxol-stabilized microtubules	Younkee Paik	45
	Plant response assessment and technology development based on environmental changes	Jongsung Jin	200
Support for Young Scientists	Biocompatible nano-medicine-based osteoporosis-control study	Kyeong Soon Park	63
	Study of functional structure of Mass Spectrometry based-RBC membrane protein	Joweph Kwon	50
	Real-time observation and nanoscale analysis of low-dimensional nanostructures and their properties-coupling behaviors by mechanical strain	Woong-Ki Hong	49
	Analysis of electron transport characteristics of functional electron spin devices	Seung Young Park	58
	High resolution structural analysis of virus capsids using Cryo-Electron Microscopy	Jae Kyung Hyun	56
	Development of cryogen-free MgB ₂ superconducting magnet system for ECR ion source	Seyong Choi	56
	Study on the chemical state analysis using high spatial resolution STEM-EELS	Hionsuck Baik	48
	Obesity reduce by the stimulation of brown adipocyte	Young Wook Cho	30
	NGFI-B and Btg2 are bi-functional proteins; Two different organs through nuclear and mitochondria	Jaell Park	48
	Understanding the growth mechanism and selective functionalization of high-quality graphene	Cheolho Jeon	54
	Characterization and development of Ru and RuO ₂ thin film by atomic layer deposition	Tae Eun Hong	54
	Construction of nano-particles for disease diagnosis and therapy using nano-imaging and analytical system	Jin Kyu Rhee	48
	Evaluation of ion beam irradiated extreme materials using HVEM	Jong han Won	45
	Histidine/Tryptophan derivatives as functional replacements for tryptophan(s) in D-Pac-525	Hee Jeon Park	50
	Development of high-speed cooled deformable mirror	Sang Won Hyun	20

Commissioned Projects

Unit : Million won

Project Title	Principal Researcher	Period	Research Fund	Partner
Development of scientific forensic technologies using cutting-edge high-tech analytical equipment	Kwang-Sik Lee	2010-12-15~2016-12-31	3,930	National Research Council of Science & Technology
Studies on excavation and functions of proteins related to diseases based on human chromosome no. 11	Joong Shin Yoo	2013-11-01~2018-10-31	1,200	Ministry of Health and Welfare(MW)
Development of national research facilities and equipment Information service for management	Dongwoo Kim	2006-01-01~ongoing	8,748	Ministry of Science, ICT and Future Planning
Development of high-speed cooling system for 200 mm deformable mirror	Sang Won Hyun	2013-12-20~2016-12-19	660	National Research Council of Science & Technology
International collaborative research network on defect engineering in nanomaterials	Woong-Ki Hong	2014-01-01~2014-12-31	15	National Research Foundation of Korea
Study of safety management of PCBs in food	Jeong Hwa Shin	2012-01-01~2016-11-30	400	Ministry of Health and Welfare(MW)
3 T MRI SAR measurement experiment	Jee Hyun Cho	2014-02-01~2014-10-31	50	Korea Research Institute of Standards and Science
Statistics of material flow by metal	Jae Sik Yoon	2014-01-01~2014-12-31	46	Ministry of Trade, Industry and Energy
Development of skin-regeneration drugs using secretory proteins from stem cell derived skin tissue	Jong Bok Seo	2013-11-01~2018-10-31	36	Ministry of Trade, Industry and Energy
Development of MRI technology for characteristic analysis of polymer absorber	Chul Hyun LEE	2014-03-01~2014-08-31	30	LG Chem
Development of a technology for using high resolution glow discharge mass spectrometer for analysis of rare metals with high accuracy	Jae Sik Yoon	2014-01-01~2014-12-31	27	Korea Institute of Industrial Technology
Project support of High-technology materials and components Center	Euh Duck Jeong	2014-01-01~2014-12-31	970	Busan Metropolitan City
Study of features and production of OMV nano particle for commercialization	Seungil Kim	2008-12-01~2014-11-30	120	National Research Council of Science & Technology
Proteomic profiling using patient-specific induced pluripotent stem cells(hiPSC)	Jong Soon Choi	2014-01-01~2015-09-30	90	National Research Council of Science & Technology
Genomic study of non-culturable microorganisms in food and human	Seong Woon Roh	2013-01-01~2017-12-31	400	Korea Food Research Institute
Technical development of cryo-specimen fixation for biological molecules	HyunSuk Jung	2013-09-17~2019-02-28	825	Ministry of Science, ICT and Future Planning
Development of spin device measurement	Seung Young Park	2011-07-15~2017-02-28	799	Ministry of Education and Science Technology
The support program for the advancement of National Research Facilities and Equipment	Kyungman Yoo	2010-02-02~ongoing	8,500	Ministry of Science, ICT and Future Planning
Analysis of facilities and equipment subject to feasibility examination of national research and development project in second half of 2013	Kyungman Yoo	2014-03-25~2014-06-16	10	Korea Institute of S&T Evaluation and Planning
Leakage of hazardous chemicals in groundwater and the establishment of management system for contaminated soil spread monitoring	Hye On Yoon	2013-04-01~2016-03-31	600	Ministry of Environment
Development of method to assess fluorine level in soil and waste and protocol for contaminated site monitoring	Hye On Yoon	2012-04-01~2015-03-31	400	Ministry of Environment

Commissioned Projects

Unit : Million won

Project Title	Principal Researcher	Period	Research Fund	Partner
Development of conduction-cooled cryo-probe station technology	Yeon Suk Choi	2014-03-01~2016-12-31	90	Myung Shin Tehnology
Development of technologies on exploration and utilization of domestic rare metal resources	Chang-sik Cheong	2014-01-01~2015-12-31	240	Ministry of Trade, Industry and Energy
Yuseong-gu science mentor for youth	Jung Lim Lee	2014-04-01~2014-10-31	11	Yuseoung District
Development of the geochemical monitoring quality guideline	Hye On Yoon	2014-04-01~2018-03-31	340	Ministry of Environment
Multi-photon biomedical imaging using biocompatible nanoparticles	Seung-Hae Kwon	2013-05-01~2016-12-31	400	Institute for Basic Science
Research on joint use and performance management systems for research facilities and equipment	Kyungman Yoo	2014-05-01~2015-01-31	50	Ministry of Science, ICT and Future Planning
Investigation of the 3D bioactive structure of anticancer drug epothilones using ² H and ¹⁹ F REDOR NMR Spectroscopy	Younkee Paik	2011-05-01~2016-04-30	171	MINISTRY OF EDUCATION
Development of analytical instruments for the evaluation of superconducting characteristics	Seyong Choi	2014-05-01~2015-12-31	15	Guemryung Tech co., LTD.
Culture of microalgae and development of new potential materials	Narae Lim(supported by Dae Kyung Kim)	2012-12-01~2015-02-28	66	Ministry of Science, ICT and Future Planning
Studies the physical and chemical properties of Water-soluble organic carbon component in atmospheric dust	Joo Ae Kim(supported by Hye On Yoon)	2012-09-01~2015-02-28	180	Ministry of Science, ICT and Future Planning
Fabrication and characterization of functional photonic crystal materials	Myung Jin Lee(supported by Weon Sik Chae)	2012-09-01~2015-02-28	180	Ministry of Science, ICT and Future Planning
Operation of junior doctor(2014)	Jung Lim Lee	2014-05-01~2014-12-31	200	Daejeon Metropolitan city
Study of ionic mobility selection by asymmetric electric field	Myoung Choul Choi	2013-01-01~2016-12-15	437	Agency for Defense Development
Development of energy storage materials based on hollow nanostructured transition metal oxide	Jin Bae Lee	2013-06-01~2016-05-31	136	MINISTRY OF EDUCATION
A development of in-situ multi-disciplinary characterization system for oxide electronics using ultrafast phase transitions	Woong-Ki Hong	2013-06-01~2016-05-31	136	MINISTRY OF EDUCATION
Research of the surface and interfacial properties of CIGS thin solar cell	Tae Eun Hong	2014-05-01~2014-06-30	30	Samsung SDI
The applicability evaluation of a lead isotope database for the provenance of bronze artifacts	Youn-Joong Jeong	2014-06-09~2014-11-30	71	Cultural Heritage Administration
Development of biological and chemical characterization methods of remicade biosimilar for the international drug approval	Hyun Sik Kim	2014-06-01~2015-05-31	20	Aprogen co., LTD.
Strengthening TLO competence for KBSI	Byung Sang Hwang	2013-05-01~2016-04-30	450	Ministry of Trade, Industry and Energy
Distribution survey of natural radioactive substances in soil	Jeong Hee Han	2014-06-05~2015-02-08	146	Ministry of Environment
High resolution MRM-MS based plasma protein quantitation using peptide antibody	Jin Young Kim	2013-06-01~2017-05-31	348	Ministry of Science, ICT and Future Planning
Observation and control of physical properties in single-crystalline VO ₂ nanostructures by electron beam irradiation	Woong-Ki Hong	2014-06-01~2015-05-31	30	Ministry of Science, ICT and Future Planning

Commissioned Projects

Unit : Million won

Project Title	Principal Researcher	Period	Research Fund	Partner
Planned research on efficient operation of expensive research equipment projects	Jungek Goo	2014-06-01~2014-12-31	40	Ministry of Science, ICT and Future Planning
Development of NMR based metabolomics/chemometrics for diagnosis and treatment of chronic kidney disease	Geum Sook Hwang	2010-06-30~2015-06-29	750	Ministry of Science, ICT and Future Planning
Research of dating and tectonic history of the central east coast terrace of the Korean peninsula using the luminescence dating of the K-feldspar fraction	Sung chan Hong (supported by Jeong-Heon Choi)	2014-07-01~2015-06-30	34	MINISTRY OF EDUCATION
Development of high resolution the thermal imager for temperature measurement	Kye Sung Lee	2012-07-01~2017-06-30	1,880	Ministry of Trade, Industry and Energy
Industrial technology development and utilization of unused equipment	Yang Soo Kim	2014-07-01~2014-08-15	72	Ministry of Trade, Industry and Energy
Magnetic nanoparticles for spintronic and biomedical Applications	Hae Jin Kim	2013-07-01~2015-06-30	100	Ministry of Science, ICT and Future Planning
A semi-metal p-MRAM technology using spin-orbit coupling	Seung Young Park	2013-06-01~2018-05-31	125	Ministry of Trade, Industry and Energy
Development of antibody characterization platform technologies for antibody-biobetter(development of antibody characterization-based technology for antibody biobetter)	Hyun Sik Kim	2011-06-01~2016-05-31	1,046	Ministry of Trade, Industry and Energy
Research on the directivity for efficient investment on R&D projects to prepare for research facilities and equipment	Kyungman Yoo	2014-07-01~2014-11-30	40	Ministry of Strategy and Finance
Development of low power consumption half-metal spin materials	Seung Young Park	2013-06-01~2018-05-31	125	Consortium of Semiconductor Advanced Research
Study on the factors affecting lithium adsorbent capacity and the controls of physicochemical process in marine environments	Hye On Yoon	2010-04-01~2015-03-31	510	Ministry of Oceans and Fisheries
Project for the youth's science activity utilizing state-of-the-art equipment	Jung Lim Lee	2004-01-01~ongoing	9,503	Ministry of Science, ICT and Future Planning
Analysis of facilities and equipment subject to feasibility examination of national research and development project in second half of 2014	Kyungman Yoo	2014-08-01~2014-12-20	79	Korea Institute of S&T Evaluation and Planning
Research equipment engineer training project	Kyungman Yoo	2012-07-01~2023-07-31	10,192	Ministry of Science, ICT and Future Planning
Metabolic profiling studies for prediction and management of the metabolic syndrome	Geum Sook Hwang	2013-08-01~2018-07-31	475	Ministry of Science, ICT and Future Planning
Development of multiple diagnostic and therapeutic technology in cardiovascular disease using fusion research of metabolomics and bio-imaging	Geum Sook Hwang	2012-07-27~2018-07-26	12,000	National Research Council of Science & Technology
Development of high resolution the thermal imager for temperature measurement	Kye Sung Lee	2013-06-01~2015-05-31	160	Ministry of Trade, Industry and Energy
Autonomous cooling technology at cryogenic temperature	Yeon Suk Choi	2013-07-29~2015-07-28	200	National Research Council of Science & Technology
Development of the cryogen-free NMR spectrometer with high-temperature superconducting magnet	Sanggap Lee	2014-08-18~2019-08-17	5,330	Ministry of Science, ICT and Future Planning

Commissioned Projects

Unit : Million won

Project Title	Principal Researcher	Period	Research Fund	Partner
Development of wien filter for application of Mass Spectrometry	Byung Seop Lee	2014-08-18~2019-08-17	110	Ministry of Science, ICT and Future Planning
Development of high precision specimen control device of transmission electron microscope (TEM) dedicated to nano-bio convergence	Jin-Gyu Kim	2014-08-18~2019-08-17	50	Ministry of Science, ICT and Future Planning
Isolation and bioprospecting of novel species of archaea from extreme environments	Seong Woon Roh	2012-09-01~2015-08-31	164	MINISTRY OF EDUCATION
Analysis of degradation mechanism and improvement of durability in PEMFC	Seokhoon Lee	2011-09-01~2016-08-31	470	Ministry of Trade, Industry and Energy
Development of standardized method for electrical characterization of graphene	Ha Jin Lee	2014-08-25~2014-12-24	28	Ministry of Trade, Industry and Energy
Analytical research on drug binding to establish a platform for excavation of leading materials based on fragments	Hae Kap Cheong	2014-09-01~2015-03-31	40	Ministry of Science, ICT and Future Planning
Development of proteomic technology for functional analysis of multi-components of natural product	Seungil Kim	2014-09-01~2017-08-31	450	Ministry of Science, ICT and Future Planning
Development and evaluation of diagnosis agent for disease using imaging modalities	Eun Kyoung Ryu	2014-09-10~2014-12-31	30	Korea Research Institute of Bioscience & Biotechnology
NBIT based kinase signaling control	Young Ho Chung	2012-07-27~2018-07-26	2,400	National Research Council of Science & Technology
Protein network analysis of hydrogen production of <i>thermococcus onurineus</i> NA1 using proteomics	Young Ho Chung	2009-07-01~2015-06-30	445	Ministry of Oceans and Fisheries
Assessment of the effect of LRRK2 inhibitors using electron Microscope in animal model of Parkinson's Disease	Hee Seok Kweon	2013-10-17~2016-10-16	300	Ministry of Science, ICT and Future Planning
Research and development of the gap control in sintering of nano-sized zirconia powder	Hye On Yoon	2014-08-14~2015-02-13	40	KCTech co., LTD.
Review on appropriateness of R&D project plans for '14 and analysis of cost for research equipment	Kyungman Yoo	2014-11-01~2014-12-20	10	Korea Institute of S&T Evaluation and Planning
Characterization of biodegrading mechanism from environmental bacteria by proteomic and genomic approach	Sang-Yeop Lee(supported by Seungil Kim)	2014-11-01~2015-10-31	33	MINISTRY OF EDUCATION
Development of a quick diagnosis methods for multidrug-resistant <i>Acinetobacter baumannii</i> using antigen-antibody reaction	Gun-Hwa Kim	2014-11-01~2017-10-31	450	Ministry of Health and Welfare(MW)
Demand driven collaborative technology support program to Integrated SME support center regional division	Kee Wook Yi	2014-07-01~2014-12-31	72	Ministry of Science, ICT and Future Planning
Development of high-resolution thermal analysis equipment for semiconductor device applications	Ki Soo Chang	2014-11-26~2015-11-25	300	National Research Council of Science & Technology
Development of cryogenic probe station using conduction cooling method	Yeon Suk Choi	2014-11-26~2015-11-25	357	National Research Council of Science & Technology
Development of a rapid biosensor system to detect human noroviruses	Joweph Kwon	2013-12-16~2015-12-15	2,460	National Research Council of Science & Technology
Development of High sensitivity portable toxic gas detection equipment	Hyun Sik Kim	2013-12-16~2015-12-15	2,800	National Research Council of Science & Technology

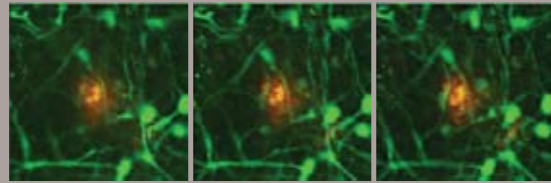
Installation, Upgrades of Advanced Research Equipment in 2014

Equipment	Division	
Equipment Installed	HT-800 MHz NMR Spectrometer	Western Seoul Center
	Near Ambient Pressure X-ray Photoelectron Spectrometer	Division of Materials Science Research
	Field Emission Transmission Electron Microscope	Daegu Center
	Ultra High Analytical Field Emission Scanning Electron Microscope (UHA FE-SEM)	Division of Electronic Microscopic Research
	Glow Discharge Mass Spectrometer	Division of Earth and Environmental Science Research
	High Resolution Accurate Mass Integrated Omics Mass Analyzer	Division of Life Science Research
	Super Resolution Confocal Microscope	Western Seoul Center
	2-dimension liquid chromatography tandem mass spectrometry system	Division of Life Science Research
	Single Crystal X-ray Diffractometer System	Western Seoul Center
	High Resolution Scanning Electron Microscope	Busan Center
	Automatic High-speed Cytometry Sorter System	Division of Life Science Research
	SQUID VSM(Superconducting QUantum Interference Device Vibrating Sample Magnetometer)	Division of Materials Science Research
	2-dimensional Gas Chromatography / High Resolution Mass Spectrometer System	Division of Mass Spectrometry Research
	WDX-SEM[EPMA-SEM]	Division of Magnetic Resonance Research
	GC X GC Chromatograph/TOF-Mass Spectrometer	Western Seoul Center
	Liquid Chromatograph/Capillary Electrophoresis-Mass Spectrometer	Western Seoul Center
	High Resolution Mass Spectrometer	Division of Mass Spectrometry Research
	Quantitative LC-MS	Western Seoul Center
	HPGe gamma-ray detector with autosample changer	Division of Earth and Environmental Science Research
	Hazardous Air Pollutant Analysis System	Division of Mass Spectrometry Research
	HPGe gamma-ray detector with autosample changer	Division of Earth and Environmental Science Research
	Plasma-enhanced Atomic Layer Deposition	Division of Materials Science Research
	Inductively Coupled Plasma Atomic Emission Spectrometer	Division of Earth and Environmental Science Research
	ICP-OES	Gwangju Center
	Automated High-throughput Protein Purification System	Division of Mass Spectrometry Research
Performance Upgrades	CCD camera for HR-TEM	Gwangju Center
	Ion Milling System for TEM	Gangneung Center
	Jet Interface kit for MC-ICP-MS	Division of Earth and Environmental Science Research
	Acoustic Focusing Flow Cytometer	Division of Magnetic Resonance Research
	Cell image multi-functional Plate Reader	Chuncheon Center
	Specimen Preparation System for TEM	Daegu Center
	Automatic Fusion system	Busan Center
	5 mm HX Magic Angle Spinning probe for 600 MHz Solid state Nuclear Magnetic Resonance	Western Seoul Center
	Chemi and Gel-Doc system	Chuncheon Center
	Open-type Microwave Digestion System	Division of Earth and Environmental Science Research
	HPLC Upgrade (High Performance Liquid Chromatography)	Division of Mass Spectrometry Research
	Micopurification System	Seoul Center

INTERVIEW

2014 KBSI Grand Paper Award and selection as the top among 10 major science and technology news by Korean Federation of Science and Technology Societies

'First cultivation of brain cells of dementia patient' (published in Nature magazine) by Dr. Young Hye Kim (Division of Mass Spectrometry Research)



'First cultivation of brain cells of dementia patient'-Serial section images of beta-amyloid (red) condensed outside Alzheimer nerve cells divided into 3D

On December 14, 2014, Korean Federation of Science and Technology Societies (KOFST) announced that 'First cultivation of brain cells of dementia patient' was selected as the top news among 10 majors science and technologies news of the year.

KOFST aggregated the results of 3 committee deliberations and 3,439 votes of scientists and non-scientists, selecting 'Cultivation of brain cells of dementia patient' as the number 1 science and technology news of the year'. 'Cultivation of brain cells of dementia patient' presented through 'Nature' magazine in October of last year involves laboratory cultivation of cells that embody brain tissue characteristics of dementia patients. The research was conducted by joint research group of Professor Doo Yeon Kim and Professor Rudolph Tanzi at Harvard University of the United States and Dr. Young Hye Kim of Korea Basic Science Institute.

They inserted a mutant gene of Alzheimer's disease into neural stem cells of human and developed an experimental model simulating brain of a patient through 3D differentiation. This was the world's first experimental demonstration of the amyloid hypothesis, the theory on occurrence of Alzheimer's disease. The research was evaluated to bring great contributions to identify causes and treatment for dementia. (Media coverage on October 13, 2014)

Q The research outcome on 'Cultivation of brain cells of dementia patient' published on Nature magazine in October 2014 received the greatest spotlight, both at home and abroad. This really means a lot.

How did you start on this research project?

A Since human brains cannot be used to conduct experiments for dementia research, rats were mainly used as experimental models until now. However, there were great limits in understanding dementia and developing cure because rats have different brain structure and physiology compared to human.

My colleagues and I came to agree that a better experimental model is required to overcome the limits of dementia research, and we decided to create a brain cell model for dementia patient using neural stem cells.



Q You have continued with this research for 4 years, and there must have been difficulties in the process. What are some difficulties that come to your mind?

A We had to stay with cells for four months, even including holidays, to cultivate nerve cells. When cells we cultivated for several months got contaminated at the last minute, we had to go back and start over from the beginning. Nonetheless, there is nothing happier for researchers than obtaining a fruitful outcome through their hypotheses. I am very lucky to be one of them.

Q How did working at KBSI directly influence or help your research efforts?

A As I worked with experts of different scientific areas at KBSI, I was able to have different views and flexible thoughts on the directivity of research by accessing latest technologies of different fields. Also, as KBSI encourages overseas training and posting, I had many opportunities to learn the best technologies through short and long-term education and training. This taught me how to naturally exchange ideas with researchers around the world. My research outcome published through Nature magazine this time is the result of joint research actively conducted with scholars of Alzheimer's disease and dementia whom I met through the overseas training course supported by KBSI.

Q Lastly, please share your goal or plan for this year.

I plan to concentrate on the development of small scale artificial human brain models for dementia similar to human brains so that our models can be used to find the cause of dementia and develop cure medicines.

2014 KBSI Annual Report Organizing Committee

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