

KBSI ANNUAL REPORT 2011 English Version





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



Gwahangno 169-148, Yuseong-gu, Daejeon, Korea 305-806 Tel. 042. 865. 3500 | Fax. 042. 865. 3404 www.kbsi.re.kr www.kbsi.re.kr



# 01 Technology development for the inhibition of interactions using the CUPID system

with NMR

. Demonstrated development of high-efficiency material and design technology Published in Angewandte Chemie-International Edition (IF=12.73, 2011. 3. 1) Dr. Oc Hee Han / Daegu Center  $\succ$ 

) 3 | Determined a new control mechanism of moto proteins that drive cell motility

• Science Korea With **KBSI**! KBSI





A Technology development to fabricate engineered nanorod perovskite film photocatalysts

under sun light Published in Advanced Materials (IF=10.88, 2011. 5. 10) )r. Hyun Gyu Kim / Busan Center>

05 | Development of advanced technology for early diagnosis of cancer

Differential diagnosis of unusual glycoproteins associated with cancer
 Published in Molecular and Cellular Proteomics (IF=8.8, 2011. 9. 23)
 ⟨Dr. Jong Shin Yoo / Div. of Mass Spectrometry Research⟩

First to measure the quantity of electric charge of reaction products in direct ethanol fuel cells

 $06 \mid ext{Theoretical study on the stability of stabilize}{\mathsf{metal clusters}}$ 

BRUKER 900

KBL

# 07 Development of MRI agent and PET/SPECT tracers for diagnosis of cancer

# Research Area TOP10 News 2011

# 08 | Success of metabolic profiling for patients with stroke

 Opened doors to early diagnosis of stroke using metabolomics approach
 Published in Stroke (IF=5.756, 2011, 5, 1) (Dr. Geum-sook Hwang / Seoul Center )

09 U-Pb age determination for the Mesozoic granitoids in Korean Peninsula

160 mill. years ago - Published in Gondwana Research (IF=5.503, 2011. 9. 1) <Dr. Jeongmin Kim / Div. Earth & Environmental Science>

BA

10 | New technology development for large-scale identification of membrane proteins

Identification and development of enrichment technology of membrane protein carriers in industrial microorganisms secreting nucleic acid
 Technology transfer contract with (c)CJ CheilJedang (2011. 3. 23)
 (Dr. Jong Soon Choi / Div. of Life Science)





# **KBSI** ANNUAL REPORT 2011

Inauguration of President Joon Taik Park as KBSI's 9th President

Term as 8th President reappointed to second term as 9th President Inauguration Ceremony held on May 24, 2011 at KBSI Auditorium



Beginning of a new era for KBSI Ochang Center

3 Held 2011 International Symposium on Analytical Science & Technology

Held at KBSI Daedeok Headquarters during Nov. 15–16, 2011
Scholars in the field of bioanalysis, material analysis, analytical chemis and environmental analysis participated from 16 countries worldwide









KBSI

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2011

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# A strong nation in basic science!

Korea Basic Science Institute leads Korea towards a world-class basic science nation

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# President's Message

# Value up! KBSI

Increasing the future value of Korea's science & technology



## KBSI challenges towards becoming a leader of convergence research!

In the year of 2011, Korea Basic Science Institute (KBSI) focused on laying the foundation for a new challenge in efforts to achieve its vision of becoming a world-class basic science institute.

Building on its strength in performing research support and collaboration in the field of basic science, KBSI made utmost efforts to create the foundation for convergence research, which was the key issue of science and technology in 2011. For instance, the 'Development of Analytical Methods for Forensic Science', which started as a NAP (National Agenda Project) in 2010, expanded to 'Establishment · Management of Analytical System for National Disaster Response' securing about 23.5 billion won for 5 years starting from 2012.

The 'Establishment · Management of Analytical System for National Disaster Response' project is the initial research project of KBSI and is expected to intensify convergence research for solving national and social problems based on analytical science. In order to efficiently carry out the project, the Center for Analytical Research in Disaster Sciences (CARDS) was established. It mainly focuses on three fields of research including radioactive material analysis, hazardous material analysis and forensic science analysis.

In addition, about 12.3 billion won was secured for the establishment of the Seoul Western District Center which will facilitate NBPT((Nano, Bio, Pharmaceutical Technology) convergence research.

Our efforts to expand research collaboration with leading overseas research institutes was also successful in 2011 by hosting the '1st International Symposium on Analytical Science & Technology'. About 320 eminent scholars in the field of analytical science & technology participated from 16 different countries.

The number of user publications, which indicates KBSI's performance on research collaborations increased by a small margin from 744 in 2010 to 787 in 2011. However, the number of SCI papers that reflect the quality of the papers rose significantly from 692 to 745. There was also a definite increase in the case of analytical services conducted. The total number of services rose from 15,313 to 16,251, the number of samples analyzed from 111,079 to 121,306 and the number of users from 4,139 to 5,457.

In accordance with promoting the installation of human MRI, the 3 T human MRI has been installed in 2011 and the 7 T human MRI is expected to be installed within 2012. Also, several projects are carried out according to plan such as the 'Super Bio-HVEM Installation Project' aimed to be completed by 2015, the in situ Analytical System Development Project' to be completed in 2014, and the 'High-precision Thermal Imaging Microscope Development Project' in 2013.

Moreover, the 'Junior Doctor' and 'X-Science' programs have certainly become Korea's representative science educational programs for the youth, which have contributed much to the public understanding of science and technology. In 2011, a total of 927 programs were held with 24,256 participants compared to 746 programs and 20,296 participants in 2010.

The accomplishments of the past year have brought KBSI a step closer to achieving our vision of becoming a world-class basic science institute for which we will continue to dedicate our best efforts.

Joon Taik Park, President of KBSI

Joontaile Parke





Research support and collaboration to advance basic science, which is the foundation for national science and technology development

• Research on analytical science and technology

• Analytical services and training of equipment specialists

• Overall management of national facilities and equipment

Enhancement of public understanding of science

# Vision, Mission & Development Goals



Vision

World-class Creative Basic Science Institute [World-class KBSI]

Mission

Research support and collaboration to advance national basic science

## **Development Goals**

National institute for facilities and equipment Leading institute for analytical science and technology International collaborative institute for natural science

# Management Goals



# **Research Field**

# Provide leading analytical services

- Enhance the quality of analysis and measurement services
- Develop and promote application of analytical methods
- Establish the foundation for regional high-tech research

### Promote joint research by utilizing national large-scale equipment

- Nano-bio High Voltage Electron Microscope (HVEM)
- High Field-Nuclear Magnetic Resonance (HF-NMR)
- Fourier Transform Ion Cyclotron Resonance Mass Spectrometer (FT-ICR MS)
- High Resolution-Secondary Ion Mass Spectrometer (HR-SIMS)

## Pioneer analytical science fields for solving national agenda

- Develop analytical technology to solve national agenda
- Develop advanced analytical equipment

# **Administration Field**

# Advance customer management system

- Strengthen the customer support system
- Reinforce customer-centric promotion activities
- Retain and strategically train qualified experts

# Promote an open cooperation system

- Vitalize international cooperation network
- Establish environment for prospective research collaborations
- Strengthen intellectual property management and application

#### Intensify contribution to the national and social development

- Increase promotion of national research facilities and equipment
- Strengthen public and cultural activities for basic science understanding
- Educate specialists in the field of analytical equipment

# Organization



# Personnel, Equipment and Budget

## Personnel >

Researchers	Engineers	Administrators	Total
111	47	48	206

#### Equipment >

Catagony	Head	Ochang				Lo	cal Cent	ers				Total
category	quarters	Center	Seoul	Busan	Daegu	Gwangju	Jeonju	Chuncheon	Suncheon	Gangneung	Jeju	Totat
Equipmer	nt 122	96	70	44	33	40	19	13	6	12	7	462
Amount	39,246	40,256	17,248	14,287	9,359	11,854	7,507	4,088	1,232	3,390	2,319	150,823

Budget

Operating Revenue		Operating Expense		
Category	Budget Category		Budget	
Government contribution	58,027	Wages	14,006	
1. Basic fund	12,933	1. Research personnel	10,356	
2. General R&D projects	34.895	2. Research support personnel	2,207	
3. Facilities and equipment	9.400	3. Retirement reserves	984	
4. Loan payment and interests	799	4. Others	459	
	111	Direct research expenses	47,455	
		1. In-house projects	34,595	
Income	17,832	2. Government/public projects	11,498	
1. Public (government)	13,833	3. Private projects	70	
2. Private	117	4. Other R&D projects	92	
3. Other R&D projects	92	5. Technology supports	1,200	
4. Technology supports	3,360	Operating costs	4,079	
5. Technical fees	120	Facilities and equipment	9,400	
6. Others	310	Others	919	
Total	75,859	Total	75,859	

(Dec. 31, 2011)

\* President included in researchers category

#### (Unit : Million won)

#### (Unit : Million won)

# **KBSI** Network

KBSI supports national basic science research and performs differentiated and specialized research based on regional industrial fields through the institute's eleven national bases.









6 Gwangju Center 🗲 in Chonnam National University









Industrial Complex



National University



7 Jeonju Center 💦

in Chonbuk National University



8 Chuncheon Center > in Kangwon National University





# 2011 KBSI Navigation

Korea Basic Science Institute (KBSI) is a government-supported research institute established for the purpose of promoting basic science and lay the foundation for advancing national science and technology.

KBSI is composed of Daedeok Headquarters, Ochang Center and nine local centers which provide continuous analytical services to universities, companies, national institutes, government-supported institutes, and etc.

Research collaborations are carried out with outstanding Korean and foreign researchers by utilizing KBSI's state-of-the-art research equipment, while in-house research is also performed based on analytical science.

The '2011 KBSI Navigation' can be utilized to comprehensively understand the research outcome of KBSI in 2011 and guide the direction for future research.



Universities 54.1%

#### Statistical trends of analytical services



#### [Unit: No. of cases, No. of samples, No. of users]







[Unit: No. of users]



[Unit: No. of papers]

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#### [Unit: No. of cases]



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

3	$\mathbf{C}$		8
	> 2011	Transfers of profit	
3	2011		8
		I ransterred institutes	
6		<b>T</b>     (	158
		l echnology fee revenue	
			<b>`</b>

[Unit: No. of cases, No. of projects, 100 million won, No. of people]



# 5

# Specialized High-tech Research Support

State-of-the-art research support capabilities of KBSI lead Korea's basic science to world-class level.

Korea Basic Science Institute builds the foundation to advance national science through world-class research support capabilities with high-tech research equipment and specialized research support system in the fields of bio science, nano science and environmental science.

# Gio Science Nano Science Cenvironmental Science

# Specialized High-tech Research Support



**Biotechnology Fusion Research** Proteomics Research Metabolomics Research Magnetic Resonance Research Magnetic Resonance Imaging Research Mass Spectrometry Research Degenerative Disease Research **Biological Imaging Research** Marine Biology Research

# Creating a biotopia for healthy human life

Biotechnology **Fusion Research** 

#### **BIO SCIENCE**

Biotechnology fusion research team, based on the advanced equipment and analytical technology in fields of cell biology and carbohydrate analysis, studied for pattern change and control mechanism of sugar, and protein-protein interaction which is the fundamental unit of cell signaling pathways, according to human diseases.

#### Main Research Activity

In 2011, for local optimization of the CUPID (Cell-based Un-/Identified Protein Interaction Discovery) system, we developed a dual expression vector which has an IRES2 and a newly designed MCS2 (Multi-cloning site). Also, we have made fluorescence-labeled human transcription factors and cancer related gene libraries.

#### **Representative Research Case**

Screening and characterization of small molecules inhibiting osteoposis We studied intracellular signal transduction pathways related in osteoposis. Also, a screening method was designed for the small molecular compounds which have inhibition characteristics in the drug targets and found two different compounds for them.

#### Image



#### **Major Achievements**

Category

Analysis Service

Research Results

Projects



Equipment



# Analytical Methods



Confocal Laser Scanning Microscope (CLSM 710-FCCS)

Equipment



| Daedeok Headguarters - Division of Life Science |



Experiment of the inhibitor screening analysis using CUPID technology for the inhibition of TAB1-TAK1 binding proteins

		Achievements			
Cases		Samples	Users		
131		692	59		
Publicati	ions	Presentations	Patents		
2 (SCI	2]	Domestic 2 / International 1	Application 1/ Registration1		
Development of ph Generation of antib	osphoprotein ir ody-specific pla	teraction analysis method in live cells te surface for homogenous direction	;		
Development of re Cell-chip-based bi Guideline for analy Development of an	al-time analysis o-mimetic prote sis of N-glycans alysis method a	of protein interaction for screening of in network express s on recombinant protein drug and application for cell membrane pro	f drug-target candidates tein		
Bio-LC DX600     Laser Scanning Confocal Microscope     HPLC and UPLC     Fluorescence Cross-correlation Spectroscope					
To Be Installed · Bio-LC(2012)					

Proteomics Research

**BIO SCIENCE** 

NANO SCIENCE

ENVIRONMENTAL SCIENCE

The goal of proteomics research field is the elucidation of biological functions using cutting-edge proteomic methods such as quantitative analysis, PTM analysis, and protein-protein interaction.

| Daedeok Headguarters - Division of Life Science |

#### Main Research Activity

In 2011, high throughput screening and quantitative analysis of diabetes- and obesity-related membrane proteins from endoplasmic reticulum were performed in Korea Membrane Protein Initiative (KMeP). Also, proteomes of outer membrane vesicle from pathogenic bacteria and marine microorganisms were analyzed.

#### **Representative Research Case**

#### The metabolic characteristics of a H<sub>2</sub>-producing archaean bacteria using proteomic analysis

Conducted to obtain a global view of the metabolic characteristics of H<sub>2</sub>-producing growth, a quantitative proteome analysis of archaean bacteria (T. onnurineus NA1). A total of 587 proteins corresponding to 29.7% of the encoding genes were identified and the major metabolic pathways were characterized at the protein level. We demonstrated for the first time that formate could be utilized as a carbon source by *T. onnurineus* NA1.

**Achievements** 

Samples

1,067

Presentations

· Division of OMV and development of proteomic methods in relation with degradation of aromatic

Development of the N-glycopeptide analysis method utilizing mass spectrometry data and the decoy

· HPLC

· Ion Trap MS

MALDI-TOF/TOF MS Functional Proteome MS Analyzer LTQ-ETD

Development of proteomic analysis of membrane proteins in cyanobacteria Gloeobacter

· Function proteomic approaches to understand mechanism of light energy transformation

Fluorescence Activated Cell Sorter(2013)

· Development of analysis method and application for cell membrane protein

Domestic 19 / International 4

Diversity of microorganism

Immuno-histochemistry using obese mice model

Research of obesity and diabetes using cell and animal model

Users

123

Patents

Application 5 / Registration 2

#### Image



**Major Achievements** 

Category

Analysis Service

**Research Results** 

Analytical Methods

Projects

Training of Equipment

A putative scheme of the cellular metabolism in the hydrogen producing arachaeon Thermococcus onnurineus NA1

Cases

185

**Publications** 

26 (SCI 24)

Protein research on diabetes

· Gene analysis of microorganism

Movement of organism toward light

database

Installed

compounds in pseudomonas putida

Study on protein SUMOylation in tumor cell

Analysis of protein c-fos SUMOylation in tumor formation

Protein Sequencer

Expression Analysis System

2D/DiGE System

#### Equipment



MAI DI-TOF-TOF/MS UltrafleXtreme



476 Protein Sequencer

Equipment	inotatiou
	To Be Installed

Metabolomics Research

Metabolomics research field is elucidating biological pathway by identifying metabolites changed by genetic and/or environmental stimulus and studying for characterization of biological resources. diagnosis, and elucidation of biological processes developed by diseases, drugs and toxic agents.

#### **Main Research Activity**

**BIO SCIENCE** 

for diagnosis.

#### **Representative Research Case**

of TB.

#### Image



Metabolite profiles of organ tissues (lung, spleen, and liver) from control and MTB-infected rats

#### Equipment



Analytical Methods

Category

Analysis Service

Research Results

On-line Liquid Chro Spectrometry-Nuclear Magnetic Resonance (LC-MS-NMR) System



Training of Equipment

Projects

Gas Chromatography Time-of-Flight Mass Spectrometer (GC-TOF-MS)

Equipment

Seoul Center

In 2011, 1H-NMR, LC-MS, and GC-MS were developed utilizing metabolic profiling technology, and characteristic metabolites of tuberculosis, obesity, and stroke disease were identified, providing a biomarker

#### Development of metabolite profiling using MTB-infected rats

Metabolic profiling was applied to organ tissue and serum samples from control and Mycobacterium tuberculosis (MTB)-infected rats, and the major metabolites related to TB were identified. We have established that the metabolomics approach can be used as an effective tool for understanding the infection



#### **Major Achievements**

Achievements						
Cases		Samples	Users			
432		2,236	167			
Publicatio	ons	Presentations	Patents			
20 (SCI 1	7)	Domestic 23 / International 4	Registration 1			
Discrimination of dandelion species using metabolomics/multivariate analysis A novel algorithm for identifying reliable potential metabolic markers using LC-Q-TOF mass spectrometry The use of UPLC-Q-TOF MS based untargeted metabolomic profiling and multivariate analysis in Nicotiana tabacum for identification of metabolics markers						
Investigation of biol approach Tracing the geogra Metabolomics/mul Development of NM disease	Investigation of biological pathway and biomarker discovery for diseases using metabolite profiling approach Tracing the geographical origin of foods using metabolomics Metabolomics/multivariate analysis for diagnostics and treatment of kidney disease Development of NMR based metabonomics/chemometrics for diagnosis and treatment of chronic kidney					
Molecular structure analysis using NMR Introduction of analysis for organic compounds by using spectroscopic methods Crime Scene Investigation: forensic analysis of crime evidence using the high resolution mass spectrometry						
On-line Liquid Chromatography-Mass Spectrometry-Nuclear Magnetic Resonance System (LC-MS-NMR)     S00 MHz Fourier Transform-Nuclear Magnetic Resonance (FT-NMR)     Gas Chromatography-Mass Spectroscopy (GC-MS)     Triple Quadrupole Liquid Chromatography-tandem Mass Spectroscopy (TQ LC/MS/MS)						
To Be Installed	<ul> <li>Ultra Perfor</li> <li>Spectroscop</li> </ul>	mance Liquid Chromatography/Quad vy (UPLC/QTOF MS) (2012)	rupole/Time-Of-Flight Mass			



NANO SCIENCE

ENVIRONMENTAL SCIENCE

Users

Researches in macromolecular structure, interaction, and dynamics are carried out using 900/800 MHz NMR spectrometers.

| Ochang Center-Division of Magnetic Resonance Research |

#### Main Research Activity

In 2011, NMR technologies have been developed to obtain 3D structures of biological macromolecules and to investigate their interactions. By using these technologies, a total of 25 papers were published.

#### **Representative Research Case**

Development of cell free protein synthesis and labeling techniques for NMR structure analysis Fast determination of the interaction surface for HAUSP protein and vILRF4 peptide by analyzing HSQC NMR spectra of <sup>15</sup> N-Trp specific labeled protein synthesized by cell free translation system.

#### Image



**Major Achievements** 

Category

Analysis Service

Determination of protein-peptide interaction surface using <sup>15</sup> N-Trp spectrum

Cases

#### Equipment



900 MHz NMR



800 MHz NMR

Analysis Service	599	233					
	Publications	Presentations	Patents				
Research Results	25 (SCI 21)	Domestic 17 / International 12	Application 5 / Registration 1				
Analytical Methods	<ul> <li>Analysis of pH dependant protein structural change using CD and NMR</li> <li>Analysis of protein-protein interaction of Daxx protein using PRE</li> <li>X-ray structure analysis of the mst2 Sarah domain</li> <li>Determination of the pKa values of ubiquitin Lys side-chains using NMR method</li> </ul>						
Projects	<ul> <li>Development of protein-protein interaction NMR analysis technique</li> <li>Development of ultra-fast NMR analysis technique</li> <li>Establishment of NMR methods for studying high molecular weight protein</li> <li>Investigation and biological application of the quorum sensing mechanism</li> <li>Synthesis of a small molecule and development of its cancer prognosis and biomarker targeting the polobox domain of mammalian polo-like kinase 1</li> </ul>						
Training of Equipment	<ul> <li>Protein crystallization and observation for 3D structural studies</li> <li>Interesting classes for biochemical experiments</li> </ul>						

**Achievements** Samples

		<ul> <li>900 MHz NMR</li> </ul>	<ul> <li>800 MHz NMR</li> </ul>
Equipment	Installed	<ul> <li>500 MHz NMR</li> </ul>	<ul> <li>300 MHz NMR</li> </ul>
		CD Spectropolarimeter	<ul> <li>Macromolecular X-ray Diffraction System</li> </ul>

# Magnetic Resonance Imaging Research

**BIO SCIENCE** 

#### Main Research Activity

research has been performed.

#### **Representative Research Case**

#### Development of MRI contrast agent for tumor cell observation and therapy

The newly developed FeCo/C nanoparticles not only showed excellent MRI contrast results compared to the conventional MRI contrast agent but enabled us to collect the Raman spectral information at the single-cell level. Also, the FeCo/C nanoparticles which combined hyperthermia and siRNA-based therapy showed effective therapeutic results in malignant tumor cells.





MR relaxivity of FeCo/C nanoparticles and Resovist (a) and T2--weighted MR images of a mouse before (t = 0 min) and 30 min. after (t = 30 min) injection of FeCo/C NPs (left) and Resovist (right) into tail vein (b)

#### **Major Achievements**

Category	Achievements					
	Cases		Samples	Users		
Analysis Service	175		854	62		
Decearch Deculta	Publicat	ions	Presentations	Patents		
Research Results	21 (SCI	19)	Domestic 28 / International 8	Application 4 / Registration 1		
Analytical Methods	<ul> <li>MRI technique to determine the capillary orientation</li> <li>Synthesis and high performance of magnetofluorescent polyelectrolyte nanocomposites as MR/near- infrared multimodal cellular imaging nanoprobes</li> <li>Integrin receptor targeting imaging probe for SPECT and PET</li> </ul>					
Projects	<ul> <li>Installation and utilization of human research MRI</li> <li>Brain research on the imaging fusion technology</li> <li>Development of the PET/MRI fusion imaging technology for the tumor targeting</li> <li>Advancement of the new concept MRI technology</li> <li>MR analysis of fat and hone mineral in the hone</li> </ul>					
Training of Equipment	<ul> <li>MRI theory and its hands-on training</li> <li>Practice of animal MRI</li> </ul>					
Equipment	- 4.7 T/9.4 T Animal MRI Installed - 600 MHz/800 MHz Micro-imaging System - 3T Human MRI - Animal micro-PET/CT/SPECT					
	To Be Installed	• 7 T Human N	/IRI(2013)			

4.7 T Animal MRI

9.4 T Animal MRI

Equipment

4.7 T /9.4 T animal MRI, 600MHz/800MHz microimaging, animal PET/CT/SPECT systems are used for measurement, analysis, joint research and methodology development.

| Ochang Center-Division of Magnetic Resonance Research |

In 2011, for diagnosis and monitoring of the treatment of disease, MR spectroscopy, MR method development, PET tracer development, MRI/PET/NIR contrast agent development, and fusion image

Spectrometry Research

**BIO SCIENCE** 

NANO SCIENCE

ENVIRONMENTAL SCIENCE

The field of mass spectrometry analyzes the molecular weight of numerous molecules included in highly complicated mixture samples with high resolution. We carry out research in this field to understand nature and discover new materials in various fields of bioscience, chemistry, environmental science and so on.

| Ochang Center- Division of Mass Spectrometry Research |

#### Main Research Activity

In 2011, we have maintained world-class mass spectrometry analysis capabilities by continuing new technology developments such as the Korean Electronic Control Instrument for High-resolution FT-ICR/MS, and by developing analytical technologies in the fields of biomarker discovery, brain proteome analysis, lipidomics and highly sensitive portable mass spectrometer.

#### **Representative Research Case**

Peptide biomarker discovery by glycoproteomics analysis in human hepatocellular carcinoma plasma

The steric hindrance of glycan units in N-linked glycoproteins significantly affects the efficiency of proteolytic digestion whose enzymatically active amino acid is adjacent to the glycosylation site. From this effect, we discovered hepatocellular carcinoma peptide biomarker by mass spectrometric approach.

#### Image



The difference of proteolytic digestion according to the degree of glycosylation between normal and cancer samples (left), and differential expression of liver cancer specific peptide of vitronectin (right)

**Achievements** 

#### **Major Achievements**

Category



ESI-QTOF Mass Spectrometer

Equipment



	Cases		Samples	Users		
Analysis Service	294		1,997	150		
Dessereb Desults	Publicati	ons	Presentations	Patents		
Research Results	29 (SCI 2	27)	Domestic 27 / International 30	Application 26 / Registration 9		
Analytical Methods	<ul> <li>Shotgun lipidomics analysis method based on UPLC/MS0</li> <li>Cold electron ionization source with an electron multiplier illuminated by UV photons</li> <li>Improvement of mass detection range by developing highly efficient ion guide</li> </ul>					
Projects	<ul> <li>Operation of the advanced multi-purpose mass spectrometer</li> <li>Development of mass spectrometry-based platform technology for molecular diagnosis</li> <li>Development of antibody characterization platform technologies for antibody-biobetter</li> <li>Improvement of neural induction from mesenchymal stem cells through combined omics analysis</li> <li>Study on the injury and regeneration of cerebral blood vessel and brain tissue in cerebral ischemic insult</li> </ul>					
Training of Equipment	<ul> <li>Understanding signal processing of mass spectrometer and making electronic circuit</li> <li>How can we measure the mass of proteins which cannot be seen</li> <li>Protein kingdom in my brain</li> </ul>					
Equipment	Installed	<ul> <li>15 T &amp; Iontrap/7 T FT-ICR High-resolution Mass Spectrometer</li> <li>MALDI MS Imaging System</li> <li>Triple Quadrupole Tandem Mass Spectrometer</li> <li>Chip-NanoLC based Triple Quadrupole Tandem Mass Spectrometer</li> <li>MALDI/ESI High-Resolution Tandem Mass Spectrometer</li> </ul>				
	To Be Installed					



# **BIO SCIENCE**

By establishment of the infrastructure of research facilities specialized in anti-aging and degenerative diseases, we aim to provide scientists in the aging-related research studies with high quality analytical services and to support commercialization of spin-offs in related R&D areas.

#### Main Research Activity

In 2011, for the first time in Korea, the Specific Pathogen Free (SPF) facility specialized for breeding of aged mice and rats was built to provide aged animal models for scientists in the aging research area. Also, a multi-functional transmission electron microscope (Multi-TEM) will be installed in 2011 to establish the foundation for enhancing research support in nano-bio sciences.

#### **Representative Research Case**

In the present work, purified plasma and thylakoid membranes were exposed to chemical cleavage and enzyme digestion, followed by nano-LC separation and MS/MS analysis, and database searches for identification. In total, 379 different proteins were identified, including 124 integral membrane proteins.





#### **Major Achievements**

Category	Achievements					
Analusia Caraina	Cases		Samples		Users	
Analysis Service	415		3,319		82	
Pacaarah Paculta	Publicatio	ons	Presentation	S	Patents	
Research Results	8 (SCI 8	3]	International 2	2	Application 1	
Analytical Methods	<ul> <li>The method of LC-MS data extract from different regional plants</li> <li>Proton-Carbon correlation 2-Dimensional NMR spectroscopy using fast NMR technique</li> <li>Analysis of colocalization using 3D data of confocal microscope</li> </ul>					
Projects	<ul> <li>Study on Mitochondrial fragmentation in necrosis</li> <li>Development of optical disease diagnosis technique using red blood cell aging marker</li> </ul>					
Training of Equipment	A basic principle of mass spectrometry and protein analysis     Cellular imaging using Laser Confocal Scanning Microscope					
Equipment	Installed	<ul> <li>Multi-functio</li> <li>Online LC-NI</li> <li>LC-MS/MS</li> <li>LCSM</li> </ul>	nal TEM MR/MS			
	To Be Installed	· Super-Resol	ution TIRF Microscope Sy	ystem(2012)		

Online LC-NMR/MS

Equipment



LC-MS/MS

Gwangju Center

#### Membrane protein identification in Cynoabcterium synechocystis

Schematic presentation of two types of membrane organization and their protein identification results in Synechocystis

**Biological Imaging** Research

**BIO SCIENCE** 

NANO SCIENCE

ENVIRONMENTAL SCIENCE

Chuncheon Center was established to support significant technological advances relevant to imaging at the nano, cellular or whole organism levels. The multiple and numerous potentialities of this field are applicable to the diagnosis and treatment of diseases such as cancer, neurological and mental diseases.

Chuncheon Center

#### Main Research Activity

In 2011, simple and easy optical imaging technology was developed to study cancer in xenograft animal models.

#### **Representative Research Case**

#### Development of optical imaging for cancer research

Engineering MLL-Luc/GFP cancer cell line for metastatic animal model system and development of nearinfrared fluorescence imaging technology to evaluate pharmacokinetics and biodistribution of anticancer drugs in tumor xenografts.

#### Image

**Major Achievements** 



Engineering of MLL-Luc/GFP cell and in vivo imaging of the metastatic tumors in tumor xenografts

#### Equipment



Luminescence and Fluorescence Animal Imaging System



Intravital Multi-photon Confocal Laser Scanning Microscope Imaging System

Category		Achievements			
	Cases	Samples	Users		
Analysis Service	573	14,037	127		
Decemb Deculto	Publications	Presentations	Patents		
Research Results	21 (SCI 20)	Domestic 6 / International 4	Application 1 / Registration 1		
Analytical Methods	<ul> <li>Development of a method to observe biomaterials using low vacuum and cooling stage of SEM</li> <li>Image analysis of SE1 and SE2 signals at SEM</li> <li>Detection method for NADH in the mitochondria at auditory cell using multi-photon laser</li> <li>Development of the CLSM detection method for Alexa546 fluorescence dye using IHC</li> <li>Engineering of MLL-Luc/GFP stable cell line for bio-imaging</li> <li>Analytical method for biodistribution of drugs using fluorescence signal</li> </ul>				
Projects	<ul> <li>Study on major depression using in vivo bioluminescence and fluorescence imaging</li> <li>Analysis of bio-active food on stress with fusion molecular imaging technology</li> </ul>				
Training of Equipment	EM(TEM/SEM) user training cours     Multi-photon CLSM user training     IVIS200 user training course	ie course			
Equipment	- Zeta-potent - Energy filter Installed - Fiber Based - Luminescer - Variable Pre	ial, Particle Size Analyzer ing-TEM · MP-CLSM Fluorescence Animal Imaging Syster ice and Fluorescence Animal Imaging ssure Field Emission-SEM	• Low Vacuum-SEM m g System		



#### **BIO SCIENCE**

#### Main Research Activity

#### **Representative Research Case**

#### Investigation into the physiological toxicity by H. circularisquama on clams

Clams exposed to H. circularisquama exhibited morphological changes concomitant with an accumulation of mucus-like substances in the gills, a profound reduction in filtration activity, and lysosomal destabilization in hemocytes. Chattonella marina was less effective than H. circularisquama, and Heterocapsa triquetra was almost harmless in all these criteria. These results suggest that H. circularisquama exerted its lethal effect on short-necked clams through gill tissue damage and subsequent induction of physiological stress.





tissues of clams exposed to the H. circularisquama (C).

#### **Major Achievements**

Category	Achievements				
	Cases		Samples	Users	
Analysis Service	60		422	21	
Dessereb Desults	Publicatio	ons	Presentations	Patents	
Research Results	8 (SCI 7	7]	Domestic 4/ International 2	Application 1	
Analytical Methods	<ul> <li>Analytical method of γ-Aminobutyricacid(GABA) in the germinated brown rice using amino acid analyzer</li> <li>Analytical method of Methyl-methionine sulphonium chloride (MMS) in the extracted cabbage substance using amino acid analyzer</li> <li>Analytical method of free sugars in the fermented mandarin bark using Bio-LC (HPAEC-PAD) System</li> </ul>				
Projects	Installation & operation project of the Jeju Center     Secure of overseas marine resource				
Equipment	Installed	<ul> <li>Inductively Coupled Plasma Mass Spectrometer</li> <li>Bio-Liquid Chromatography</li> <li>LC/MSn System</li> <li>Recycling Preparation HPLC</li> <li>Amino Acid Analyzer</li> <li>Bio Imaging Navigator</li> <li>Headspace GC-Mass Tandem Mass Spectrometer</li> <li>High Sensitivity Spectral Laser Confocal Microscopy System</li> <li>Variable Pressure Field Emission scanning Electron Microscope with Scanning Transmission Electron Microscope</li> </ul>			
	To Be Installed	• Electron Spir	Resonance Spectrometer		

Headspace Gas Chromatography Tandem Mass Spectrometer



Equipment

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

KOREA BASIC SCIENCE INSTITUTE

For a comprehensive understanding and development of marine biology, research in biomedical manufacturing technology and environment-friendly recovery using marine organisms are carried out.

Jeju Center

In 2011, research for the ichthyotoxic mechanism of harmful dinoflagellate phytoplankton and various effects of bio-active substances isolated from marine algae were carried out.



Plankton mass culture system (A), lysosomal destabilization of hemocytes of clams exposed to the live cell suspension (B), and cross-sections of gill



Electron Microscopy Research Nano Materials Research High Field Magnetic Research Surface Physical Property Research High-Tech Materials & Components Research High-Tech Functional Materials Research Nano Structure Analysis & Characterization Research New Materials Research Nano Materials Imaging Research

# Converting imagination into reality in the nano scale world

KBSI provides state-of-the-art analytical technology to promote progress in national nano sciences by studying the functional mechanisms of advanced materials on a nano scale and investigating the threedimensional atomic/molecular structures of condensed matters.

Electron Microscopy Research

**BIO SCIENCE** 

#### Main Research Activity

In 2011, enhancing electron crystallography and electron spectroscopy that are essential techniques for the 3-D analysis of most materials have been major research activities this year, which will be used as powerful analytical methods for exploring functional nano-bio materials.

#### **Representative Research Case**

The structure of hydroxyapatite nanopowder has been determined by applying the theta-scan electron precession diffraction technique which was newly developed. This technique could be applied to electron crystallography for N/BT fusion nano-crystalline materials.

#### Image



TEM image of hydroxyapatite nanopowder and its theta-scan EPD pattern

#### Major Achievements

Category	Achievements					
	Cases		Sai	mples	Users	
Analysis Service	849		5	i,967	251	
Dessenab Desculta	Publicatio	ons	Prese	entations	Patents	
Research Results	33 (SCI 3	0)	Domestic 18	/ International 3	Application 16 / Registration 5	
Analytical Methods	<ul> <li>Analysis of polycrystalline orientation distribution using HVEM &amp; PED</li> <li>Quantitative structure analysis of powder specimen using new specimen preparation and inner standard specimen</li> <li>Bio specimen preparation method using cryo-fixation and 9 others</li> </ul>					
Projects	<ul> <li>Super Bio Electron Microscope Installation &amp; Operation Project and 11 others</li> <li>Key Technology Development of Precise Specimen Movement and 5 others</li> </ul>					
Training of Equipment	<ul> <li>KBSI Imaging School 2011</li> <li>Women Scientist Research Equipment Specialist Training</li> </ul>					
Equipment	Installed	<ul> <li>1250 keV HV</li> <li>120 keV EF-</li> <li>EPMA</li> <li>E-SEM</li> </ul>	'EM TEM	- 200 ke - Bio-HV - HT-XR - FIB, Qu	V FE-TEM /EM D Janta 3D FEG, FEI	
	To Be Installed	• EF-TEM(201 • Super Bio-H	2) VEM(2015)			



CCD upgrade for high resolution cryo-EM

Equipment

studies

Computing System for Cryo-EM



NANO SCIENCE

Our researches are aiming for the development of cutting-edge EM techniques including Cryo-EM and insitu EM techniques, which can be applied to analyze 3-dimensional structures and/or dynamic properties of N/BT materials from atomic to micrometre scale.

| Daedeok Headquarters-Division of Electron Microscopic Research |

#### Application of theta-scan electron precession diffraction to electron crystallography

NANO SCIENCE

ENVIRONMENTAL SCIENCE

Nano Materials Research

based hydrogen-storage materials for green energy.

We are developing cost-effective secondary battery electrode materials with high-efficiency and nano-

| Daedeok Headguarters-Division of Materials Science |

#### Main Research Activity

In 2011, we prepared MnO<sub>2</sub> nanospheres with high crystallinity to minimize the deformation of electrode in charge/discharge process. We elucidated the origin of the increase of hydrogen storage via analyzing the morphology of materials. BET, SEM, and XRD were mainly employed.

#### **Representative Research Case**

#### Facile synthesis route to highly crystalline mesoporous $\gamma$ -MnO<sub>2</sub> nanospheres

Mesoporous  $\gamma$ -MnO<sub>2</sub> nanospheres with high crystallinity were prepared, using ultrasonic waves, for the efficiently large-scale and environmentally benign production of anode materials offering high electrochemical performance in LIBs.

#### Image



Facile synthesis route to  $\gamma$ -MnO<sub>2</sub> nanospheres and good cycle performance

#### **Major Achievements**



X/Q-band CW/Pulse EPR



X-band CW-EPR

Category			Achievements			
	Cases	5	Samples	Users		
Analysis Service	-		-	-		
De e e e e e e e e e e e e e e e e e e	Publicati	ons	Presentations	Patents		
Research Results	30 (SCI	30)	Domestic 15/ International 3	Application 22 / Registration 4		
Projects	<ul> <li>Development of na</li> <li>Development of ec</li> <li>Development of hig secondary battery</li> <li>Synthesis and char</li> <li>Understanding the</li> <li>Development of on</li> <li>Fabrication of SER concentration)</li> <li>Synthesis and char</li> </ul>	Development of nanostructured materials for hydrogen storage Development of eco-friendly meta nanostructured materials for energy storage Development of high efficiency and capacity electrode using nanostructure for the next-generation secondary battery Synthesis and characterization of magnetic semiconductor nanoparticles Understanding the structure and stability of ligand-stabilized metal clusters Development of organic-inorganic nanohybrid anode materials for high-power Li-ion battery Fabrication of SERS-active nanostructures and its applications to detect bio-molecules at the low concentration) Synthesis and characterization of hollow nanostructures for energy storage				
Equipment	Installed	<ul> <li>500 MHz MA</li> <li>MSB-AD-H/</li> <li>BET</li> <li>AFM/NSOM</li> <li>STM</li> <li>X/Q-band CV</li> <li>X-band CW-</li> </ul>	AS Solid-state NMR /PCT /Raman Spectroscopy W/Pulse EPR -EPR			
	To Be Installed	Low Energy Electron Microscopy(2012)     Photemission Electron Microscopy(2012)				

# **High Field** Magnetic Research

High field magnet can be utilized not only for analysis of material property, control of composition and reaction of materials, micro-gravity, but as well as separation of nano material. Research is conducted to analyze the characterization of spin devices at high magnetic field and magnetic properties of nano-sized materials under high magnetic field. Crystal growth, synthesis and separation of materials are also being | Daedeok Headguarters-Division of Materials Science | performed.

#### Main Research Activity

**BIO SCIENCE** 

In 2011, rectangular and cylindrical ferromagnetic resonators have been developed to measure the damping constant which plays a key role in determining the switching properties of spin device, such as magnetic tunnel junction. Low temperature FMR has been also developed using the co-planar wave guide.

#### **Representative Research Case**

#### Measurement of perpendicular spin torgue at high bias

We report an experimental method to estimate the bias dependence of the perpendicular spin torque in magnetic tunnel junctions. The bias dependence of the perpendicular spin torque at high bias was found to be linear for a voltage polarity. This method will be useful to address spin torque effects in magnetic tunnel junctions at high bias.

#### Image



Hand-made TE102 mode cylindrical resonator(left) and the bias dependence of perpendicular spin torque(right)

#### Major Achievements

Category	Achievements				
	Cases	i	Samples	Users	
Analysis Service	70		252	43	
Decemb Deculto	Publicatio	ons	Presentations	Patents	
Research Results	14 (SCI 1	1)	Domestic 10 / International	8 Application 3/ Registration 2	
Projects	<ul> <li>Spin torque nano oscillator</li> <li>A development of flash memory device</li> <li>A study of spin transfer torque switching</li> <li>Development of spin device measurement</li> </ul>				
Training of Equipment	<ul> <li>Analysis of electrical and magnetic properties of materials</li> <li>Properties of magnetic materials and its application</li> <li>Principle and application of magnetic properties measurement</li> <li>Observation of micro surface and micro magnetic images</li> </ul>				
Equipment	Installed	<ul> <li>Physical Property Measurement System</li> <li>Magnetic Property Measurement System</li> <li>Scanning Probe Microscope</li> <li>Cryogenic Probe Station</li> <li>High Magnetic Field System</li> </ul>			
	To Be Installed	• 16 T Physica	l Property Measurement System	n (2012)	

Cryogenic Probe Station

Equipment



Physical Property Measurement System

NANO SCIENCE



NANO SCIENCE

ENVIRONMENTAL SCIENCE

The field of surface characterizations is extending the scope of state-of-the-art instruments such as AR-XPS, nano-SIMS, and TEM for analyzing the surface morphology, structure, compositions, and depth profiling, and providing a comprehensive research service in the field of nano-sized surface areas.

Busan Center

Users

56

Patents

#### Main Research Activity

In 2011, the coating formation of anode materials for lithium-ion secondary batteries was optimized by using the surface analysis instruments. The research was focused on the surface/interface characteristics of lightemitting diode materials and oxide semiconducting hybrid nanocomposites.

#### **Representative Research Case**

#### Characterization of surface coated cathode materials for Li secondary ion batteries

By synthesizing the cathode materials for lithium-ion secondary batteries with the co-precipitation method, the structure and elemental distribution were analyzed. The surface-coated materials were obtained and the morphology and elemental distribution of the surface-coated cathode materials were analyzed by using nano-SIMS. The electrochemical charge-discharge results reveal that the electrochemical properties of surface-coated cathode materials improved significantly.

**Achievements** 

Samples

9,435

Presentations

#### Image

**Major Achievements** 

Category

Analysis Service

**Research Results** 



<Co distribution image> < Al distribution image > Elemental distribution of aluminum and cobalt at the cross section of surface-coated cathode material obtained by Nano-SIMS

Cases

1,439

**Publications** 



Equipment

Surface Physical

Property

Research

Nano secondary ion mass spectrometer



Research Results	17 (SCI	14]	Domestic 17	Application 4 / Registration 2
Analytical Methods	Development of c     Development of i	quantitative metho mpurity depth pro	d for ternary oxide film by using filing on the small area by using	SIMS oxygen ion beam of Nano SIMS
Projects	<ul> <li>Study on nano-cr</li> <li>The analysis of th</li> <li>Development of h</li> <li>Development and</li> </ul>	ystalline Ru-base he recycling magni hybrid-nanostructi d studies of the fur	d ternary thin films by atomic lay esium ingot and impurity by proc ured oxide fibers actional inorganic oxide material	er deposition ess s and surface characterizations
Training of Equipment	<ul> <li>Principle and app</li> <li>4th Surface Analy</li> </ul>	olication of XPS an ysis Workshop	d 20 others	
Equipment	Installed	<ul> <li>Secondary Ic</li> <li>Scanning Ele</li> <li>Angle-resolv</li> <li>Glow Dispers</li> <li>Nano Second</li> </ul>	n Mass Spectrometer ectron Microscope red X-Ray Photoelectron Spectro sion Spectrometer dary Ion Mass Spectrometer	meter

High-Tech Materials & Components Research

**BIO SCIENCE** 

#### Main Research Activity

#### **Representative Research Case**

#### Engineered Nanorod Perovskite Film Photocatalysts to Harvest Visible Light

Development of PbBi2Nb209 nanorods as photoelectrochemical electrode materials : PbBi2Nb209 nanorod photoanodes display 10 to 20 time higher photocurrents compared with PbBi2Nb2O9 nanoparticle photoanodes under visible light. Dramatically improved photoactivity is demonstrated by comparing PbBi2Nb2O9 particle electrodes and nanorod electrodes.





Category

Analysis Service

#### Equipment





Head-space Gas Chromatography/Mass Spectrometry

Analytical Methods



Projects Training of Equipment

Equipment

spectrometer

NANO SCIENCE

The field of high-tech materials & components develops basic and applied technologies specialized for the local materials and components industry. We are an authorized analysis organization which carries out infrastructure support projects by installation of large-scale instruments.

Busan Center

In 2011, we conducted development of lead tap components using metal polymer bonded technology for Li ion battery, and this resulted in technology transfer to Taesung Polytech Co., Ltd.



A uniform array of Aurivillius phase perovskite PbBi2Nb209 photocatalyst in a nanorod configuration

#### **Major Achievements**

Achievements							
Cases	Cases Samples Users						
2,120		13,514 648					
Publicatio	ns	Presentations Patents					
59 (SCI 51	) Domestic 56 / International 10 Application 8 / Registration 6						
Crystal structure analytical method of semiconductor nano fiber Development of quantitative analytical method for Mg(metal) and MgO(oxide) in the surface and bulk of recycling magnesium ingot Radiation test of pearl nucleus sample using EPR Development of analytical method for organic-inorganic hybrid coating layer using Glow Discharge Spectrometer (GDS) AFM lithography using multistep mechanical patterning and 7 others							
Development of convergence and integration nano structure oxide fiber Building of advanced small and medium partical beam facility using ECR ion source Establishment and management of High-Technology Materials Research Center(Busan) Development and application of metal-organic polymer combination technology as an energy storage and 7 others							
Youth Education Support Programs with Advanced Scientific Instruments (60 programs)							
Installed - Inductively-Coupled Plasma - Atomic Emission Spectrometer - Microscopic FT-IR/Raman Spectrometer - Gas-Chromatograph Mass Spectrometer - Combustion Ion Chromatograph and etc.							
To Be Installed	• Time of Fligh	nt Secondary Ion Mass Spectrometer	(2012)				

NANO SCIENCE

ENVIRONMENTAL SCIENCE

Research support and development of advanced materials, including fuel cells, nano complex agents, porous materials, membrane protein, ferroelectrics, and smart materials are carried out through molecular characteristics analysis and chemical response tracking of materials with advanced functions.

Daegu Center

#### Main Research Activity

In 2011, research was accomplished on solid nuclear magnetic resonance and development of structure analysis technology of green energy and smart materials to improve the performance of fuel cells.

#### **Representative Research Case**

#### Synthesis and catalytic activity study of FeEC cathode catalysts

The development of inexpensive platinum-free cathode catalysts with high oxygen reduction reaction(ORR) rates and long-term stabilities is essential for the practical application of low temperature fuel cells. This work demonstrates the successful synthesis of composite FeOx nanoparticles embedded carbon(FeEC) prepared by chemical vapor deposition of CH4 on ironphthalocyanine and the relatively high catalytic activity of FeEC towards ORR. These results indicate that Fe oxides and Fe metal embedded in porous carbons, but not nitrogen-coordinated iron compounds, were the active catalytic sites in FeEC.

#### Image



TEM mode image of composite FeOx nanoparticles(FeEC) embedded in porous carbon

#### **Major Achievements**

Category



Equipment

High-Tech

Research

**Function Materials** 

FT-NMR(Nuclear Magnetic Resonance) Spectrometer



There are a solution mass spectronnete
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	Cases	5	Samples	Users		
Analysis Service	2,761		14,509	483		
	Publicati	ons	Presentations	Patents		
Research Results	24 (SCI 2	20)	Domestic 8/ International 5	Registration 1		
Analytical Methods	<ul> <li>Identification and quantification of the reaction products in direct ethanol fuel cell by <sup>13</sup>C NMR</li> <li>Simultaneous polefigure analysis using multi crystal planes of a epitaxial layer</li> <li>The change of the particle sizes of SiO<sub>2</sub> nanopowder attached on TiO<sub>2</sub>due to osmium coating time</li> <li><sup>13</sup>C NMR analysis of grephene-oxide nanocomposite materials</li> </ul>					
Projects	<ul> <li>Study of NMR for improvement of performance in fuel cell</li> <li>Development of structure analysis technology of green energy and smart materials</li> </ul>					
Training of Equipment	Youth education su     (Advanced science	ipport program experience, iso	s with scientific instruments : 61 prog late experimental experience, etc.)	rams		
Equipment	Installed	<ul> <li>600 MHz / 4</li> <li>500 MHz FT</li> <li>X-ray / High</li> <li>High Resolu</li> </ul>	00 MHz / 200 MHz solid state FT-NMF -NMR Spectrometer Resolution X-ray / Multi-purpose X-r ition Mass Spectrometer	R Spectrometer ay/ Multi-Function X-ray Diffractometer		

**Achievements** 

· Ultra High Resolution Field Emission Scanning Electron Microscope

Field Emission Scanning Electron Microscope

Nano Structure Analysis & Characterization Research

#### **BIO SCIENCE**

materials and nano-structures.

#### Main Research Activity

Interesting research activities performed in 2011 were development of the nanostructure materials based on nanocarbon composites, advanced-/multi-functional polyelectrolytes complexes, inorganic/organic interface research, organic solar cell, and so on.

#### **Representative Research Case**

bimetallic particles

investigated.

#### Image



#### **Major Achievements**

Category	Achievements				
	Cases	Samples	Users		
Analysis Service	1,122	8,914	437		
	Publications	Presentations	Patents		
Research Results	29 (SCI 29)	Domestic 16 / International 1	Application 9/ Registration 1		
Analytical Methods	<ul> <li>Development of standard measurement method of electrical resistivity for carbon nanotubes film</li> <li>Development of iron oxide dispersion method</li> <li>Development of pretreatment method and thickness measurement for nanofilm cross-section using IBC/UHR FE-SEM</li> <li>Measurement of electrical properties for a single nanoparticle using AFM</li> <li>Development of carbon quantitative analysis for carburizing sample in narrow area using EPMA</li> </ul>				
Projects	<ul> <li>Development and application of carbon dioxide adsorb using a state-of-the-art instruments</li> <li>Study of structural properties and electron transfer mechanism in organic/inorganic hybrid device interfaces</li> <li>Development of analysis technic for nanostructure and its properties</li> <li>Development of quantitative analysis for DNA immobilization and high performance DNA chip</li> </ul>				
Training of Equipment	Youth Education Support Program	s with Advanced Scientific Instrument	s(60 programs)		
Equipment	FE-EF-TEM Micro XPS UHR FE-SEI Installed FE-SEM PSA System Single Cryst AFM System	M al XRD			

Field emission electron filtered transmission electron microscope (FE-EF-TEM)

Equipment



Ultra high resolution field emission scanning electron microscope (UHR FE-SEM)

KOREA BASIC SCIENCE INSTITUTE

NANO SCIENCE

Jeonju Center is performing research support and collaborations to improve nanoscience and nanotechnology. Our research area is specifically focused on the analysis and characterization of nano-

Jeonju Center

#### Polyelectrolyte complex particle-based multifunctional freestanding films containing highly loaded

A facile approach to the development of multifunctional freestanding films consisting of polyelectrolytes (PEs) and polyelectrolyte complexes (nPECs) with highly embedded metal nanoparticles (NPs) was



A schematic for facile approach to fabricate multifunctional freestanding composite films



NANO SCIENCE

ENVIRONMENTAL SCIENCE

The nano materials sector carries out research, development and professional analyses on nano materials. Our center supports joint research and analyses utilizing FE-TEM, FE-SEM, XRD, XRF, DSC/TGA and materials design using DFT.

Suncheon Center

#### Main Research Activity

As one of the research groups in Korea to develop new technology for the manufacturing of advanced Li adsorbent, in 2011 research was performed to develop new materials such as high capacity next generation negative materials for Li 2nd battery and positive electrode materials using spent lithium batteries.

#### **Representative Research Case**

#### Nb-based alloys and oxides as potential anode materials

While there are Nb-based alloys and oxides as potential high-capacity electrode materials, there is no precedent of a specific examination on the anode characteristics of these materials. Our research team determined the possibilities of Nb-based alloys and oxides as anode materials and obtained an essential patent.

#### Image



Established potential of negative electrode for lithium 2nd batteries

#### **Major Achievements**



Equipment

New Materials

Research

High Resolution- Transmission Electron Microscope



Scanning Electron Microscope

Category	Achievements				
	Cases	;	Samples	Users	
Analysis Service	513		5,671	54	
Pacaarah Paculta	Publicatio	ons	Presentations	Patents	
Research Results	8 (SCI 4	.]	Domestic 13 / International 3	Registration 1	
Analytical Methods	$\cdot$ Transforming the DMol file structural optimized to the DV-X $\!$				
Projects	<ul> <li>Materials design for Li-related materials using DFT</li> <li>Research on the new technology and manufacture of the advanced Li adsorbent</li> <li>Development of negative electrode material for secondary batteries with high capacity using metal oxides</li> <li>Development of positive electrode materials using spent lithium batteries</li> </ul>				
Training of Equipment	<ul> <li>Youth education support programs with advanced scientific instruments: 32 programs</li> <li>DSC/TGA equipment training</li> <li>FE-TEM equipment training</li> </ul>				
Equipment	Installed	<ul> <li>X-ray Diffractometer System</li> <li>Photoluminescence Mapping system</li> <li>Field-Emission Scanning Electron Microscope</li> <li>Field Emission Transmission Electron Microscope</li> <li>X-ray Fluorescence Spectrometry</li> <li>Thermal Analyzer</li> </ul>			

#### KOREA BASIC SCIENCE INSTITUTE

**BIO SCIENCE** 

# Nano Materials **Imaging Research**

Research is performed on characteristics imaging for nano- and micro-samples. The physical characteristics of infinitesimal samples are analyzed and transformed into 2D visualized images.

#### Main Research Activity

molecule and/or nano-/micro-materials.

#### **Representative Research Case**

A FLIM 2D imaging microscope was used to reveal that the phosphorescent sensor of Ir(III) complex is very useful to detect mobile Zn ions in biological cell based on intensity and lifetime enhancements of the sensor molecule when it combines with Zn.

Image



Category

Analysis Service

Research Results

#### Equipment



Analytical Methods

Field Emission Transmission Electron Microscope (FE-TEM)



Training of Equipment

Projects

Time-Resolved Fluorescence Confocal Microscope (FLIM)

Equipment



NANO SCIENCE

| Gangneung Center |

In 2011, optical nano-imaging microscopes were used for the realization of unprecedented fusion characteristic 2D images based on the ultrafast fluorescence lifetime and vibrational absorption of a

#### Imaging of phosphorescent sensor for biological mobile Zinc

Dual-functional phosphorescent Zn sensor based on intensity and lifetime imaging

#### **Major Achievements**

Achievements							
Cases		Samples	Users				
315		3,193	87				
Publicatio	ns	Presentations	Patents				
9 (SCI 8)		Domestic 7 / International 1	Application 1				
Analytical method fo In-situ measuremer Analytical method fo	Analytical method for ultrafast time-gated Imaging using FLIM In-situ measurement of UV-Vis-NIR-IR absorption using FT-IRM Analytical method for resolution enhancement of TE image on FE-SEM						
An international join Smart nanoporous r Characterization of o Fundamental study Functional control o	t research for 3 naterials for st colloidal mater on natural min f nanoparticle-	3D dielectric functional materials timuli-responsive controlled release ials in Geumjin hot spring water terals as materials for medical tour superlattice structures					
Advanced user train Advanced user train	ing of electron ing of optical n	microscopes ano-imaging microscopes					
<ul> <li>Field Emission Transmission Electron Microscope</li> <li>Field Emission Scanning Electron Microscope</li> <li>Multi Purpose X-ray Diffractometer</li> <li>Time-resolved Fluorescence Confocal Microscope</li> <li>FT-UV-VIS-IR Spectroscopic Imaging Microscope</li> </ul>							
To Be Installed	· Wavelength	Dispersive X-ray Fluorescence Spect	rometer(2012)				



Isotope Research Age Determination Research Environmental Research



# Realizing the dream of a green future



Isotope research is performed by using various advanced mass spectrometers for the analysis of trace elements and environmental isotopes of samples which are of environmental importance. Research is often in collaboration with researchers in the earth and environmental science field.

# **Main Research Activity**

**BIO SCIENCE** 

#### **Representative Research Case**

#### Determining the geographical origin of Ginseng using Sr isotopes, multielements, and 1H NMR

Sr isotopes, multi-elements and 1H NMR analysis on Ginseng were performed using samples from Korea and China, aiming at discriminating the geographical origin of the Ginseng samples between the two countries. The study showed that the discrimination was successful when 87Sr/86Sr and REE contents were considered together. In particular, PCA analysis on 1H NMR magnified the discrimination of the geographical origin.

#### Image



Principal component analysis (PCA) derived from the 1H NMR spectra of Korean and Chinese ginsengs.

#### **Major Achievements**

Category	Achievements			
	Cases	Samples	Users	
Analysis Service	1,586	16,037	509	
Dessereb Desults	Publications	Presentations	Patents	
Research Results	11 (SCI 10)	Domestic 8/ International 9	Application 5	
Analytical Methods	Mg isotope analysis of geological and environmental samples     Analytical method of trace elements in rock samples by acid digestion of fused glass beads     Trace element analysis using LA-ICP-MS, based on stoichiometry of minerals)     Determination of Br contents using MC-ICP-MS isotope dilution method     Assessment of chemical enrichment and isotope fractionation during production of desalinated marine     water     Discrimination of geographical origins of Kimchi using trace elements and isotope composition			
Projects	Tracing the geographic origin of Chinese cabbage     Development of analytical methods for forensic science     Tracing the origin of food using isotopes			
Training of Equipment	Training programs for students and experts: 5 programs			
Equipment	<ul> <li>Multi-collector Inductively Coupled Plasma Mass Spectrometer</li> <li>Stable Isotope Ratio Mass Spectrometer</li> <li>Quadrupole Inductively Coupled Plasma Mass Spectrometer</li> <li>Inductively Coupled Plasma Atomic Emission Spectrometer</li> <li>Atomic Absorption Spectrometer</li> <li>Thermal Ionization Mass Spectrometer</li> <li>Static Vacuum Mass Spectrometer</li> </ul>			





SIRMS

Equipment

| Ochang Center-Division of Earth and Environmental Science |

In 2011, research was carried out for the identification of the geographical origin of food using isotopes and Pb-Pb dating methods for terrestrial materials were also developed. Investigation on dating methods for Quaternary faults and marine terrace sediments were also performed.





NANO SCIENCE

ENVIRONMENTAL SCIENCE

The geochronology team is a unique research group in Korea with a wide range of up-to-date instruments for geochronology, and is also comprised of experienced researchers from various fields of geological sciences.

| Ochang Center- Division of Earth and Environmental Science |

#### Main Research Activity

In 2011, SHRIMP U-Pb age determination of detrital zircons in metasandstones of the Taean Formation of western Gyeonggi massif in Korea and analysis of oxygen isotopic measurements of silicate using SHRIMP were carried out.

#### **Representative Research Case**

#### Age determination of Mesozoic granitoids in Korean peninsula

The precise zircon U-Pb ages and Sm-Nd idotopic data for granitoids from the Gyeonggi massif and Ogcheon folded belt were derived. Most granitoids intruded at 230-225 and 184-167 Ma. High alkaline content of Triassic samples implies a post-collisional signature.

#### Image



Internal structure of zircon from the (a) Triassic and (b) Jurassic granitoids and U-Pb age results

Installed

#### **Major Achievements**

Equipment



HR-SIMS

Equipment



Category	Achievements				
	Cases	Samples	Users		
Analysis Service	99	939	52		
Dessereb Desults	Publications	Presentations	Patents		
Research Results	18 (SCI 12)	Domestic 10/ International 8	-		
Analytical Methods	<ul> <li>Development of U-Pb dating method of apatite</li> <li>Improvement in mass resolution of SHRIMP by modification of collector slit</li> <li>Development in surface chemical analysis of galena using LA-ICP-MS</li> <li>Post IR IRSL dating of Quaternary sediments</li> <li>Development of rock surface luminescence dating method</li> </ul>				
Projects	<ul> <li>Geological sequestration near CO<sub>2</sub> capture facility</li> <li>Chronology of Acheulean-type industries in Korea-Thailand-France: contributions of newly developed luminescence dating methods</li> <li>Age dating and experimental development for Quaternary faults and marine terrace sediments near NPP sites</li> </ul>				
Training of Equipment	Training programs for students and experts: 21 programs				
Fauipmont	Installed · Heavy Mir	neral Separation System			

High Resolution Secondary Ion Mass Spectrometer



Environmental analysis field emphasizes the use of chemical and structural analysis equipment such as ICP, XRF, and XRD. Target materials are soil, groundwater, ceramics, high molecular composite materials, metals, and even bio-samples. Particularly, speciation analysis research supported by the hyphenated analytical instrument system such as LC-ICP-MS is focused.

#### Main Research Activity

soils was developed.

#### **Representative Research Case**

**BIO SCIENCE** 

#### Development of analytical technology to resolve DMMTA and DMDTA with using LC-ICP-MS

Dimethylmonothioarsinic acid (DMMTAV), which was recently observed in municipal landfill leachate, has received increasing attention due to its high toxicity to human cells. We developed analytical technology to resolve DMMTA and DMDTA by using LC-ICP-MS.





R2=0.9960) (b) Chromatogram of arsenic species in standard solutions (i.e., 0, 1, 10, 20 and 40 ppb) using a isocratic ion-exchange system separating arsenite (iAsIII), arsenate(iAsV), monomethylarsonicacid(MMA), and dimethylarsinicacid(DMA).

#### **Major Achievements**

Category	Achievements			
	Cases	Samples	Users	
Analysis Service	487	5,701	340	
Research Results	Publications	Presentations	Patents	
	4 (SCI 3)	Domestic 8/ International 4	-	
Analytical Methods	<ul> <li>Studies on metabolite analysi</li> <li>Studies on analysis of flourine</li> </ul>	s of arsenic species using LC-ICP/MS in soil samples using XRF		
Projects	Study on the factors controllin marine pollutant	g lithium recovery process by marine control f	factors and the behavior of	



Equipment

Inductively Coupled Plasma Mass

Spectrometer

01

Inductively Coupled Plasma Atomic Emission Spectrophotometer

Equipment

Seoul Center

In 2011, arsenic and mercury speciation researches in soil and groundwater, and bio-fouling effect analysis on the adsorbent in seawater were carried out. Also, WD-XRF analytical method for fluorine in contaminated



(a) Chromatograms of the synthesized DMMTAVat three concentration levels (i.e., 10, 50, and 100 µg-As/L) with the calibration results (inset graph,

Development of XRF analytical method for fluorine in contaminated soils

Training of Equipment · Technical training course for the environmental materials analysis by using ICP-AES, ICP-MS, XRF

Installed	<ul> <li>Liquid Chromatography Gas Chromatography Inductively Coupled Plasma Mass Spectrometer (LC-GC-ICP-MS)</li> <li>Inductively Coupled Plasma Atomic Emission Spectrophotometer (ICP-AES)</li> <li>X-ray Fluorescence Spectrometer (XRF)</li> </ul>
To Be Installed	· LC-ICP-MS(2012)

# Installation • Operation of National Large-scale Research Equipment



# Installation · Operation of National Large-scale Research Equipment

Large-scale research equipment is the foundation to achieving dreams in science and technology

KBSI is making an effort to create the best basic science research environment for domestic and overseas researchers by providing world-class research equipment. This leads to the development of new science and technology and the driving force to become a world-class research institute.

- HVEM
- FT-ICR MS
- HF-NMR
- HR-SIMS
- Human 7 T MRI System
- In situ Analytical System
- Super Bio-HVEM



High Voltage	
Electron	
Microscope	

HVEM

#### Operation of Nationa

High voltage transmission electron microscope (HVEM), which enables direct observation of atomic structure, has been installed in the Daedeok headquarters. HVEM is commonly utilized in basic and applied sciences, such as structural analysis of new materials, structure determination of small proteins, and development of infinitesimal materials. (Installed in April 2004)

| Daedeok Headguarters-Division of Electron Microscopic Research |

#### **Characteristics of Equipment**



- > Observation of three-dimensional (3D) atomic structure of materials by concurrently implementing the atomic resolution power (0.12 nm) and the high tilt angle  $(\pm 60^\circ)$
- > Chemical signal detection with high collection rate using the stateof-the-art energy filter (HV-GIF) that utilizes the relativity effect
- > Dynamic experiment and Cryo-EM analysis with specially manufactured specimen holder
- > Capability of collaboration with remote researchers through remote control

# Fourier Transform Ion Cyclotron Resonance Mass

FT-I CR MS

Spectrometer



#### **Major Applications**





#### **Representative Research Case**



Revelation of 5 different hemes by UHR FT-ICR MS





#### **Representative Research Case**



Chemical structural image of core-shell magnetic nanonarticles

#### Chemical structural imaging of core-shell magnetic nanoparticles for efficient heat induction

In order to overcome difficulties associated with the structural analysis of core-shell magnetic nanoparticles using high-resolution imaging, chemical structural imaging technique was applied using energy filtering system of HVEM. As a result, it was demonstrated that the core-shell nanoparticles have anti-tumor effects 30 times higher than previously developed magnetic nanoparticles due to the conversion of electromagnetic energy to heat.

The world's first 15 T FT-ICR MS was developed to build the infra of a world-class mass spectroscopy in Ochang Center. The profiles of proteome, metabolome, petroleome, and nano-complex materials are prepared with the ultra-high resolution mass spectroscopy. (Installed in December. 2007)

Ochang Center-Division of Mass Spectrometry Research

#### **Characteristics of Equipment**



- > Dual ion source : ESI / MALDI
- > Applicable methods : MALDI Imaging, APCI, APPI, LC/MS/MS
- > Various MS/MS techniques : CID, ECD, ISD, IRMPD



#### Elucidation of the existence of five different hemes in cytochrome C by UHR MALDI FT-ICR MS.

A heme is a prothetic group of hemoproteins that plays an important role in the electron transport chain. Hemes can exist in various states according to the oxidation number of the iron bound to the heme. Ultra-high resolution MALDI FT-ICR MS of cytochrome C showed there are five different hemes in the process of laser energy dissipation of MALDI.

ANNUAL REPORT 2011 54 55



#### tion · Operation of National

The 900 and 800 MHz Nuclear Magnetic Resonance (NMR) spectrometers, and 4.7 and 9.4 T Magnetic Resonance Imaging(MRI) animal scanners were installed in Ochang campus as the core equipment for researches in molecular structure determination, drug discovery, development of diagnosis and treatment technology. These research equipments are being operated as the national user facilities in Korea. (Installed in April 2006) [Ochang Center- Division of Magnetic Resonance Research ]

#### HF-NMR

#### **Characteristics of Equipment**



- > 900 MHz NMR <sup>1</sup>H sensitivity 8000 : 1, <sup>13</sup>C sensitivity 1400 : 1 (microanalvsis)
- > 800 MHz NMR H sensitivity 1800 : 1
- > 9.4 T and 4.7 T MRI : Animal MRI scanners with 21 cm and 40 cm bore sizes respectively

#### Major Applications



#### **Representative Research Case**



Comparison of the free and DNA-bound  $hZ_{\beta^{DA}}$ structures

Solution structure of the hZ<sub>B</sub>DAI and its binding modes to B- and Z-DNAs

The Z-DNA binding protein hZBDAI has a unique Z-DNA recognition mode. To get structural information of the unique Z-DNA binding mode, we determined the free hZBDAI structure and performed NMR studies on B-DNA and Z-DNA binding. The structure of  $hZ\beta$ DAI structures in solution is different from its complexed form. The binding of the protein to DNA induces conformational change. This structural information suggests the innate immune response of foreign DNA recognition.

# High Resolution-Secondary Ion Mass Spectrometer

HR-SIMS

#### **Characteristics of Equipment**



#### **Major Applications**



#### **Representative Research Case**





The High Resolution Secondary Ionization Mass Spectrometer (HR-SIMS), which measures the isotope ratio for minute area of solid materials, has been installed and operated as research equipment of the national user facilities for age determination and stable isotope research. (Installed in June 2009)

| Ochang Center- Division of Earth and Environmental Science |

- >Cs-gun and aluminum ion distribution pipe exclusively for stable isotopes
- > Improved multiple detection device that can concurrently measure even Pu isotopes
- > Convenience of remote analysis
- > Reproducibility of the uranium-lead age determination within 1%



#### Age determination of the Paleoproterozoic igneous activity in Yeongnam Massif, Korea

The precise zircon U-Pb ages for granitoids and metamorphic rocks from Yeongnam Massif in central Korea reveals the deposition of the protolith for metamorphic rocks at ca. 2.0 Ga and the subduction-zone magmatism at 19.9 Ga. We also report the the regional metamorphism at ca. 18.5 Ga in Korean peininsula and suggest its association with the formation of the supercontinent Columbia. This research were on-line published in Gondwana Research (IF=5.503).

Geologic map of the Yeongnam massif (left) and cathodoluminescence images of sectioned zircon grains and SHRIMP zircon U-Pb data for the representative granitoids (right)



#### Operation of Nation

The human 7 T MRI system at KBSI will be a new and revolutonary ultra-compact and whole body scanner with an actively shielded magnet and multiple channel transmitter and receiver coils, which will give highly resolved and sensitive images. (To be installed by Apr. 2013)

| Ochang Center-Division of Magnetic Resonance Research |

#### **Characteristics of Equipment**

- > Active shielding magnet
- > Multiple channel transmitter and receiver coils
- > Whole body imaging including brain imaging

#### Major Applications





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-ends of leading analysis instruments and device fabrication process. (To be installed by Dec. 2014)

#### [Daedeok Headquarters-Division of Materials Science]

#### **Characteristics of Equipment**



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

#### **Major Applications**



- **01\_** Essential analysis for the organic nano
- **02\_** in situ total surface analysis for the next generation of semiconductor



#### **Characteristics of Equipment**



- > Advanced cryo-EM function at cryo temperature ( $\langle 98^{\circ} K$ ) for the protein structure analysis
- > Enhanced auto high tilt function to  $\pm 70^{\circ}$  for the 3D structure analysis
- > Reinforced In-situ function with improved signal to noise ratio

#### **Major Applications**



#### • Operation of Nationa

Electron microscope equipped with state-of-the-art functions, which is optimized for 3D analysis of biomolecules, is scheduled to be installed. It will lead as a national user research equipment in nano-bio fusion research fields. (To be installed by Dec. 2015)

| Daedeok Headquarters-Division of Electron Microscopic Research |

- 01 Characteristic structures of biological proteins visualized by high resolution imaging of HVEM
- 02\_ In-vivo ultrastructural imaging of intracellular organelles distinctively larger in size

# Advanced Analytical Science Reséarch

# Advanced Analytical Science Research

technology.

the-art research equipment and secure basic technology to avoid importing, thus greatly

- Development of National Agenda-Solving Technology
- Development of Leading-Edge Analytical Equipment



Pioneering new research fields in basic science and developing stateof-the-art equipment contribute to advancing national science and

# Development of Analytical Technology for membrane Protein

Advanced Analytical Science Research

Final goal of this project is to set up a bio-infrastructure, which can be used for elucidation of disease mechanisms and new drug discovery. Bio-infrastructure can be a basic tool for interdisciplinary research.

| Daedeok Headquarters-Division of Life Science |



#### Main Research Activity

In 2011, function of novel membrane Cyp4A, which is a potent therapeutic target for type 2 diabetes, was elucidated and function and 3D structure of OMV from pathogenic bacteria, Acinetobacter baumannii was analyzed. Also, drug repositioning technology was established as a CUPID application method.

#### Future Plans of Research

Established technology will be applied for study of human diseases, infectious diseases by various drug resistant bacteria. Discovery & structural analysis of virulent factors, infection mechanism, and functional analysis will be the main research topics.

#### Images



Development of New-Concept Nano Materials Utilization Technology

the next decade.



#### Main Research Activity

and PPMS.

#### Future Plans of Research

We will try to synthesize 3D nanohybrid and perform molecular simulation screening for application of the hydrogen storage, Li-ion battery and supercapacitor. In addition, AFM-Raman, TEM, NMR, PPMS, and EPR will be employed to evaluate the material characteristics.

#### Images



We are primarily focused on the development of nano-structured and organic/inorganic hybrid materials through molecular simulation and characterization for the high performance green energy storage over



| Daedeok Headguarters-Division of Materials Science |

In order to develop the electrode materials for supercapacitor and Li-ion secondary battery, graphene oxide based metal oxide nanocomposites were fabricated and characterized with TEM, XRD, NMR, AFM-Raman,

- 01\_ (a) Schematic diagram of hydrogen storage of graphene oxide (b) SEM image of graphene oxide
- 02\_ Electrochemical property of 3D porous graphene/MnO2 composite film electrodes



# Development of National Agenda-Solving Technology

Advanced Analytical Science Research

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



Technology to Discriminate the Origin of Agricultural and Livestock Produce

Development of the integrated analysis technology for discriminating the geographical origin of foods, which are currently being circulated in Korean markets, is being established.

| Ochang Center- Division of Earth and Environmental Science |

#### Main Research Activity

Country-of-origin discrimination techniques for foods, which are currently being circulated in Korean markets, have been developed based on multi-tracer analyses : isotopes, trace elements, and metabolites.

#### Future Plans of Research

An integrated standardization system for discriminating the geographical origin of various foods will be developed.

#### Images



Technology to Analyze Harmful Chemicals

In collaboration with universities, industries and research institutes, a national monitoring project and reliable quality assurance of persistent organic pollutants are carried out. Also, information on the environmental impact and managing environmental risk is provided.

#### Main Research Activity

In 2011, the distribution of dioxins and PCBs in food within Korea have been monitored and the biological effect assessment system on persistent organic pollutants using metabolomics was developed.

#### Future Plans of Research

Future research will provide an improved scientific basis for environmental analysis and the major areas of research will include the rapid detection technology of hazardous materials for disaster science.





Bio-Imaging Technology for Early Disease Diagnosis

Bioimaging technology by means of 4.7 T and 9.4 T animal MRI, PET/CT/SPECT, MALDI MSI, Bio-EM and optical imaging can help the early detection of diseases and the new drug development including contrast agents

#### Main Research Activity

Installation of human 3 T MRI, imaging optimization of MRI for disease animal models, synthesis and evaluation of PET probe for early detection of tumor, and acquiring highly resolved protein complex EM imaging were performed.

#### Future Plans of Research

Installation, development, and application of 3 T and 7 T human MRI, biomedical fusion study on the animal brain and disease model is on going.

#### Images



Seoul Center

- 01 Daily dioxins dietary intake of Korea population by age and food group 02 Gas Chromatography - High Resolution
- Mass Spectrometer

| Ochang Center-Division of Magnetic Resonance Research |

- 01\_ Set-up of human 3 T MRI
- 02\_ (Above) PET imaging and (Below) MRI imaging with contrast agents for tumor model



Technology for Cultural Preservation

The system on the origin and classification of ancient bronze artifacts in Northeast and South Korea based upon lead isotope and trace element compositions of ancient bronze artifacts was developed.

| Ochang Center- Division of Earth and Environmental Science |

#### Main Research Activity

In 2011, we investigated and collected the samples for 40 galnea deposits, and obtained lead isotope ratio and trace elements of analytical data of galena samples as well as some important bronze artifacts.

#### Future Plans of Research

We will continue to analyze more galena and bronze artifact samples to assess the origin and classification.

#### Images



Technology for Crime Scene Investigation

Development of scene-adaptive analytical techniques for fast and accurate crime scene investigation is being established based on forensic isotopes and biomarkers.

| Daedeok Headquarters/Ochang Center |

#### Main Research Activity

In 2011, the bulk and compound-specific carbon isotopic analyses of gasoline from four Korean oil companies were performed. Biochemical post-mortem interval markers have been identified based on animal models.

#### Future Plans of Research

Elemental compositions of window glasses from Korean vehicles will be obtained to aid forensic investigations. The verification of biochemical post-mortem interval markers through in vivo analysis will be carried out.

Images



**Development of** Leading-Edge Analytical Equipment

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 analytical equipment



Femtosecond Multi-Dimensional Spectroscope

New types of femtosecond multi-dimensional and chiroptical spectroscopic techniques have been developed, and ultrafast dynamics of biomolecules and chiral chemical species have been studied using these methods.

#### Main Research Activity

In 2011, ultrafast chemical exchange reactions of artificial amino acids have been revealed by using twodimensional infrared spectroscopy, and various types of ultraviolet-visible optical activity spectrometers have been developed to study structural dynamics of biomolecules such as proteins and DNA.

#### Future Plans of Research

be carried out.

#### Images



Seoul Center

In combination with proper triggering methods such as temperature-jump, folding/unfolding dynamics of biopolymers will be studied and further development towards multi-dimensional chiroptical techniques will



- **01\_** Broadband ultraviolet-visible optical activity spectrometer (below) and chiroptical signals measured (above)
- 02\_ Polarization-angle-scanning twodimensional infrared spectrometer



High-Precision Thermal-Imaging Microscope System

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.

| Daedeok Headquarters-Division of Instrument Development |

#### Main Research Activity

In 2011, the fabrication and performance test of prototype thermal imaging microscope systems, including infrared micro-thermography and thermo- reflectance microscopy systems, was completed. Also, the precise temperature imaging and thermal analysis method of micro-electronic devices were developed, as an application technology of thermal imaging microscope.

#### Future Plans of Research

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

#### Images



Small and Medium Accelerators Utilizing the ECR lon

The study of a functional energy material, treatment of material surface, ion implantation, and nondestructive analytical device will be carried out by developing and building the heavy ion beam facility using the ECRIS (Electron Cyclotron Resonance Ion Source).

Busan Center

#### Main Research Activity

In 2011, the core technologies of 28 GHz ECRIS including a vacuum chamber, a gyrotron, the design and winding of superconducting magnets were carried out. The designs of a LEBT (Low Energy Beam Transport) and a RFQ (Radio Frequency Quarduropole) have also been progressed.

#### Future Plans of Research

The fabrication of ECRIS, the designs of LEBT and RFQ will be finished in 2012. The production of RFQ and the design of QWR (Quadrupole Wave Resonator) will be studied.

#### Images



and a cryostat for the test of super-02\_ Chamber of ECR ion source

Conduction Cooling Type 15 T High Magnetic Field Material Research System Development of cryogen-free superconducting magnet technology, under extreme condition of 15 T high magnetic field and below 3 K low temperature, measurement of various materials properties, evaluation of superconductor, material synthesis and crystal growth are carried out.

#### Main Research Activity

proceeded.

#### Future Plans of Research

carried out.

#### Images



| Daedeok Headguarters-Division of Materials Science |

In 2011, performance test of cryogen free 15 T superconducting magnet and VTI (variable temperature insert) system cooling test down to 3 K and protein crystal growth test in high magnetic field have been

Various material property measurements under high magnetic field and low temperature, evaluation of superconducting materials and magnet, magnetic separation, material synthesis and crystal growth will be

- 01 Cryogen Free 15 T Superconducting Magnet with Crystal Growing System
- 02\_VTI (Variable Temperature Insert) System for 15 T SC Magnet



# Reinforcement · Promotion of National **Basic Science Support Systems**

and research institutes.

KBSI comprehensively manages national research facilities and equipment with the goal of realizing strategic expansion and systematic joint utilization of research facilities and equipment. Based on our world-class analytical technology, KBSI is fostering analytical S&T experts. Also, KBSI operates various support systems to reinforce industrial technological competitiveness and promote industry-university-institute cooperation by utilizing the research infrastructure.

- Online Research Service System

- Reinforcing Industry-Institute Cooperation System
- Public Understanding Program for Science & Technology
- National · International Networks

Reinforcement · Promotion of National Basic Science Support Systems

## Leading national S&T infrastructure, KBSI trains future S&T specialists and promotes cooperation among industries, universities

• Operation of National Research Facilities & Equipment Center (NFEC)

• Operating Graduate School of Analytical Science and Technology (GRAST)

• Publishing of Journal of Analytical Science and Technology (JAST)

Operation of National Research Facilities & **Equipment Center** 

Overview of NFEC

The National Research Facilities and Equipment Center (NFEC) performs overall management for the advance of research facilities and equipment through 'strategic investment', 'promotion of share-use',

rcement · Promotion of Nationa

'equipment engineer', and 'enhancement of development capabilities' of national research facilities and equipment. NFEC supports policy-making and legislating of research facilities and equipment, to construct and operate the Deliberative Council of Research Equipment Budget for the efficiency of national R&D investment. I Daedeok Headquarters-NFEC I



Support policy-making and legislating for research facilities and equipment

National Research Facilities & Equipment Center

> Act as a national think-tank by supporting policy-making and legislating for the strategic expansion and the promotion of shared-use of research facilities and equipment.

#### **Major Activity**

In 2011, support was carried out for 11 policy-makings and 1 legislating of research facilities and equipment for a 'Proposal to improve the efficiency of national R&D investment'. Also, we laid the foundation for policymaking to cooperate with the government of research facilities and equipment by organizing and operating a supporting consultative group of government agency of research facilities and equipment and the legislation task force of national research facilities and equipment.

#### **Future Plans**

A national research facilities and equipment basic plan for overall management system of national research facilities and equipment will be established, which will lead a systematic implementation to cooperate with the government by the collaboration system of research facilities and equipment.

#### Images



02\_ The 1st consultative group of government agency of research facilities and equipment, 1st legislation task force of national research facilities

#### Organization and

management of the 'Deliberative Council of Research Equipment Budget' for allocation of the national R&D budget

budget.

#### Major Activity

equipment of 14 government agencies.

#### Future Plans

Equipment Budget'

#### Images



Promote implementation of the 'National Research Facilities and Equipment Management Manual'

Provide integrated management guidelines, from acquisition to disposal for an effective operation and a national management system of research facilities and equipment.

#### **Major Activity**

presentations and 357 participants.

#### **Future Plans**

Plan to distribute the brochure and online contents of the 'Easy To Understand Manual on National Research Facilities and Equipment Management' to researchers and research institutes, and aim to reinforce the operation of the manual by its diffusion and promotion.

#### Images



Improve the efficiency of national R&D investment by operating the 'Deliberative Council of Research Equipment Budget' for feasibility examinations when the strategy and finance allocates the national R&D

In 2011, the 'Deliberative Council of Research Equipment Budget' was held twice for the efficiency of national R&D investment. Expenditures were reduced by 373 billion won through 481 councils of research

Minimize acquisition of unnecessary and non-urgent research equipment through enhancing feasibility examinations with advanced constructions and operations and of the 'Deliberative Council of Research

02		THE STREET		THE PROPERTY IN THE PROPERTY INTE PROPERTY IN THE PROPERTY INTE PROPERTY IN THE PROPERTY IN THE PROPERTY INTE PROPERTY I		01_ Deliberative Council of Research Equipment Budget
	( 1, 1600 ) 00.10-10 100000000000000000000000000000	E 1. 49-49)	10.000.000	0000 880 80.11	(1000200) 001111 101111	<b>02_</b> Agenda for holding the council and deliberation materials
	(Incomposition)	INVOLUTION		mrra Iowerda est ma management ma management	The processing	
CINEC-	0.00.0000			********	000100000	

In 2011, we distributed the Implement Recommendation Plan of the 'National Research Facilities and Equipment Management Manual' to government agencies, research institutes, and researchers. Also, an effective operation management system of research facilities and equipment was led through 9



01_ Presentations held re	gionally
---------------------------	----------

02\_ The 'National Research Facilities and Equipment Management Manual' and Implement Recommendation Plan



#### Construction and management of the National Science & Technology Information Service (NTIS)

Construct and operate a supporting system of promoting shared-use and effective operation of national research facilities and equipment by managing an integrated database of equipment and facilities (acquisition, utilization, management, and refuse).

#### **Major Activity**

In 2011, we improved the information retrieval system of research facilities and equipment, and research equipment specialists for better accessibility and convenience. Also, we provided information of 102 large research facilities for promotion of shared-use and supported consultations both online and offline by organizing and operating 90 mentors from the research equipment mentoring group.

#### Future Plans

Utilization and management will be reinforced through information integration between research institutes and research facilities and equipment. Also, research facilities and equipment information will be provided through a smart service focusing on IT environment changes and customized information will also be provided by the analysis of user trends.

#### Images



Implement Equipment Education Program for General Users

Produce and operate an education program combining practice with theory for professionalism and utilization improvement of research equipment engineers.

#### **Maior Activity**

In 2011, contributed to improving the skill of research equipment engineers [432 in total] by providing general users with various equipment education and held the annual Imaging Equipment Education School, which is a program specialized in professional imaging equipment.

#### Future Plans

Improve operation, management, and analysis skills of research equipment engineers by expanding general user education programs to more than 20. Also, the 2nd Korea Basic Science Institute (KBSI) Imaging Equipment Education School will be held which focuses on practical training.

#### Images



Promote support program of high-cost and special research equipment

Support operation costs (employment and maintenance) to universities and research institutes that own research equipment with values of 100 million won or more for smooth functioning of the equipment.

#### Major Activity

In 2011, supported fees for operating high-cost research equipment by evaluating outstanding research equipment operation plans, and promoted shared-use of the research equipment by opening to the public.

\* Supported 400 million won for 40 projects in 2011

#### **Future Plans**

The amount of support fees per research project will be expanded to improve the effectiveness and satisfaction of operating high-cost research equipment. Also, the system will change so that the researcher can receive support of both staff salaries and maintenance costs instead of having to select one.

#### Images



Publication of the trend report for research facilities and equipment

Publish 'NFEC PRISM', which analyzes issues of local and international management systems and a survey of research facilities and equipment to provide useful information of policy-making.

#### Maior Activity

In 2011, published a total of 16 NFEC PRISM reports, including 'The trend and strategy of international large research facilities construction (OECD)' and 'The investment situation of national research facilities and equipment'. Researchers can easily download the reports through the NFEC home page (www.nfec.go.kr).

#### Future Plans

easily accessed.

#### Images



Publish and expand the NFEC PRISM based on user needs for the policy of research facilities and equipment, and the investment trends. Also, the data will be available on the NFEC home page so it can be

	IN RESTATISTICS	MANUAL	NFEC PRISM reports
Qrec.	Qree Qree .	©722	



#### preement · Promotion of Nation

OCS (Online Research Service System) utilizes the most advanced cutting-edge Information Technologies to improve the convenience of research support. Users can simultaneously engage in the analysis process through OCS technologies at the KBSI headquarters and the local centers. On the OCS web service, users can communicate with KBSI's operator through the video conference system to share their opinion for sample analysis. The OCS web service provides various fields of research support including data analysis(S/W), Q&A and etc. | Daedeok Headquarters-Division of Policy & Strategy |

# **Online Research** Service System



#### **Major Activity**

In 2011, a total of 45 analysis equipment was applied to the OCS and in the research support service area, 485 analysis cases were processed based on OCS. Especially OCS adopted new state-of-the-art media streaming technologies for transferring analysis image data to users. Also, to retain the best operational condition, OCS has been continuously improved.

#### Future Plans

The intelligent OCS will be improved to promote shared-use of research facilities. OCS' s performance will also be continuously upgraded for R&D utilization improvement and will contribute to public understanding of science & technology.

#### Images



**01**\_ OCS remote experiment(GISE) 02 International remote experiment (KBSI-Hongkong Korean International

Operating Graduate School of Analytical Science and Technology

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.



#### **Major Activity**

In 2011, there were 29 faculties in GRAST, 13 researchers belonging to KBSI and 16 professors belonging to CNU. In the same year, 30 master course and Ph.D course students entered GRAST and 14 students have araduated since GRAST was established in 2009. In order to cultivate students of executive ability in the field of analytical equipment, GRAST introduced expert certification programs. In result, 5 students obtained a license in the field of electromicroscope, mass spectrometry, MRI and etc.

#### Future Plans

#### Images

GRAS'

분석과학기술대학원



| Daedeok Headquarters-Chungnam National University |

GRAST will gradually increase the number of expert certification programs from four fields to eight, grant more students certifications and foster specialists required in the research and industry fields.

- 01\_ 2011 Graduation of GRAST
- 02 Industry visiting program

Publishing the
Journal of
<b>Analytical Science</b>
& Technology
(JAST)

Promotion of Nationa

JAST(Journal of Analytical Science & Technology) is a journal which publishes creative research or application on the analytical principles, techniques, methods, procedures, and equipment in all their respects.

| Daedeok Headguarters-Division of Policy & Strategy |

#### **Major Activity**

The Journal of Analytical Science & Technology (JAST) has been issued biannually (March, September) since 2010. 17 peer-reviewed articles and 35 invited articles were published in 2011. The online edition of the journal is available at www.jastmag.org and it is an open-access journal.

#### Future Plans

The vision of JAST is to be an internationally influential and widely read analytical science journal. To improve our journal, we are carrying out as following: 1. Active recruitment of high-impact articles by courting researchers, 2. Offering authors better services, 3. Boosting the journal's media profile, 4. More careful article selection.

#### Images



01\_ JAST Vol. 2, No. 1(Mar, 2011) 02\_ JAST Vol. 2, No. 2(Sept, 2011) 03 JAST Vol. 2, Supplement A

Reinforcing Industry-Institute Cooperation System

Plays a central role of facilitating efficient shared-use and joint research of state-of-the-art research equipment with the foundation of KBSI's eleven regional centers around the country including Daedeok Headquarters, Ochang Center and etc. Also, promotes various cooperation programs with universities, companies and other research institutes for an inclusive growth.



Visiting Researcher Support Program

The visiting researcher support program provides full-time researchers in other institutes with expenses for their stay in KBSI, who visit to perform joint research and utilize the research equipment at KBSI.

#### **Major Activity**

environment.

#### Future Plans

utilization.

#### Images



| Daedeok Headguarters-Division of R&D Cooperation |



In 2011, a total of 15 visiting researchers(13 local, 2 foreign) were selected and provided with living expenses, round-trip airfare, private research space and accommodation at the Ochang Center Guest House. Especially, starting this year, an office for visiting researchers has been prepared to improve the working

To offer more local and foreign researchers the opportunity to participate in the program, promotion will be strengthened to universities, companies and related institutes. Also, full support will be provided to improve the research environment to derive the best research results from expanding collaborations and equipment



- 01\_ Evaluation Committee held for selection of visiting researchers
- **02\_** Office for visiting researchers

Operate technical counselling center and membership program for small and medium companies

In order to strengthen technical competitiveness and settle difficulties of small and medium companies, the counselling center was set up to consult technology and equipment repair by utilizing state-of-the-art equipment and experts in KBSI. Furthermore, outstanding member companies are selected to give discount benefits(10%~50%) on charges for device usage.

#### **Major Activity**

In 2011, a total of 353 cases of analytical services of technical counselling for small and medium companies were carried out. Also, for membership services, 46 discount members and 240 general members were selected to provide discounts for equipment use and various information.

#### **Future Plans**

In the future, the service support system for small and medium companies will be strengthened and will contribute to revitalizing consumer-directed joint utilization and research of high-tech equipment.

#### Images



#### Support technical innovation for small and medium companies

In order to enhance technical innovation capabilities and strengthen the competitiveness of small and medium companies, custom-built research development support is provided through utilizing a nationwide high-tech research support network and outstanding R&D resources.

#### **Major Activity**

In 2011, in order to support technology development of small and medium companies utilizing state-of-theart research equipment, 6 research projects were performed with 6 small and medium businesses such as ISOL Technology Inc. and Duksan Techopia Co.

#### Future Plans

In the future, various R&D support will be provided to solve difficulties of small and medium companies by utilizing the best research infrastructure, and to create new technology and high-valued products through joint utilization of research equipment.

#### Images



Representative case of industrial partnership with small and medium companies in 2011 (Development of real-time analysis of protein interaction for screening of drugtarget candidates)

Public Understanding Program for Science & Technology

The purpose of this project is to improve the public awareness of national R&D activities by providing various outreach programs using R&D infrastructures such as research equipments and researchers and R&D performance products.



#### **Program Contents**

Category Outline

Lectures, traini sessions and to to experience Experience advanced scient technology and raise interest a awareness in science.



Experiments utilizing various state-of-the-ar Experiment equipment to foster future

Exploration research

X Science Character

KOREA BASIC SCIENCE INSTITUTE

Outline	Course	Contents
	Science Class	Educational program to experience the research site which utilizes the institute's high-tech equipment in connection with the school curriculum (3-12th graders)
Lectures, training sessions and tours	Remote Experiment	Experiencing high-tech research equipment through the internet, overcoming the distance barrier to the institute (3-12th graders)
advanced scientific technology and raise interest and	Let' s Meet a Scientist	Scientific lectures for the youth (3-12th graders, the public)
awareness in science.	In-service Teacher Training	Training sessions for teachers to experience the scientific research field to apply to teaching materials (teachers)
	Lab Tour	Explore the dynamic laboratory and explanations by researchers (3-12th graders)
Experiments utilizing various state-of-the-art equipment to foster future experts	Science Camp	Experience various scientific programs at different institutes which lasts for one day or more (3-12th graders)
	One-day Scientist	1 student and 1 researcher work as a team to directly experience the research equipment, select a research subject, collect data and have discussions (7-12th graders)
	Analytical Equipment Practice	Provide state-of-the-art research equipment information to guide students of natural sciences and engineering in deciding their future specialty (undergraduates)
Intensive academic exploration of research	Youth Research	Scientists' research process downsized to a program for students to select a research topic, get results and make presentations with a researcher (7-12th graders)
equipment and latest research information	Undergraduate Internship	Students of natural sciences and engineering perform research projects, make a report on the results and present the results with the guidance of a researcher (undergraduates)
Junior Doctor		This program is offered with other research institutes which provide various scientific hands-on experiences, experiments, lectures and tours to enhance the public' s understanding of S&T. (3-9th graders)

#### **Major Activity**

- In 2011, KBSI provided students and the public with 'X-Science Program' and 'Junior Doctor Program' to improve public understanding of science and technology. A total of 22,997 youths and the public participated in these programs.
- **X-Science** : 10 kinds of courses such as science class, science camp and youth research program, which are utilize research equipment, were held at the 11 sites of KBSI throughout the country. As a result, 13,970 students and others participated in this program in 2011.
- Junior Doctor : '2011 Junior Doctor' was held during the summer vacation in Daedeok research complex. KBSI planned and arranged the '2011 Junior Doctor' and 30 research institutes, universities and etc. joined the event. As a result, 9,027 elementary and middle school students from all over the country participated in the program and 405 participants received honorary degrees.

Ca	tegory	Course	Number of program	Number of participants
		Science Class	253	5,197
		Remote Experiment	46	1,780
	Experience	Let' s Meet a Scientist	31	1,702
		In-service Training for Teachers	5	109
		Lab Tour	145	3,803
X-Science	Experiment	Science Camp	7	577
		One-day Scientist	49	89
		Analytical Equipment Practice	45	655
	Exploration	Youth Research	7	35
		Undergraduate Internship	19	23
		Sub Total	607	13,970
	Junior Doctor			9,027
	Total			22,997

#### **Program Operation Results**

#### Survey of Participants' Satisfaction



#### Future Plans

#### Images









KBSI has provided various outreach programs since 2004. 'X-Science' and 'Junior Doctor' are now acknowledged for outstanding S&T programs for the youth and public. KBSI will continue to make an effort for 'X-Science' and 'Junior Doctor' to be representative S&T outreach programs in Korea.

# National · International Networks





National Network

KBSI is building a vast cooperative network with national industries, universities and institutes to facilitate the use of research equipment and to promote research collaborations and exchange of researchers and students.

選 서울대학교	🚺 한발대학교	() 전북대학교 CHONGUK NATIONAL UNIVERTIT	오남대학교 HOINAM UNIVERSITY	충북테크노파크 CHUNGBUK TECHNOPARK
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www.science.go.kr 국립중앙과학관 National Science Museum	왕주광역시 GWANGJU <b>CITY</b>	NFS 국립과학수사연구원 National Foremite Service	한국과학창의재단	이 문 이 주 대 학 교 Kongju National University
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Sogang University	WISET 한국여성과학기술인지원센터		<b>KBIO</b> 오송첨단의료산업진흥재단	경상북도과학교육원           Operating States

International Network	KBSI is strengthening the network with overseas advanced institutes to reinforce world-class research collaboration.			
USA	01_ Lawrence Livermore National Laboratory [LLNL]	Italy	13_ Consorzio Mario Negri Sud	
	02 National High Magnetic Field Laboratory [NHMFL], University of Florida	Russia	14_ Kazan State University [KSU]	
	03_ University of Illinois [UIUC]	Slovenia 📲	15_Jozef Stefan Institute [JSI]	
	04_ University of California, Berkeley [UC Berkeley]	Australia	16_ Australian National University [ANU]	
	05_ University of California, San Diego [UCSD]		17 Dutherford Applaton Laboratory [DAL]	
	06_ Salk Institute for Biological Studies	N UK	[7] Ruthenord Appleton Laboratory [RAL]	
	07_ Newyork University [NYU]	*` China	18_ Institute for Multiple lon Physics, Beijing University	
			19_ State Key Lab of Metal Matrix Composites, Shanghai	
JAPAN	08_National Institute for Material Sciences [NIMS]		Jiao Tong University	
	09_ National Institute for Basic Biology [NIBB]			
	10_ RIKEN Yokohama Institute	Poland	20_ Adam Mickiewicz University (AMU)	
	11_National Institute for Physiological Sciences [NIPS]	Greece	21_ National Center for Scientific Research Demokritos	
	12_Osaka University	★ Vietnam	22_ Institute of Marine Biochemistry (IMBC)	

# Appendix

- Representative Research Cases in 2011
- Research Projects in 2011
- 2011 KBSI Photo News
- KBSI Researcher of 2011 Interview

# Appendix



• Installation, Performance Upgrades of Advanced Equipment in 2011

## Studies on regulatory mechanism of myosin 10

Hyun Suk Jung (1stAuthor), Division of Electron Microscopic Research



### Paper Title

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Phospholipid-dependent regulation of the motor activity of myosin X (IF : 13.685)

### Publication

Nature Structual & Molecular Biology (2011. 6. 12)

## Equipment

**Bio-TEM** 

#### >

#### Joint Researchers

Umeki, Nobu (1st author, UMASS Medical School), Tsuyoshi Sakai(1st author, UMASS Medical School), Osamu Sato(Co-author, UMASS Medical School), Reiko Ikebe(Co-author, UMASS Medical School)

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#### **Research Contents**

Structural determination of intramolecular interaction observed in inactivated myosin motor: Structural features of motor proteins, which can provide great details of their regulatory mechanisms in filopodia, was demonstrated for the first time. This study has a core potential for further exploration to determine the control mechanism of cell motility in cancer cells.

#### >

#### **Expectations**

Based on the findings from this study, regulatory mechanisms of filopodia will be further determined. This can be accomplished by the combinational studies of electron microscopy and light microscopy. Ultimate goals of this study can provide informative basic insight into cancer researches, contributing drug discovery.

#### Images



Representative Research Cases in 2011 02

# Identification and Quantification of Reaction Products in Direct **Ethanol Fuel Cells**



# Paper Title

**Publication** Angewandte Chemie-International Edition (2011. 3. 1)

# Equipment

#### >

## Joint Researchers

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### **Research Contents**

Different anode catalysts (Pt/C, PtRu/C, Pt3Sn/C) and operating potentials lead to different product distributions in the anode exhaust of direct ethanol fuel cells, as demonstrated by liquid-state 13C NMR spectroscopy in this work. Addition of Ru or Sn to Pt/C increases current density, mainly due to enhanced acetic acid production, and potential dependences of products give clues to reaction pathways of ethanol electro-oxidation

#### > **Expectations**

Quantitative analyses of the reaction products, as demonstrated in this work, will provide information that can be used to overcome the hindrances to commercialization of fuel cells with optimum operatioal condition and fuel cell materials. The variation parameters for the analyses include fuel-cell operating conditions such as potential, fuel concentration, and reagent flow rates. Fuel cells that are prepared with different components such as catalysts or electrolyte membranes can be also analyzed.

#### Images



Oc Hee Han (Corresponding author), Daegu Center

Catalytic Reactions in Direct Ethanol Fuel Cells (IF : 12.73)

500 MHz liquid state NMR Spectrometer

In Kim(KBSI, SNU), Oc Hee Han(KBSI, GRAST), Seen Ae Chae(KBSI), Younkee Paik(KBSI), Sung Hyea Kwon(KBSI), Kug Seung Lee(SNU), Yung Eun Sung(SNU), Hasuck Kim(SNU)

## **Direct Monitoring of the Inhibition of Protein-Protein** Interactions in Cells by Translocation of PKCd Fusion Proteins

Kyung Bok Lee, Jung Me Hwang(1st Author), Division of Life Science



## **Paper Title**

Direct Monitoring of the Inhibition of Protein-Protein Interactions in Cells by Translocation of PKCd Fusion Proteins

### **Publication**

Angewandte Chemie-International Edition (2011. 2. 7)

### Equipment

laser scanning confocal microscope (LSM 710)

#### >

#### Joint Researchers

Insung S. Choi(KAIST), Jaerang Rho(CNU), Jong Soon Choi(KBSI), Gun Hwa Kim(KBSI), Seung IL Kim(KBSI)

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#### **Research Contents**

We demonstrate that the inhibition of protein-protein interactions (iPPI) using a small molecular inhibitor can be monitored directly by a redistribution approach. Protein kinase C (PKC) is known to translocate from the cytoplasm to the plasma membrane in response to physiological stimuli, as well as exogenous ligands such as phorbolesters. In a study using PKC tagged with green fluorescent protein (GFP) the dynamics of PKC translocation in response to different stimuli was monitored in real time in live cells. Therefore, we hypothesized that a PKCd-fused bait protein would quide cotranslocation with the target protein, and a chemical inhibitor would interrupts PPI, making it possible to monitor iPPI.

#### >

#### Expectations

Our technique is robust and widely applicable to the analysis of novel interacting partners such as chemical compounds, peptides, and proteins for library screening.

#### Images



Representative Research Cases in 2011 04

Harvest Visible Light



# Paper Title

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**Publication** Advanced Materials (2011, 5, 10)

#### > Equipment

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#### **Joint Researchers**

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#### **Research Contents**

Hydrogen has been regarded as a promising energy carrier because it is a clean fuel that does not produce CO2 and other pollutants in combustion, and could be manufactured from abundant resources such as water. The development of Photoelectrochemical (PEC) water splitting system with high efficiency (conversion efficiency for the photochemical decomposition of water into H2 and O2), therefore, has become the most important topic in the photocatalysis research today. In the present study, we have successfully fabricated a perovskite PbBi2Nb209 nanorods film as a photoelectrode for the PEC cell. Further we have also discovered that the PbBi2Nb209 nanorods configuration dramatically improves the performance of H2 generation during PEC electrolysis of water under visible light irradiation.

#### >

#### Expectations

Hydrogen energy is a prerequsite for eventual hydrogen economy and to support transportation industry using fuel cell vehicles. Fabrication technique of perovskite nanorods film will be applied to hydrogen fuel production by PEC Cell and photocatalysis under sun light.

#### Images



# Engineered Nanorod Perovskite Film Photocatalysts to

Hyun Gyu Kim (1stAuthor), Busan Center

Engineered Nanorod Perovskite Film Photocatalysts to Harvest Visible Light (IF : 10.88)

Scanning electron microscopy, Transmission electron microscopy, X-ray photoelectron spectroscopy, X-ray diffraction, Ultraviolet-visible diffuse reflectance spectroscopy

Jae Sung Lee (Corresponding author, POSTECH), Promod H Borse(IACPMH, India), Jum Suk Jang (POSTECH), Chang Won Ahn (KBSI), Euh Duck Jeong (KBSI)



- 01 PbBi2Nb209 nanorods on F-doped tin oxide (FTO) substrate
- 02 Schematic diagram describing the mechanism for the charge transport in PbBi2Nb2O9 nanorods photoanode film

# 2011 05



### Paper Title

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clusters

Can an electron-shell closing model explain the structure and stability of ligand-stabilized metal clusters (IF : 9.023)

Theoretical studies on the stability of ligand-stabilized metal

Young Kyu Han (Corresponding author), Division of Materials Science

## Publication

Journal of the American Chemical Society (2011. 4. 20)

### Equipment

PC cluster (H/W), Gaussian09 (S/W)

#### >

#### Joint Researchers

Jae Hoon Jung (LG Chem. Research park), Hye Mi Kim (LG Chem. Research park)

#### >

#### **Research Contents**

We successfully interpret the structure and stability of AlmHn using molecular orbital analysis, which clearly shows the failure of an electron-shell closing model (or a superatom model) to explain it. The structure and stability are closely associated with the molecular orbital stabilization owing to the effective orbital overlap between Alm(Mm) and nH(nL). The importance of retaining the electronic structural integrity of Mm in MmLn within an electron-shell closing model has been underestimated or even disregarded.

#### >

#### **Expectations**

Controversies surrounding superatom model is still ongoing. This work traces the origin of the controversies in the scientific community, and can be used as a basic research to understand the stability of ligandstabilized metal clusters.

#### Images



Representative Research Cases in 2011 06

Biomaterials

Naeun Choi, Sung-Eun Kyoung Ryu' A R T I C L E I Artist tener Bernel II May 2011 Acquid 4.5 or 2011 Acquid 4.5 or 2011 Aparente Roka (1947) K.B K.D. Hills The Nagrania Tathar

# Development and evaluation of radioligand for diagnosis of tumor using PET



## **Paper Title**

(IF: 7.883)

### **Publication**

Biomaterials (2011. 10. 1)

## Equipment micro PET/CT/SPECT

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#### Joint Researchers

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#### **Research Contents**

In this study, a fusion protein, cyclic arginine-glycine-aspartate (RGD)-HSA-TIMP2, formed by conjugating HSA-TIMP2 with a RGD peptide, and its 123I- and 68Ga-labeled compounds, were synthesized and evaluated with in vivo tumor imaging using single photon emission computed tomography (SPECT) and positron emission tomography (PET). The 123I-and68Ga-labeled fusion proteins were prepared and subsequently injected into the tail veins of mice bearing human glioblastoma cancer U87MG xenografts for SPECT and PET imaging and biodistribution studies. Tumor uptake of radioligand was high in both the PET images and in the biodistribution studies at 3 h after injection. These studies demonstrated that the new fusion protein has potential not only as an anticancer agent but also as a radioligand for the diagnosis of tumors.

#### >

#### Expectations

#### Images



KOREA BASIC SCIENCE INSTITUTE

Eun Kyoung Ryu (Corresponding author), Division of Magnetic Resonance Research

The use of the fusion protein RGD-HSA-TIMP2 as a tumor targeting imaging probe for SPECT and PET

Naeun Choi(1st Author), Sung Min Kim(KBSI), Kwan Soo Hong(KBSI), Gyunggoo Cho(KBSI), Jee Hyun Cho(KBSI), Chul Hyun Lee(KBSI), Eun Kyoung Ryu, KBSI

We anticipate that this radioligand will be applicable to diagnosis of tumor using PET or SPECT modalities and this result will be helpful to monitor biological event in vivo.

- 01 Scheme of fusion protein and identified with MALDI-TOF mass
- 02 micro PET or SPECT imaging or radioligand in tumor-bearing mice



# Development of MRI T1 contrast agent for diagnosis of liver tumoe lesions

Kwan Soo Hong (Corresponding author), Division of Magnetic Resonance Research



# Paper Title

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>

Uridine-based Paramagnetic Supramolecular Nanoaggregate with High Relaxivity Capable of Detecting Primitive Liver Tumor Lesions (IF : 7.883)

#### **Publication**

Biomaterials (2011, 09, 01)

#### Equipment

4.7 T Animal MRI

#### >

#### Joint Researchers

Sankarprasad Bhuniya(1st Author, Korea Univ.), Hye Young Moon(KBSI), Hyun Seung Lee(KBSI), Su Min Lee(Korea Univ.), Dae Yeul Yu(KRIBB), Jong Seung Kim(Korea Univ.)

#### >

#### **Research Contents**

Uridine nucleoside-based amphiphilic gadolinium complex as MRI T1 contrast agent for diagnosis of lever tumor lesions was synthesized. The highest relaxivities achieved were 30.3 and 23.4 mM-1s-1 at 60 and 200 MHz, respectively, about 6 times bigger than commercially available MRI T1 contrast agents. In vivo pharmacokinetics of the contrast agent showed highly specific for hepatocytes resulting in additional secretion pathway through gall bladder and intestine, and maximum image contrast about 2 hours after iv injection. With the liver-specific property of the contrast agent, small liver tumor lesions with size of ~1.5 mm could be detected in liver hepatocellular carcinoma (HCC) animal model.

#### >

#### **Expectations**

Early diagnosis of liver tumor lesions

#### Images



Representative Research Cases in 2011 08

Jee Yoon Jung, MD; Ho-Sub Lee, MD, PhD; Dae-Gill Kang, PhD;

metabolic profiling

#### > Paper Title

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**Publication** Stroke (2011. 5. 1)

Equipment 600 MHz LC-MS-NMR System

## >

## Joint Researchers

Jeeyoun Jung(KBSI), Ho Sub Lee(Wonkwang Univ.), Dae Gil Kang(Wonkwang Univ.), Nosoo Kim(KIOM), Minho Cha(KIOM), Oksun Bang(KIOM), Do Hyun Ryu(Sungkyunkwan Univ.), Geum Sook Hwang(KBSI)

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#### **Research Contents**

We used a 1H-NMR-based metabolomics approach in patients with cerebral infarction to identify potential biomarkers of stroke. Multivariate statistical analysis showed a significant separation between patients and healthy individuals. The plasma of stroke patients was characterized by the increased excretion of lactate, pyruvate, glycolate, formate, and by the decreased excretion of glutamine and methanol; the urine of stroke patients was characterized by decreased levels of citrate, hippurate, and glycine. These metabolites detected from plasma and urine of patients with cerebral infarction were associated with anaerobic glycolysis, folic acid deficiency, and hyperhomocysteinemia. We detected a clear separation in the metabolic profiling models of plasma and urine. Furthermore, in the plasma model, we were able to predict the presence of stroke with high accuracy.

#### >

#### Expectations

#### Images



# Development of diagnosis for cerebrla infarction using

Geum Sook Hwang (Corresponding author), Seoul Center

<sup>1</sup>H-NMR-Based Metabolomics Study of Cerebral Infarction (IF : 5.756)

The non-invasive approach of metabolic profiling with NMR spectroscopy can be used not only as a novel diagnostic technique, but also as a tool for monitoring progress in cerebral infarction.



# U-Pb age determination for the Mesozoic granitoids in Korean Peninsula

Jeong Min Kim (1st Author), Division of Earth and Environmental Science



# **Paper Title**

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>

Geochronological and geochemical constraints on the petrogenesis of Mesozoic high-K granitoids in the central Korean peninsula (IF : 5.503)

#### Publication

Gondwana Research (2011, 9, 1)

#### Equipment

Sensitive high resolution ion microprobe (SHRIMP), Thermal ionization mass spectrometer (TIMS)

#### >

#### Joint Researchers

Chang Sik Cheong (Corresponding author, KBSI), Keewook Yi (KBSI), Youn Joong Jeong (KBSI)

#### >

#### **Research Contents**

The precise zircon U-Pb ages and Sm-Nd isotopic data for granitoids from the Gyeonggi massif and Ogcheon folded belt in Korean peninsula are derived. Most granitoids intruded at 230-225 and 184-167 Ma. High alkaline content of Triassic samples implies a post-collisional signature.

#### >

#### **Expectations**

This result can provide new information on the crustal growth history of the Korean Peninsula during Mesozoic era.

#### Images



Representative **Research** Cases in

# Metabolite profiling of Mycobacterium tuberculosis

2011 10

Geum Sook Hwang (Corresponding author), Seoul Center



# Paper Title

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**Publication** Jounal of Proteome Research (2011. 5. 1)

#### Equipment 600 MHz LC-MS-NMR System

#### > **Joint Researchers**

Geum Sook Hwang(KBSI)

#### >

#### **Research Contents**

Tuberculosis (TB) is one of three major infectious diseases, and the control of TB is becoming more difficult because of the emergence of multidrug-resistant and extensively drug-resistant strains. In this study, we explored the 1H NMR based metabolomics of TB using an aerobic TB infection model. The precursors of membrane phospholipids, phosphocholine, and phosphoethanolamine, as well as glycolysis, amino acid metabolism, nucleotide metabolism, and the antioxidative stress response were altered based on the presence of MTB infection. This study suggests that NMR-based global metabolite profiling of organ tissues and serum could provide insight into the metabolic changes in host infected aerobically with virulent Mycobacterium tuberculosis.

#### >

#### Expectations

efficient diagnosis and treatment of TB.

#### Images



KOREA BASIC SCIENCE INSTITUTE

1H NMR-based Metabolomic Profiling in Mice Infected with Mycobacterium tuberculosis (IF : 5.46)

Ji Hyun Shin(1st Author, NIH), Ji Young Yang(1st Author, KBSI), Bo Young Jeon(1st Author, Yonsei Univ.), Yoo Jeong Yoon(KBSI), Sang Nae Chol Yonsei Univ.), YeonHo Kang(NIH), Do Hyun Ryu(Sungkyunkwan Univ.),

Metabolomics approach could provide a important information for host-pathogen interactions, as well as

- 01 1H NMR spectra of lung, spleen, and liver tissues and serum
- 02 Metabolic profiling of the 1H NMR spectra of tissue extracts obtained from naive control and MTB-infected mice



## Development of systematic large-scale membrane proteome technology

Jong Soon Choi (Corresponding Author), Division of Life Science



# Paper Title

>

Model for Membrane Organization and Protein Sorting in the Cyanobacterium Synechocystis sp. PCC6803 Inferred from Proteomics and Multivariate Sequence Analyses (IF : 5.46)

#### Publication

Journal of Proteome Research (2011, 8, 5)

### Equipment

7T LTQ-FT mass spectrometer

#### >

>

#### Joint Researchers

Tatiana Pisareva(Co-1st author, Stockholm Univ.), Birgitta Norling(Co-corresponding author, Stockholm Univ.), Ji Hyun Oh(KBSI), Soo Hyun Kim(KBSI), Changrong Ge(Stockholm Univ.), Ake Wieslander(Stockholm Univ.)

#### >

#### **Research Contents**

Cyanobacteria are unique eubacteria with an organized subcellular compartmentalization of highly differentiated internal thylakoid membranes (TM), in addition to the outer (OM) and plasma membranes (PM). This leads to a complicated system for transport and sorting of proteins into the different membranes and compartments. By newly designed shotgun proteomics of plasma and thylakoid membranes from the cyanobacterium Synechocystis sp. PCC6803, a large number of membrane proteins were identified. Proteins localized uniquely in each membrane were used as a platform describing a model for cellular membrane organization and protein intermembrane sorting and were analyzed by multivariate sequence analyses to trace potential differences in sequence properties important for insertion and sorting to the correct membrane.

#### >

#### Expectations

The newly developed shotgun membrane proteomics can be applicable to the retractable Gram-negative bacterial membrane proteomes as well as the animal cell membrane proteomes in the absence of cell wall.

#### Images



Representative **Research** Cases in 2011 12

# liquid chromatography-based proteomic research of membrane proteins



# Paper Title

Acinetobacter baumannii (IF : 5.46)

# **Publication**

# > Equipment

#### >

#### Joint Researchers

#### **Research Contents**

To investigate proteome regulation in A. baumannii under antibiotic stress conditions, guantitative membrane proteomic analyses of a clinical MDR A. baumannii strain cultured in subminimal inhibitory concentrations of tetracycline and imipenem were performed using a combination of label-free (1DE-LC-MS/MS) and label (iTRAQ) approaches. In total, 484 proteins were identified, and 302 were classified as outer membrane, periplasmic, or plasma membrane proteins. The induction of resistance-nodulation-cell division transporters and protein kinases, and the repression of outer membrane proteins were common responses in the presence of tetracycline and imipenem. Induction of a tetracycline resistant pump, ribosomal proteins, and ironuptake transporters appeared to be dependent on tetracycline conditions, whereas  $\beta$ -lactamase and penicillin-binding proteins appeared to be dependent on imipenem conditions.

>

#### Expectations

#### Images



Sung Ho Yun (1st Author), Division of Life Science

Quantitative Proteomic Analysis of Cell Wall and Plasma Membrane Fractions from Multidrug-Resistant

Jounal of Proteome Research(2011, 2, 4)

LC-MS/MS(LTQ-FT), Probot, MALDI-TOF/TOF(ABI 4700), Mascot

Chi Won Choi(KBSI), Sang Oh Kwon(KBSI), Gun Wook Park(KBSI), Kun Cho(KBSI), Kyung Hoon Kwon(KBSI), Jin Young Kim(KBSI), Jong Shin Yoo(KBSI), Je Chul Lee(KBSI), Jong Soon Choi(KBSI), Soo Hyun Kim(KBSI)

Combined liquid chromatography-based proteomic approaches can be used to identify and profile cell wall and membrane proteins involved in bacteria and cells

- **01** Analytical scheme for guantitative analysis of membrane-associatedprotein
- 02\_ Differential protein identification by label and label-free-proteomic methods



# Research Projects in 2011

# Main Projects

Title	Subtitle	Period	Principal Researcher	Research Funds (mill. won)
Enhancing Joint Utilization of Advanced Equipment	Analytical Services		Youngho Chung	5,677
Advancement of Large-scale Equipment				
Installation and Promotion of Research Facilities and Equipment				
	National Research Facilities & Equipment Center Operation Program			
Development of Advanced Analytical Equipment	Development of Ultra-precision Thermal Imaging Microscope (UPTIM)			
	Development of Compact Linear Heavy-ion Linear Accelerator using Superconducting Electron Cyclotron Resonance Ion Source			
	Title         Enhancing Joint Utilization of Advanced Equipment         Management and Technology         Advancement of Large-scale Equipment         Installation and Promotion of Research Facilities and Equipment         Development of Advanced Analytical Equipment         Strengthening Future Research Competence	Title         Subtitle           Enhancing Joint Utilization of Advanced Equipment         Analytical Services           Management and Technology Advancement of Large-scale Equipment         Operation of High Voltage Electron Microscope           Management of Large-scale Equipment         Operation of Magnetic Resonance Facility           Operation of Advanced Multipurpose Mass Spectrometers         Operation of Sensitive High Resolution Ion Microprobe           Installation and Promotion of Research Facilities and Equipment         Installation of Research Equipment for Degenerative Disease Research           Development of platform technology and construction of analytical instruments for Jusion science         National Research Equipment Center Operation Program           Joint utilization and Promotion of Research Facilities and Equipment         National Research Facilities & Equipment Center Operation Program           Joint utilization support of expensive special research equipment         Installation and Application of Human MRI Equipment           Development of Advanced Analytical Equipment         Development of Ultra-precision Thermal Imaging Microscope (UPTIMI Superonducting Electron Octoron Resonance Ion Source           Development of Advanced Analytical Equipment         Superonducting Electron Octoron Resonance Ion Source           Strengthening Future Research Competence         Strategic Research for Future	TitleSubtitlePeriodEnhancing Joint Utilization of Advanced Equipment and Technology Advanced Equipment and Technology Advanced Fulpionent Deration of Magnetic Resonance FacilityOperation of Magnetic Resonance FacilityManagement and Technology Advanced Fulpionent Large-scale EquipmentOperation of Advanced Multipurpose Mass Spectrometers Operation of Sensitive High Resolution Ion MicroprobeInstallation not Advanced Multipurpose Mass SpectrometersInstallation and Promotion of Research Facilities RequipmentInstallation of Research Equipment Establishment of Joint-Use Equipment for Degenerative Disease Research Installation and Application of Human MRI EquipmentJan 1, 2011 Development of utilization support of expensive special research equipmentInstallation and Application of Human MRI Equipment Installation and Application of Human MRI EquipmentDevelopment of Advanced Development of Uttra- precision Thermal Imaging Microscope (UPTIM)Development of Uttra- precision Thermal Imaging Microscope (UPTIM) Sperconducting Electron Octorina Research Facilitical System for Nanotechnology and Related ScienceDevelopment of Multi-disciptinary Insitu Analytical System for Nanotechnology and Related ScienceStrengthening Future Research CompetenceStrategic Research for Future CompetenceStrengthening Future Research CompetenceStrategic Research for Future CompetenceStrengthening Future Research CompetenceStrategic Research for Future CompetenceStrengthening Future Research CompetenceStrategic Research for Future CompetenceStrengthening Future Research Com	Title         Subtitle         Period         Period           Enhancing Joint Utilization of Advanced Equipment         Analytical Services         Youngho Chung           Operation of High Voltage Electron Microscope         Seckhoan Lee         Gunggoo Cho           Management and Technology Advancement of Large-scale Equipment         Operation of Magnetic Resonance Facility         Gunggoo Cho           Development         Operation of Magnetic Resonance Facility         Jungnin Kim           Large-scale Equipment         Operation of Sensitive High Resolution Ion Microprobe         Jungnin Kim           Promotion of Promotion of Pr

# In-house Projects

Category	Project Title	Principal Researcher	Period	Research Funds (mill. won)
	Development of platform technology for analysis of membrane proteins	Seungil Kim		1,110
	PET/MRI Fusion-Imaging Technology Targeted to Cancer Diseases			
- Strategic Research for				
Future -	Development of HTS Insert Coil Technology for High Field NMR			
- Seed type				
National Agenda Project 				
rontier Research				
			-	

Category	Project Title	Principal Researcher	Period	Research Funds (mill. won)
	Study on nano-crystalline Ru-based Ternary thin films by atomic layer deposition	Taeeun Hong		70
Support for Collaborations between KBSI and Universities				
	Study on ptorein SUMOylation in Tumor cell			
	Development of the state-of-art solid-NMR analysis package for the high-efficiency hydrogen storage media and the hydrogen-bonded ferro-electrics phase transition			
International Research Collaboration Project				
Support for Young Scientists				
	Fabrication of SERS active nanostructure and its application studies for low concentration analysis of protein			
- Support for Senior - Researcher -				

# Commissioned Projects

#### Project Title

IALDI-TOF for the diagnosis of BRCA mutation and genitourinary infec athogen
Development of Scientific Forensic Technologies Using Cutting-edge Hi ech Analytical Equipment
luman Biomonitoring of Heterocyclic amines
Development of National Research Facilities and Equipment Informa Dervice for Joint Utilization
Cell-chip-based bio-mimetic protein network express
Production and structure determination of the designed repeat proteins
nalysis of bio-active food on stress with fusion molecular imag echnology
Proteomic study of marine extremolphiles for screening of novel prote nd metabolic characterization
eochemical analysis and field survey of galena deposits from South Kore
imultaneous determination of nitrogen and oxygen isotopes in nitrate etermination of anthropogenic sources
ge dating and experimental development for Quaternary faults and mai errace sediments near nuclear power plant sites
evelopment of nanostructured materials for hydrogen storage
lechanism of oxidative stress in neurodegenerative disorders
he Support Program for the Advancement of National Research Facili nd Equipment
Development and synthesis of nano(rod,wire,bulk)-type photocatalysts hoto electrochemical reduction of water under visible light
he Development of Antifreezing Material using Glyco Peptoid-Pep ybride
evelopment of Mass Spectrometry-based Platform Technology Aolecular Diagnosis
Brain Elucidation and Intelligent IT Foundational Development thro Mathematical Decipherment of Brain Function

Principal Researcher	Period	Research Funds (mill. won)	Partner
Younjoong Kim	11. 1. 1 ~ 11.12.31		Korea Research Institute of Standard and science
Haekap Cheong			Korea Institute of Science and Technology
			Korea Ocean Research and Development Institute
Myoungtaek Hyun			
Haejin Kim	11. 4.1 ~ 12. 3.31	680	Hydrogen Energy R&D Center
Weonsik Chae	11. 5.1 ~ 12. 4.30		National Research Foundation of Korea
			Korea Institute of Geoscience and Mineral Resources
			Medical Instruments National Institute for Mathematical Science

Project Title	Principal Researcher	Period	Research Funds (mill. won)	Partner
Study of Structural Properties and Electron Transfer Mechanism in Organic/Inroganic Hybrid Device Interfaces				
Development of NMR based metabonomics/chemometrics for diagnosis and treatment of chronic kidney disease				
Improvement of neural induction from mesenchymal stem cells through combined omics analysis				
Development of Spin Device Measurement	Younghun Jo			Korea Advanced Institute of Science and Technology
Study on immune cell infiltration by in vivo MRI in animal autoimmune myocarditis				Korea Advanced Institute of Science and Technology
Multi-sensors for Heavy Metals and Pretreatment System of Refractory Organic Matrix				
Peptide nanoarchitecture: Paradigm shift in cancer therapeutics				Korea Environmental Industry and Technology Institute
Development of Organic-inorganic nanohybrid anode materials for high-power Li-ion battery				
Research of resistant material and cultural environment for plants using polyphenol metabolomics				
Clinical Development of Inflammatory Disease Therapeutic Biosimilar Antibody Enbrel				
Studies of regulatory mechanisms on the extracellular secretion of ARS cytokine				
Analysis of degradation mechanism and improvement of durability in PEMFC				
Diagnosis of myocarditis using magnetic nanoparticle contrast agent-based MRI				
Development of parallel RF coils for cardiac MR imaging	Chulhyun Lee			
				Korea Technology and Information Promotion Agency for Small and Medium Enterprise
				Korea Technology and Information Promotion Agency for Small and Medium Enterprise
Development of quantitative analysis for DNA immobilization and high performance DNA chip				Korea Technology and Information Promotion Agency for Small and Medium Enterprise
Development of new echo-friendly materials for funtional cosmetics using LC/NMR/MS				Korea Technology and Information Promotion Agency for Small and Medium Enterprise

# Installation, Upgrades of Advanced Research Equipment in 2011

	Equipment	Department
	7. MALDI-TOF-TOF MS	
Equipment Installed		
Equipment installed		
* Standard: installation fee over		
	21. UHV SPM system	

	1. Multi-Analytic Validation System	Division of Life Science
	2. Pre-Concentration system for IRMS	Division of Earth and Environmental Science
	3. EPMA Gas Channel	
	4. Internal Preamp and video output port kit	Division of Materials Science
	5. Nano SIMS Primary Column Upgrade	Busan Center
rformance - grades - andard: - grade fee over - nill. won -	6. Auto Microinjection System	Gwangju Center
	7. Trace Gas Pre-Concentration System	Division of Earth and Environmental Science
	8. Automatic Chip-based Nanoelectrospray Ionization System	Division of Mass Spectrometry Research
		Division of Life Science
	10. Conductive AFM System	Jeonju Center
	11. Automatic Fusion Machine	Division of Earth and Environmental Science
	13. ICCD Detector	Gwangju Center

Pe

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January 01 2011. 1. 13 2011 Workplace Security Education



011년도 창의연구사업 선정평가 공개발표회(3분

A strong nation in basic science! Korea Basic Science Institute leads Korea towards a world-class basic science nation















 01
 2011.2.
 9
 2011 Evaluation Session for '2011 Creative R&D Projects'

 02
 2011.2.
 10th Leadership Colloquium (Hyun Soon Lee, Vice President of Hyundai Motor Group)

KOREA BASIC SCIENCE INSTITUTE

012011.3. 29th KBSI Fabrica (Chang-Sik Cheong, Ochang Center Director)022011.3.11Arbor Day Ceremony at Ochang Center032011.3.16Meeting with TV reporters of Chungbuk area (Ochang Center)042011.3.17Visit by Vietnam IMBC-VAST delegation052011.3.18Visit by Yeo Pyo Yun, Chief Director of Osong Medical Innovation<br/>Foundation062011.3.21JDC-KBSI Agreement Ceremony072011.3.2910th KBSI Fabrica (Geon Hoi Kim, General Affairs Team)082011.3.312nd KBSI International Advisory Committee Meeting092011.3.31Visit by Sun-Uk Kim, President of Ewha Womans University

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저온 현상을 이용한 책에에







- 01 2011.4.7 Ochang Center Openning Ceremony
- 02 2011.4. 8 Awards Ceremony of the 'Annual Conference of Women in Science, Engineering and Technology
- 03 2011.4. 9 Participate in '2011 Spring Science Day'
- 04 2011. 4. 13 Participate in '2011 Spring Korean Physical Society Meeting'
- 05 2011. 4. 30 Participate in '2011 Science Family Festival'





Power of KBSI!



01 2011.6. 1 Visit by Kangil Choe, President of the Association of Korean-Canadian Scientists and Engineers 02 2011. 6. 22 Launching ceremony for NFEC mentoring program

# 05

- 01 2011.5. 6 Visit by Cha Dong Kim, Vice Minister of the National Science & Technology Commission 02 2011.5.12 Visit by Dongpil Min, Chairman of Korea Research Council of Fundamental Science & Technology 03 2011.5.19 KBSI 23rd Foundation Day Ceremony 04 2011.5.24 Appointment Ceremony of local centers' Heads 05 2011.5.24 Inauguration Ceremony of KBSI President





- Science Korea with KBSI



























- 01 2011.7.7 11th KBSI Fabrica (Yong Kyu Kim, )
- 02 2011.7.13 KBSI Leader Workshop
- 03 2011.7.15 KBSI-DGMIF(Daegu-Gyeongbuk Medical Innovation Foundation) Agreement Ceremony
- 04 2011. 7. 19 KBSI-Osong Medical Innovation Foundation Agreement Ceremony
- 05 2011.7.21 Visit by Yuseong District Office delegation
- 06 2011.7.22 Agreement ceremony with congress member Eun-hee Bae for the promotion of welfare, protection and ethical care of laboratory animals
- 07 2011.7.25 Daejeon Distinguished Scientist Award Ceremony (Dr. Zee-won Lee, Division of Life Science)
- 08 2011. 7. 27 Visit by Cheong-Won Cho, Chairman of Korea Scientists & Engineers Mutual-aid Association
- 09 2011. 7. 28 11th Leadership Colloquium (Si-jong Lee, Head of North Chungcheong Province)







- 02 2011.8.8 GRAST Korea-Germany Workshop
- 03 2011.8.10 Participate in '2011 Korea Science Festival'
- 04 2011.8.16 2011 Eulji Training
- 05 2011.8.18 Junior Doctor with congress member Sang Min Lee
- 06 2011, 8, 23 GRAST-US Agilent Technologies Carbohydrate Analysis Research Education Center Agreement Ceremony
- 07 2011.8.30 Auditor Sung Hee Yoon Appreciation Plaque Awarding Ceremony











Science Korea with KBSI





# September

- 01 2011.11.7 2011 Sexual harassment prevention education
- 02 2011. 11. 10 1st KBSI Imaging Equipment Education School
- 03 2011. 11. 30 12th Leadership Colloquium (Min Hwa Lee, Chairman of Korea Digital Hospital Export Agency)
- 04 2011.11.15~17 2011 International Symposium on Analytical Science & Technology





- - 01 2011.9. 5 2011 Innovative Technology Show President's Award (Dr. Geon Hee Kim, Division of Instrument Development)
  - 02 2011. 9. 15 Progress report meeting with Keon Kim, Chairman of Korea Research Council of Fundamental Science & Technology
  - 03 2011.9.14 Appointment Ceremony of Myeun Kwon as Director General of NFRI
  - 04 2011.9.29 Participate in '2011 Fall Korea Chemical Society Meeting'















- 01 2011. 10. 1 Participate in '2011 Cheongwon Organic Life Festival'
- 02 2011.10. 7 Evaluation session for '2011 Strategic Research for Future Projects'
- 03 2011.10. 8 Participate in '2011 Fall Science Day'
- 04 2011. 10. 13 Green Growth Recognition Award
- 05 2011. 10. 14 2011 Junior Doctor Awards Ceremony
- 06 2011. 10. 27 2011 Information security education
- 07 2011. 10. 21 12th KBSI Fabrica (Gi Hoon Park, R&D Policy Team)



December

#### Nobember





- 01 2011.12. 6 2011 Job training for new employees
- 02 2011. 12. 13 2011 Research ethics training
- 03 2011. 12. 20 Director Kyung Jae Lee, Division of Instrument Development, Appreciation Plaque Awarding Ceremony
- 04 2011. 12. 22 13th KBSI Fabrica (Dr. Keewook Yi, Division of Earth and Environmental Science)







# 2011 KBSI Researcher of the Year Interview

# "Challenging towards developing platform technology for drug development"

Soohyun Kim, PhD Division of Life Science

Every year the 'KBSI Researcher of the Year Award' is given to recognize the commitment of an employee who has made innovative and outstanding research achievements throughout the year. Dr. Soohyun Kim, a principal researcher in the Division of Life Science who has been carrying out the 'Pioneer Research Center for Protein Network Exploration (PRCPNE)' funded by Ministry of Education, Science and Technology, was presented the 'KBSI Researcher of the Year Award' for 2011.

#### **Q1.** How do you feel about receiving the 'KBSI Researcher of the Year Award'?

A First of all, I would like to extend my appreciation for the award and I believe this was given to award the entire research team who contributed to performing the research together. Rather than an evaluation of past achievements, I consider this award as an encouragement for the future, to make significant research achievements qualified for the 'KBSI Researcher of the Year Award'.

#### Q2. Could you describe what the PRCPNE funded by Ministry of Education, Science and Technology is?

A Contrary to other research projects, this project focuses on original technology development. We are focusing on protein interaction as a novel drug target. There is estimated to be about 10,000 expressed proteins in a cell of human body. Through interaction, proteins make cell signaling pathways which communicate each other. Therefore, since looking the whole signal network of a cell is required to identify the relevant drug target, technology to detect protein interaction faster and more accurate is required.

The PRCPNE is what carries out such research, which began in July 2010 to be completed by February 2016. Also, a total of 5.5 billion won, 1 billion won per year, is invested in this research project. Currently, Institut Pasteur Korea and Ulsan National Institute of Science & Technology are participating in the projects together with KBSI.

#### Q3. You have published many outstanding papers in the past year through the development of the CUPID system. Could you describe what the CUPID system is?

A 'CUPID' system is a breakthrough in that high fidelity, quick and easy detection of protein-protein interaction in living cells.

Identification of specific drug targets, compound screening and drug repositioning can be carried out more easily and quickly by applying this technology. , Credibility of the CUPID system is expected over 70%, while the existing method is less than 10%.

Drug repositioning is for example, applying aspirin which is an antipyretic (fever reducer), as a thrombolytic agent or applying a drug developed for growing hair as an impotency drug. Since numerous drugs were developed based on effect, discovering additional effects saves developmental costs and creates new market opportunities.



#### **Q4.** What are your future plans for research?

system in relation with the PRCPNE. real protein interaction.

The field of research which I especially would like to look into is kinase. Kinase family is an emerging drug target and it is known to have 518 different species in human. Currently, research and development to block the ATP pocket of kinase is being conducted. I would like to execute a new drug development targeting the protein interaction of kinase in the future.

#### **Q5.** What is most rewarding as a scientist? What are your major achievements?

**A** Although the field of natural sciences and engineering is recently avoided and scientists are said to be neglected in our society today, I think it makes my career as a scientist of 20 years worthwhile that I can speak favorably of becoming a scientist to my children and others around me.

If I had to choose a major achievement, it would have to be discovering research planning projects such as K-MeP and being devoted to research with young scientists.

From the view of a senior of this institute now in my mid-50s, I would like to advise the junior that if producing analytical results by utilizing high-cost state-of-the-art equipment was KBSI's ver 1.0 period, from now on progressive efforts is needed to develop into the ver 2.0 period of providing new outlooks to researchers by developing our own analytical methods and equipment.

A First of all, I plan to focus on developing a high-sensitivity and high-speed platform based on the CUPID

The existing methods use over-expressed proteins. By decreasing the expression level to about 100 to 1,000 times from the current one, that is similar to physiological condition of the human body, it is expected to find

Soo Hyun Kim, PhD Division of Life Science

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#### KBSI Annual Report 2011 Organizing Committee

Chairman Committee Members

With **KBS** 

Seok-Kwon Hong(Director of Division of R&D Cooperation) Gun-Hwa Kim(Division of Life Science) Jee-Hyun Cho(Division of Magnetic Resonance Research) Hwanuk Kim(Division of Electron Microscope Research) Jeong-Heon Choi(Division of Earth and Environmental Science) Seung Yong Kim(Division of Mass Spectrometry Research) Gaehang Lee(Division of Materials Science) Sun-Cheol Yang(Division of Instrument Development) Jong Bae Park(Jeonju Center) Dong-kyu Won(National Research Facilities & Equipment Center) Soo Yeon Kim(Division of Policy & Strategy, R&D Policy Team) Sung Yeon Kim(Division of R&D Cooperation, Public Relations Team)

Assistant Administration Jae-Yun Kang(Division of R&D Cooperation, Public Relations Team Leader)

#### 2011 KBSI Annual Report

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# **Contact** Information

# Daedeok Headquarters **Ochang Center** Seoul Center **Busan Center** High-tech function materials research **Daegu Center** Degenerative disease research GwangjuCenter TEL: +82-62-530-0890 FAX: +82-62-530-0519 Jeonju Center Biological imaging research Chuncheon Center Suncheon Center **Gangneung Center** Marine biology research Jeju Center TEL: +82-64-800-4921 FAX: +82-64-805-7800

Fusion biotechnology, Functional proteomics, Electron microscopy, Nanomaterials, High magnetic field physical property of materials, Development of research instruments KBSI Headquarters, Gwahangno 169-148, Yuseong-gu, Daejeon, Korea (305-333) | TEL: +82-42-865-3500 | FAX: +82-42-865-3404

Magnetic resonance, Magnetic resonance imaging, Mass spectrometry, Isotope research, Age determinating research TEL: +82-43-240-5022~5025 FAX: +82-43-240-5059

Metabolomics, Environmental analysis, Multidimensional laser spectroscopy TEL: +82-2-920-0700 FAX: +82-2-920-0708

Surface physical property research, High-tech materials & components research TEL: +82-51-974-6102 FAX: +82-51-974-6116

KBSI Busan Center, Busan National University, 30 Jangjeon-dong, Geumjeong-gu, Busan, Korea (609-735) TEL: +82-51-510-1902 FAX: +82-51-959-3405

KBSI Daegu Center, Kyungpook National University, 1370 Sangyeok-dong, Buk-gu, Daegu, Korea (702-701) TEL: +82-53-959-3404 FAX: +82-53-959-3405

KBSI Gwangju Center, Chonnam University, 77 Yongbong-ro, Buk-gu, Gwangju, Korea (500-757)

Nano structure analysis & characterization research KBSI Jeonju Center, Chonbuk National University Hospital, 634-18 Geumam-dong, Deokjin-gu, Jeonju-si, Jeollabuk-do, Korea (561-180) TEL: +82-63-270-4306 FAX: +82-63-270-4308

KBSI Chuncheon Center, Kangwon National University, 1 Kangwondaehak-gil, Chuncheon-si, Kangwon-do, Korea (200-701) TEL: +82-33-250-7275 FAX: +82-33-255-7273

TEL: +82-61-752-8154 FAX: +82-61-752-8156

TEL: +82-33-640-2896 FAX: +82-33-640-2895