

2022 ANNUAL REPORT

2022

ANNUAL  
REPORT



The First Mover in Environmental Sustainability

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KIST Europe





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Germany

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Global Cooperation Department,  
KIST Europe Forschungsgesellschaft mbH



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K I S T  
E U R O P E  
A N N U A L  
R E P O R T



## DIRECTOR'S GREETING

A pessimist sees the difficulty in every opportunity; an optimist sees the opportunity in every difficulty. - Winston Churchill

Dear Readers,

KIST Europe was established in Saarbrücken, Germany in 1996. With the support of the Korean government, KIST Europe has enjoyed nearly 26 years of successful operations accomplishing many great achievements and is performing its mission of facilitating joint research among high-tech R&D institutes throughout Korea and the EU. Such an outcome was possible because of our researchers and supporting staff - while they may hail from different cultural and ethnic backgrounds, they are united in their pursuit of excellence and their commitment to further enhancing their capabilities and expertise.

With this in mind, we are very pleased to present you this annual report summarizing our research activities and notable achievements for 2022. In this report, you will find affirmation of our specialized expertise in conducting open and innovative research, as well as detailed descriptions of the diverse forms of collaboration in which we participate.

Despite these past achievements, KIST Europe remains deeply committed to exploring potential new opportunities for cooperation. For research institutes seeking an experienced collaboration partner for joint research projects or industry organizations wishing to expand into the Korean or European markets, KIST Europe, which plays a key role in facilitating S&T cooperation between Korea and the EU, could be the ideal partner to realize that.

I wish to thank everyone who has consistently supported the work we do at KIST Europe. It is only through your efforts that our success has been possible. My particular gratitude goes out to the Saarland Government and Saarland University for always standing by our side. I hope that our partnership will only continue to strengthen over the years to come.

Lastly, I wish to express my heartfelt appreciation to the staff at KIST Europe for their hard work and valuable contributions. Their dedication is truly unparalleled. As KIST Europe turns 26, we look forward to the journey ahead, and to strengthening KIST Europe's solidarity as the only Korean government R&D institute in Europe.

Sincerely,

Dr. Soo Hyun Kim  
Director, KIST Europe

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# ●OUR PR●FILE









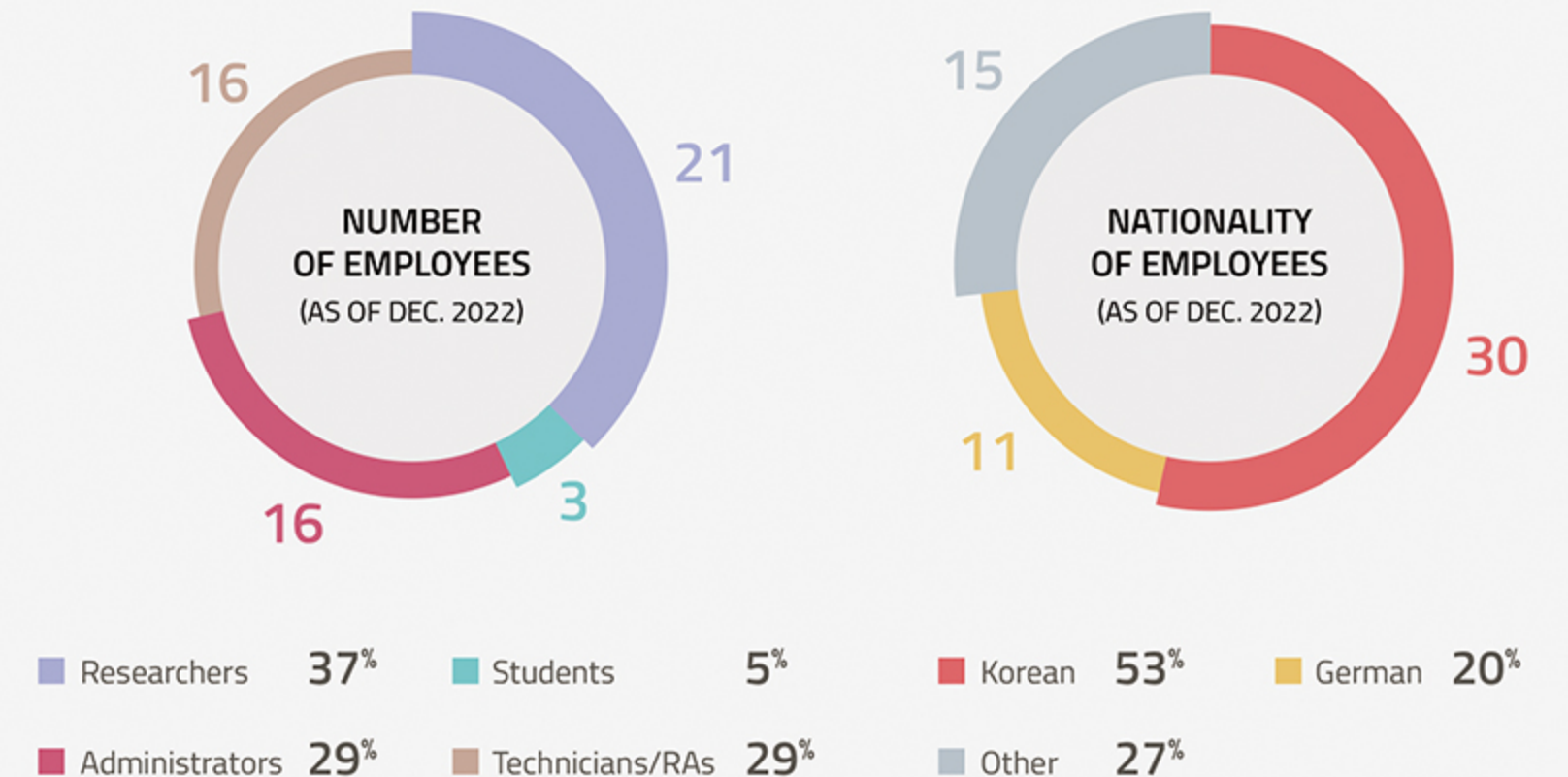
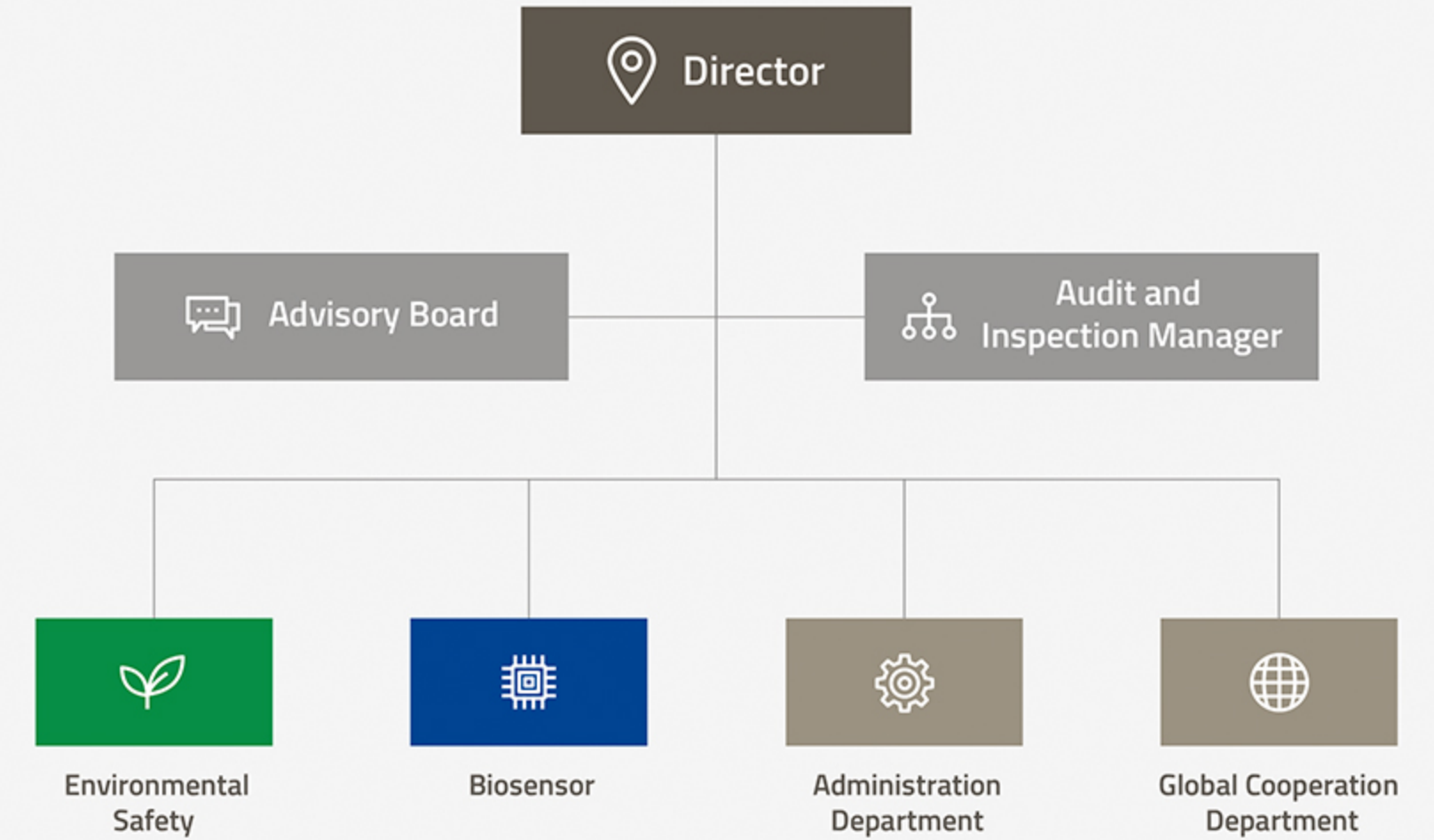
## HISTORY OF KIST EUROPE

1995.03	Official Visit by 14 <sup>th</sup> President of Korea KIM, Youngsam to Germany
1996.02	Foundation of KIST Europe
2004.04	Completion of 1st Building (4 stories, 5,275 m <sup>2</sup> )
2006.04	10 <sup>th</sup> Anniversary
2010.04	Completion of 2nd Building (3 stories, 2,069 m <sup>2</sup> )
2016.05	20 <sup>th</sup> Anniversary
2021.01	Inauguration of 9th Director (Dr. Soo Hyun Kim)
11	Opening of Guest House

## CONTACTS

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<p><b>Audit and Inspection Manager</b> <b>Mr. Tae Min Kim</b></p> <p>+49 (0) 681-9382-113 taemin.kim@kist-europe.de</p>	<p><b>Head of Administration</b> <b>Dr. Kyu Young Lee</b></p> <p>+49 (0) 681-9382-207 kylee@kist-europe.de</p>	<p><b>Head of Global Cooperation</b> <b>Dr. Jeongho Seo</b></p> <p>+49 (0) 681-9382-364 j.seo@kist-europe.de</p>

## ORGANIZATION & PEOPLE





## VISION & STRATEGIES

"KIST Europe, a specialized on-site institution leading the future of environmental research"

### Excellence

Respond to society's needs through excellence in research

- Strengthening environmental research capacity under Industry 4.0
- Expanding research areas through international joint R&D

### Support

Pursuing initiatives to support collaboration

- Establishing an on-site R&D base camp for collaboration with domestic institutions
- Expanding areas of service for domestic SMEs

### Governance

Emphasizing innovative governance

- Promoting the efficiency and advancement of administrative support functions
- Implementing integrated project management systems and processes

## ADVISORY BOARD



### German Members (as of December 2022)

#### Ms. Elena Yorgova-Ramanauskas

State Secretary and Chief Information Officer,  
Ministry of Economic Affairs, Innovation,  
Digital and Energy



#### Prof. Dr. Manfred Schmitt

President,  
University of Saarland



#### Prof. Dr. Andreas Schäffer

Director of Institute for  
Environmental Research,  
RWTH Aachen



#### Prof. Dr. Dr. Wolfgang Wahlster

Chief Executive Advisor,  
German Research Centre for  
Artificial Intelligence (DFKI)



#### Prof. Dr. Rolf Müller

Managing Director,  
Helmholtz Institute for Pharmaceutical  
Research Saarland (HIPS)



#### Dr. Gerold Heinrichs

Head of Department,  
European and International Cooperation,  
DLR-Projektträger



#### Prof. Dr. Jörg Wallaschek

Executive Director,  
Institute of Dynamics and Vibration Research,  
Leibniz Universität Hannover



### Korean Members (as of December 2022)

#### Dr. Seok-Jin Yoon (Chairman)

President,  
Korea Institute of Science and Technology



#### Mr. Seong Gyu Kim

Director General of the International  
Cooperation Bureau,  
Ministry of Science and ICT



#### Dr. Kil-choo Moon

Distinguished professor,  
Korea University



#### Dr. Kyung Hwan Na

Professor,  
Dankook University



#### Mr. Seok Young Jang

Chief Executive Officer,  
Kumyang Innovation Co., Ltd.





# OVERVIEW OF KIST HEADQUARTERS

## History

The Leading Contributor in Science and Technology in Korea

### 1960 ~ 1980s

- February 1966 KIST is founded
- January 1981 KIST and the Korea Advanced Institute of Science (KAIS) combine to form the Korea Advanced Institute of Science and Technology (KAIST)
- June 1989 KIST separates from KAIST and is reestablished

### 1990s

- February 1996 KIST Europe is established
- March 1999 KIST becomes affiliated with the Korea Research Council of Fundamental Science & Technology under the Office of the Prime Minister

### 2000s ~ Present

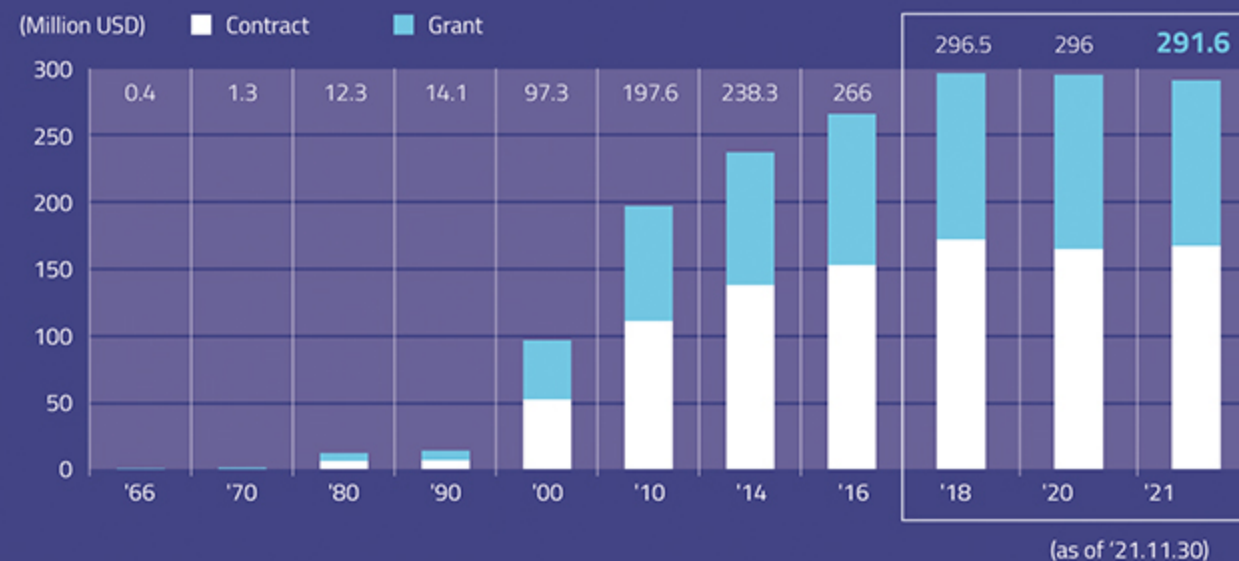
- May 2003 KIST Gangneung is established
- January 2008 KIST Jeonbuk is established
- July 2017 KIST becomes affiliated with the National Research Council of Science and Technology under the Ministry of Science and ICT
- July 2020 Dr. Seok-Jin Yoon is appointed President of KIST

## Personnel and Budget

### Research Staff

Regular Positions	Executives	Principal	Senior	Associate	Total
	1	-	-	-	1
	304	247	50	601	
	16	23	70	109	
	38	36	56	130	
	-	-	121	121	
Overall		359	306	297	962
Temporary Positions		Ph.D.	Master's	Bachelor's or below	Total
		386	207	155	748
Students		Ph.D.	Master's	Integrated	Total
		321	338	335	994
Total					2,704

### Budget



# OVERVIEW OF KIST HEADQUARTERS

## Location of Headquarters and Research Areas

### Headquarters – KIST Seoul

KIST was established in 1966 with the primary goals of developing creative, original, and cutting edge technologies improving Korea's scientific and technological capacities, and participating in the active transfer of these technologies. Initially, KIST focused on developing technologies suitable for industrialization, and these technologies contributed greatly to the modernization of Korea and fostered remarkable economic growth throughout the nation. Over the course of time, KIST has since gone on to produce many premier S&T talents and spin off numerous specialized research institutes. Such achievements cemented KIST's status as Korea's leading S&T institute. By applying its accumulated R&R expertise, KIST is now expanding its role and taking on large-scale, long-term interdisciplinary R&D projects which are typically considered too challenging for universities or private entities. KIST is continually striving to advance the field of science and technology, both domestically and internationally.



### Research Divisions



#### Brain Science

Brain mapping and diagnosis of brain diseases



#### Post-Silicon Semiconductors

Quantum computing / artificial neural chips



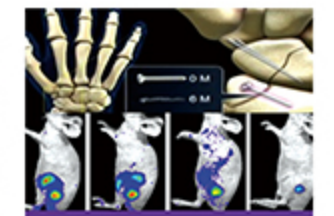
#### AI and Robotics

AR/VR, human communication robots, HRI (Human-Robot Interaction)



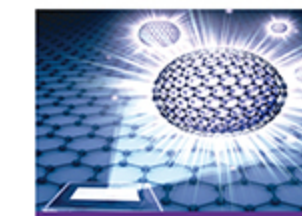
#### Climate & Environment

Water and clean air / environment, health and welfare



#### Biomedical

Customized treatment and rehabilitation



#### Advanced Materials

NT/BT-based materials and component technologies



#### Clean Energy

Renewable energy, carbon cycle and system convergence



#### The KIST Gangneung Institute of Natural Products

Bringing the world happiness through natural products!



#### The KIST Jeonbuk Institute of Advanced Composite Materials

Serving as a key player for composite materials technology in Korea



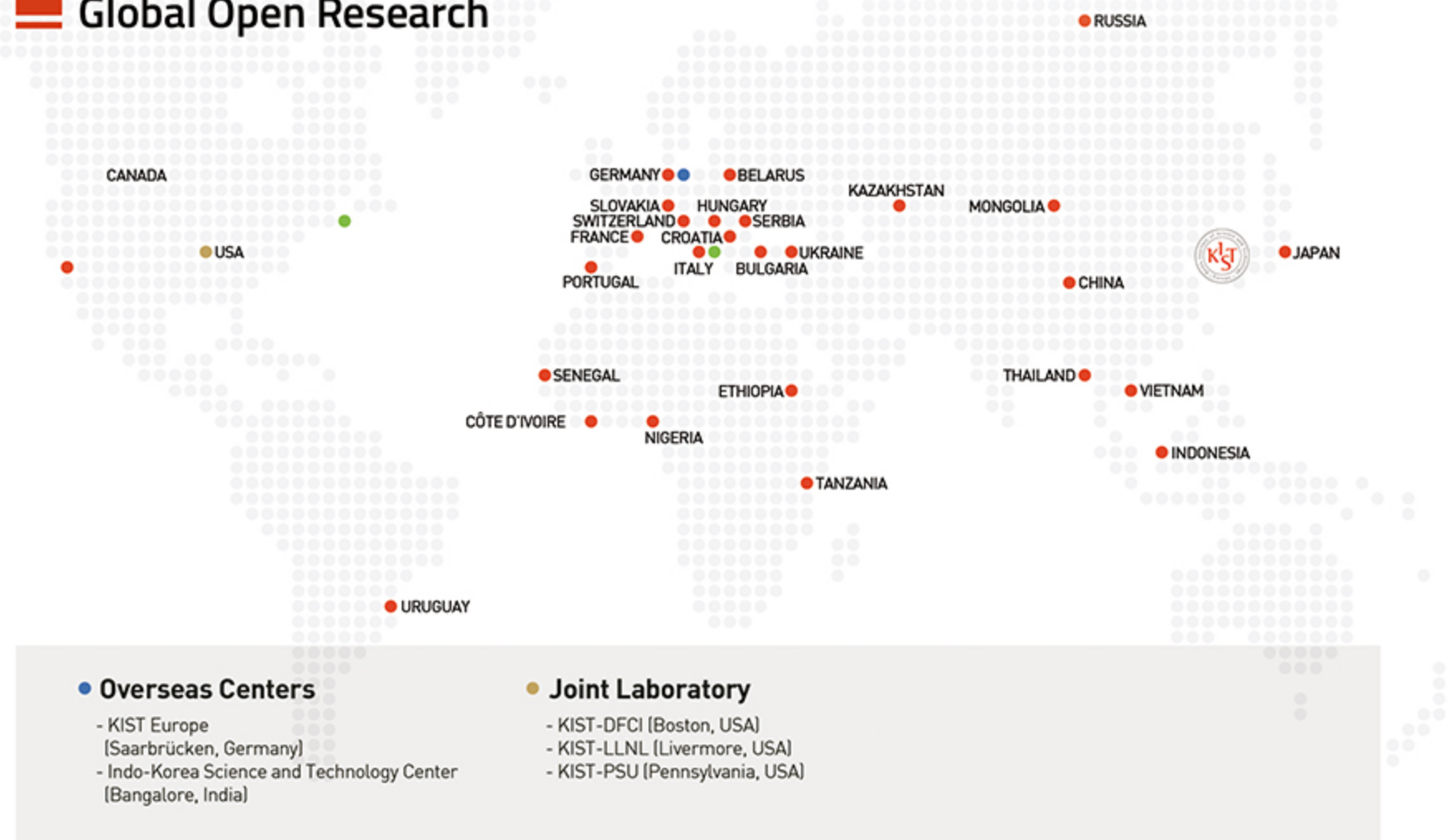
#### Research Resources

Doping control, advanced analysis, research animal resources



## KIST'S INTERNATIONAL COOPERATION ACTIVITIES

### Global Open Research



#### KIST Europe

Founded in Saarbrücken, Germany in 1996, KIST Europe is Korea's only government R&D institute in Europe. Since its inception, KIST Europe has exhibited sustainable growth as it pursues its goal of establishing a bridgehead for Korean R&D institutes and industries seeking opportunities to collaborate and make advances into Europe.



#### Indo-Korea Science and Technology Center

The Indo-Korea Science & Technology Center was established in Bangalore, India in 2020. Because India has emerged as an important world market, the center has contributed to building Korea's trade relations with India and has performed ICT convergence research (focusing on computational science) that takes advantage of India's rich potential in the science and technology field. The center has become the focal point in promoting scientific and technological exchanges between the two countries.



## KIST'S INTERNATIONAL COOPERATION ACTIVITIES

### Headquarters – KIST Seoul

#### Belarus

- National Academy of Sciences of Belarus (NAS of Belarus)

#### Bulgaria

- Bulgarian Academy of Sciences (BAS)

#### Canada

- Shanghai Academy of Science and Technology (SAST)
- University of British Columbia (UBC)

#### China

- Shanghai Academy of Science and Technology
- Shanghai Industrial Technology Institute (SITI)
- Science and Technology Department of Sichuan Province
- Shenzhen Institutes of Advanced Technology, Chinese Academy of Sciences (SIAT, CAS)

#### Croatia

- Ministry of Science and Education (MSE)
- University of Zagreb (UniZG)

#### Cote d'Ivoire

- Université Felix Houphouët-Boigny

#### Ethiopia

- Ministry of Science and Higher Education (MoSHE)

#### France

- University of Grenoble Alpes (UGA)
- Laboratoire d'Electronique et de Technologies de l'Information (LETI)
- Ecole Nationale Supérieure des Mines de Saint-Etienne (MINES Saint-Etienne)

#### Germany

- Technische Universität Berlin
- Fraunhofer-Gesellschaft (FhG)
- Karlsruhe Institute of Technology (KIT)
- Helmholtz Centre for Infection Research (HZI)

#### Hungary

- Eotvos Lorand University (ELTE)
- Budapest University of Technology and Economics (BME)

#### Indonesia

- Universitas Indonesia (UI)

#### Italy

- Institute for Advanced Energy Technologies (ITAE)

#### Japan

- Tohoku University
- Tokyo Institute of Technology

#### Kazakhstan

- JSC "Center for International Programs" (JSC "CIP")

#### Mongolia

- Mongolia Academy of Science (MAS)
- Mongolia National Olympic Committee (MNOC)
- Mongolian National Anti-Doping Agency (MONADA)
- National University of Mongolia (NUM)

#### Nigeria

- African University of Science and Technology (AUST)

#### Russia

- All-Russian Institute of Aviation Materials (VIAM), Academy of Technological Sciences of the Russian Federation
- Volgograd State Technical University
- M. V. Lomonosov Moscow State University
- Russian Academy of Sciences
- Kurchatov Institute

#### Senegal

- ACE-MITIC, University of Gaston Berger

#### Serbia

- University of Belgrade

#### Slovakia

- Comenius University in Bratislava

#### Switzerland

- Swiss Federal Laboratories for Materials Science and Technology (EMPA)

#### Tanzania

- Sokoine University of Agriculture

#### Thailand

- Asian Institute of Technology (AIT)

#### Ukraine

- Taras Shevchenko National University of Kyiv (TSNUK)
- Ministry of Education and Science of Ukraine (MON)
- UNDP
- United Nations Development Programme (UNDP)

#### USA

- Stony Brook University (SBU)
- Dana-Farber Cancer Laboratory (DFC)
- National Cancer Institute (NCI)
- Pennsylvania State University (Penn State / PSU)

#### Uruguay

- National Research and Innovation Agency

#### Vietnam

- The Ministry of Science and Technology of the Socialist Republic of Vietnam (MOST)
- Institute of Science and Technology (VKIST)
- Academy of Science and Technology (VAST)
- National University of Agriculture (VNUA)

#### World Bank

- Partnership for Skills in Applied Sciences, Engineering and Technology



#### VKIST

VKIST is a new public science and technology agency affiliated with Vietnam's Ministry of Science and Technology (MOST). It was established through a joint ODA project between the Vietnamese and Korean governments following the signing of a Presidential Agreement on September 9th, 2013. VKIST makes use of a specialized financial mechanism to attract professional scientists from both Vietnam and abroad to carry out their research activities at the institute. Going forward, VKIST will serve as a multi-disciplinary scientific research institute with internationally certified researchers. The state-run institute is also equipped with modern infrastructure and research equipment, and will have a self-regulatory mechanism in place as well.



#### KIST-DFCI On-Site-Lab

To create a synergistic effect through mutual cooperation in the area of cancer biology, KIST and the Dana-Farber Cancer Institute, a major affiliate of Harvard Medical School, signed an MOU to promote joint research in cancer biology in 2013.

In accordance with this agreement, subsequent measures have included various joint cancer research projects and the establishment of a lab at Dana-Farber Cancer Institute operated by KIST.





## INFRASTRUCTURE

Office Space **64** rooms **11** conference & meeting rooms

Parking for **40~50** vehicles

Guest House

Technical Center

2<sup>nd</sup> Building  
(Korea-EU Cooperation Center)

1<sup>st</sup> Building

## RESEARCH FACILITIES

### Laboratory Areas

**20** labs  
GVO-1, Biosafety Levels 1 & 2

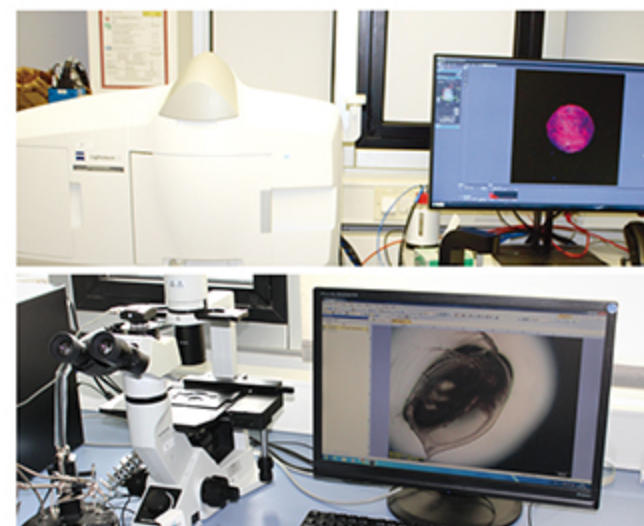
**20** work rooms

**3** dark rooms

**1** Technical room

### Specialties

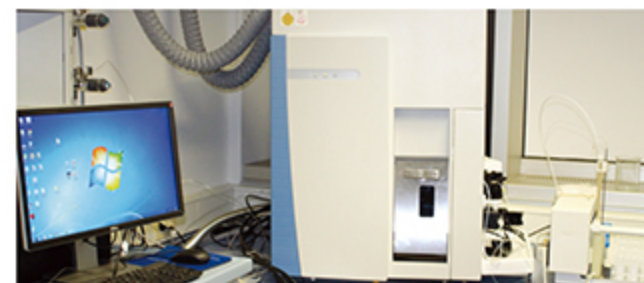
Microscopy



Microfabrication



Mass Spectrometry





# - GUEST HOUSE FACILITIES -

## Single room

1 bed, drawers, closet with hangers, desk, kitchen with induction range, shower



15 single rooms (17m²)



11 single rooms (22m²)



1 single room for disabled guests (24m²)



## Family room

2 beds, drawers, closet with hangers, desk, kitchen with induction range, shower, dining table, TV, sofa, balcony table, dishwasher, microwave



2 family rooms (44m²)



2 family rooms (60m²)



# - GUEST HOUSE FACILITIES -

## Common Facilities



Lobby



Laundry Room



Elevator



## Contact

Mr. Holger Krause

✉ [guesthouse@kist-europe.de](mailto:guesthouse@kist-europe.de)

☎ +49 (0) 681-2106-8290

📱 +49 (0) 170-5538-259

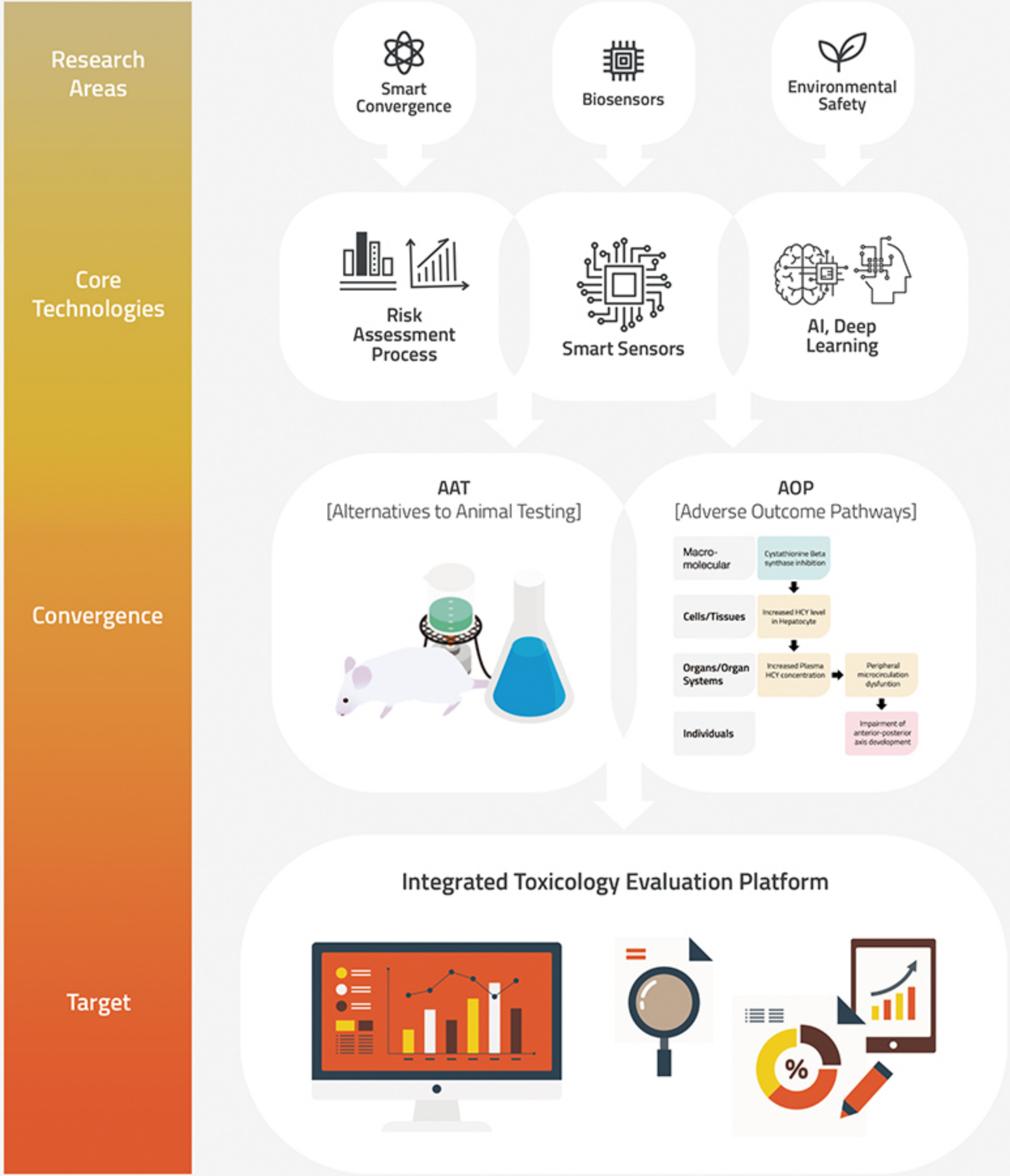


RESE▲RCH  
WITH P▲SSION●





Basic concept for AOP development and toxicology evaluation platform



17 AOPs developed, 11 adopted by OECD (9 pertaining to COVID-19)

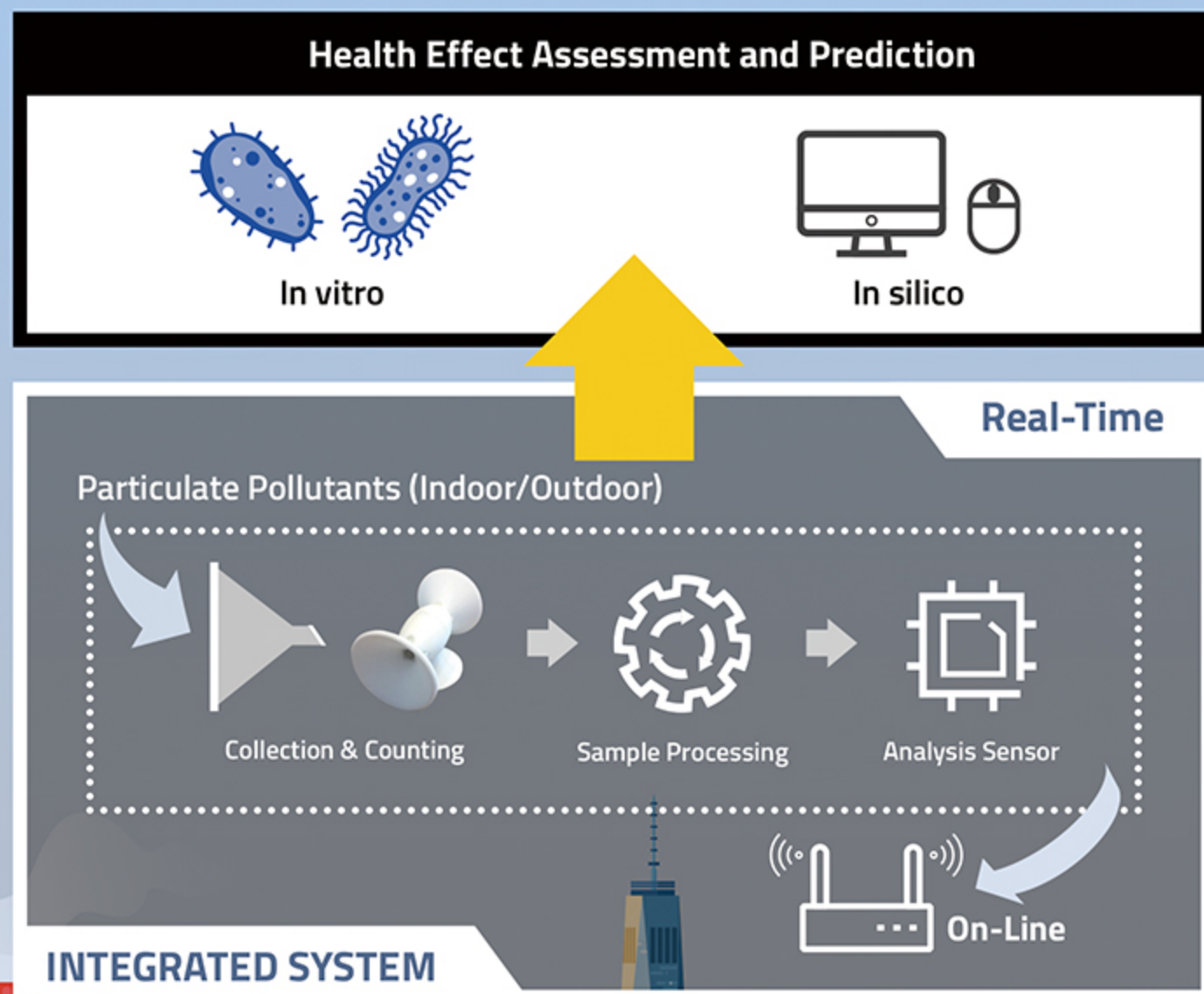
- Expansion of own research capacities including COVID-19 research themes
- 2022 (2) : Own Capacities and joint development with U.S. EPA
- 2021 (4) : Own capacities      2020 (4) : Own capacities      2019 (5) : Own capacities
- 2018 (1) : Joint development with Korea Institute of Toxicology

AOP No.	OECD PJT ID	AOP Title	Status	Ref.	Reg. Year
271	1.59	TPO inhibition leading to impaired fertility in fish: Inhibition of thyroid peroxidase leading to impaired fertility in fish	Coaching	+KIT	2018
289	1.81	Inhibition of 5 $\alpha$ -reductase leading to impaired fertility in female fish	Coaching	KIST Europe	2019
292	1.78	Inhibition of tyrosinase leads to decreased population in fish	Coaching	KIST Europe	
297	1.77	Inhibition of retinaldehyde dehydrogenase leads to population decline	Coaching	KIST Europe	
301	-	Inhibition of Cystathionine Beta synthase leading to impaired early development of anterior-posterior axis	Under Development	KIST Europe	
309	-	Luteinizing hormone receptor antagonism leading to reproductive dysfunction	Under Development	KIST Europe	
319	1.96	ACE2 antagonism leading to lung fibrosis	Coaching	CIAO[COVID-19]	2020
320	1.96	Binding of viral S-glycoprotein to ACE2 receptor leading to acute respiratory distress associated mortality	Coaching	CIAO[COVID-19]	
348	1.93	Inhibition of 11 $\beta$ -HSD leading to impaired spermatogenesis in fish	Under Development	KIST Europe	
349	1.93	Inhibition of 11 $\beta$ -hydroxylase leading to infertility in male fish	Under Development	KIST Europe	
379	1.96	Increased susceptibility to viral entry and coronavirus production leading to thrombosis and disseminated intravascular coagulation	Coaching	+ NISH [COVID-19]	
381	-	Binding of viral S-glycoprotein to ACE2 receptor leading to dysgeusia	Under Development	KE[COVID-19]	2021
382	-	Angiotensin II type 1 receptor (AT1R) agonism leading to lung fibrosis	Coaching	KE[COVID-19]	
383	-	Inhibition of Angiotensin-converting enzyme 2 leading to liver fibrosis	Under Development	KE[COVID-19]	
384	-	Hyperactivation of ACE/Ang-II/AT1R axis leading to chronic kidney disease	Under Development	KE[COVID-19]	
385	1.96	ACE2 binding to viral S-protein leading to microvascular dysfunction via ACE2 dysregulation	Coaching	CIAO[COVID-19]	2022
430	1.96	Binding of SARS-CoV-2 to ACE2 leads to viral infection proliferation	Coaching	+EPA[COVID-19]	



Basic concept and target of project

## INTERNET OF AIR QUALITY



Advanced real-time risk assessment of airborne anthropogenic particles (from 2022)







Dr. Young Jun KIM

Group Leader  
youngjunkim@kist-europe.de



## Objectives

The Environmental Safety Group contributes to the protection of human health and the environment from hazardous chemicals and mixtures containing these chemicals.

This group also contributes to enhancing the national competitiveness of the chemical industry by ensuring high safety standards for products.

## R&D Areas

### Alternative Toxicity & Ecotoxicity Assessments

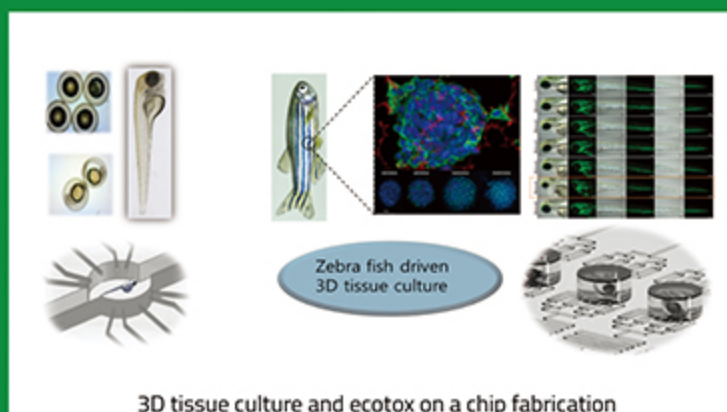
- 3D tissue mimicry for high-throughput toxicity screening
- Development of Alternatives to Animal Testing (AAT) systems for chronic toxicity screening
- Development of environmental risk assessment tools and modelling methodologies

### Mathematical Biology & Computational Toxicology

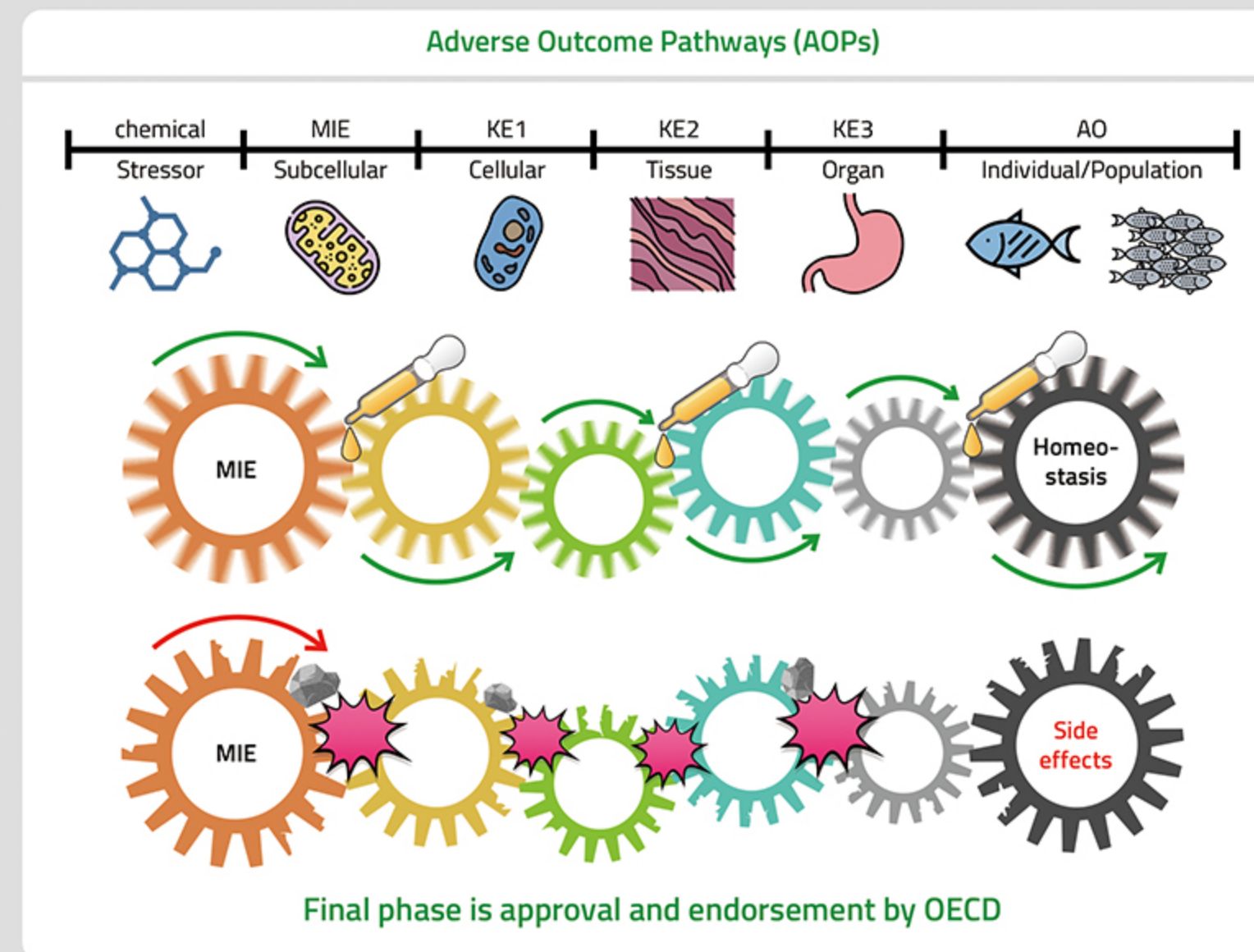
- Development of analytical models for mechanism-based toxicity prediction
- Quantitative in silico approach for ecotoxicity screening
- ADMET/QSAR modelling and industrial applications

### Development of Metabolomics and their Application to Biomarker Discovery

- Targeted/pseudo-targeted metabolomics of chemicals
- Metabolite identification and reaction phenotypes



## Basic concept for AOP development and toxicology evaluation platform



## AOP Development Process

TGs/GDs published by OECD  
i.e. First skin sensitization AOP implemented into OECD Toolbox

Regulatory conclusion	Once an AOP is endorsed by the WINT/TFHA, it is considered adopted by the OECD for the development of Guidance Documents.
WoE assessment	Once the AOP has successfully passed the EAGMST review, it is handed over for external review to experts nominated by the WINT and the TFHA.
Information generation	Once an AOP is considered mature enough by its authors, it can undergo an internal review by members of the EAGMST.
Problem formulation	AOPs in the lowest tier can, but do not have to, go through the EAGMST procedure to get onto the OECD work program.



## Journals

Cho, H., Choi, I., Kim, S. K., Baik, S., & Ryu, C. S. (2022). LC-MS-based assay of granisetron 7-hydroxylation activity for the evaluation of CYP1A1 induction from diesel particulate matter-exposed hepatic and respiratory cell lines. *Food and Chemical Toxicology*, 161, 112829. Web of Science Core Collection: SCIE 2022 JIF: 6.025

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Park, J., Park, C., Lee, Y., Ryu, C., Park, J., & Kim, Y. (2022). Acute adverse effects of metallic nanomaterials on cardiac and behavioral changes in *Daphnia magna*. *Environments*, 9(2), 26. Web of Science Core Collection: ESCI 2022 JIF: -

Park, C. G., Ryu, C. S., Sung, B., Manz, A., Kong, H., & Kim, Y. J. (2022). Transcriptomic and physiological analysis of endocrine disrupting chemicals Impacts on 3D Zebrafish liver cell culture system. *Aquatic Toxicology*, 245, 106105. Web of Science Core Collection: SCIE 2022 JIF: 4.964

Jun, I., Li, N., Shin, J., Park, J., Kim, Y. J., Jeon, H., ... & Song, J. J. (2022). Synergistic stimulation of surface topography and biphasic electric current promotes muscle regeneration. *Bioactive Materials*, 11, 118-129. Web of Science Core Collection: SCIE 2022 JIF: 14.593

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Çetin, T., Samadi, A., Reçber, T., Dinçer, A. K., Eser, B., Yalcinkaya, A., ... & Sabuncuoğlu, S. (2022). Possible Effect of Chelation Treatment on Metabolomic and Lipidomic Analysis in Lead Exposure. *Journal of occupational and environmental medicine*, 64(5), e284-e290. Web of Science Core Collection: SCIE 2022 JIF: 2,162

Tanabe, S., Beaton, D., Chauhan, V., Choi, I., Danielsen, P., Delrue, N., ... & Yauk, C. (2022, April). Report of the 1st and 2nd Mystery of Reactive Oxygen Species Conferences. In *Altex: alternatives to animal experimentation*. Web of Science Core Collection: SCIE 2022 JIF: 6.043

Sullivan, K. M., Ko, E., Kim, E. M., Ballance, W. C., Ito, J. D., Chalifoux, M., ... & Kong, H. (2022). Extracellular microenvironmental control for organoid assembly. *Tissue Engineering Part B: Reviews*, 28(6), 1209-1222. Web of Science Core Collection: SCIE 2022 JIF: 6.389

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Park, C. G., Jun, I., Lee, S., Ryu, C. S., Lee, S. A., Park, J., ... & Kim, Y. J. (2022). Integration of Bioinspired Fibrous Strands with 3D Spheroids for Environmental Hazard Monitoring. *Small*, 18(22), 2200757. Web of Science Core Collection: SCIE 2022 JIF: 13.281

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Froment, J. (2022, May 15-19). Why Is the Air Toxic? Virtual Effect-Directed Analysis (vEDA) to Identify Human Health Hazards in [Conference presentation]. SETAC Europe 32nd Annual Meeting, Copenhagen, Denmark.

Lee, S. A. (2022, June 30-July 2). Growth-acceleration of *Haematococcus lacustris* by indigenous key-role bacteria identified from the algal phycosphere [Conference presentation]. The 2nd FEMS Conference on Microbiology, Belgrade, Serbia.

Yoon, J. (2022, July 18-22). AI-based computer vision for phenotypic screening [Conference presentation]. Europe-Korea Conference on Science and Technology (EKC) 2022, Marseille, France.

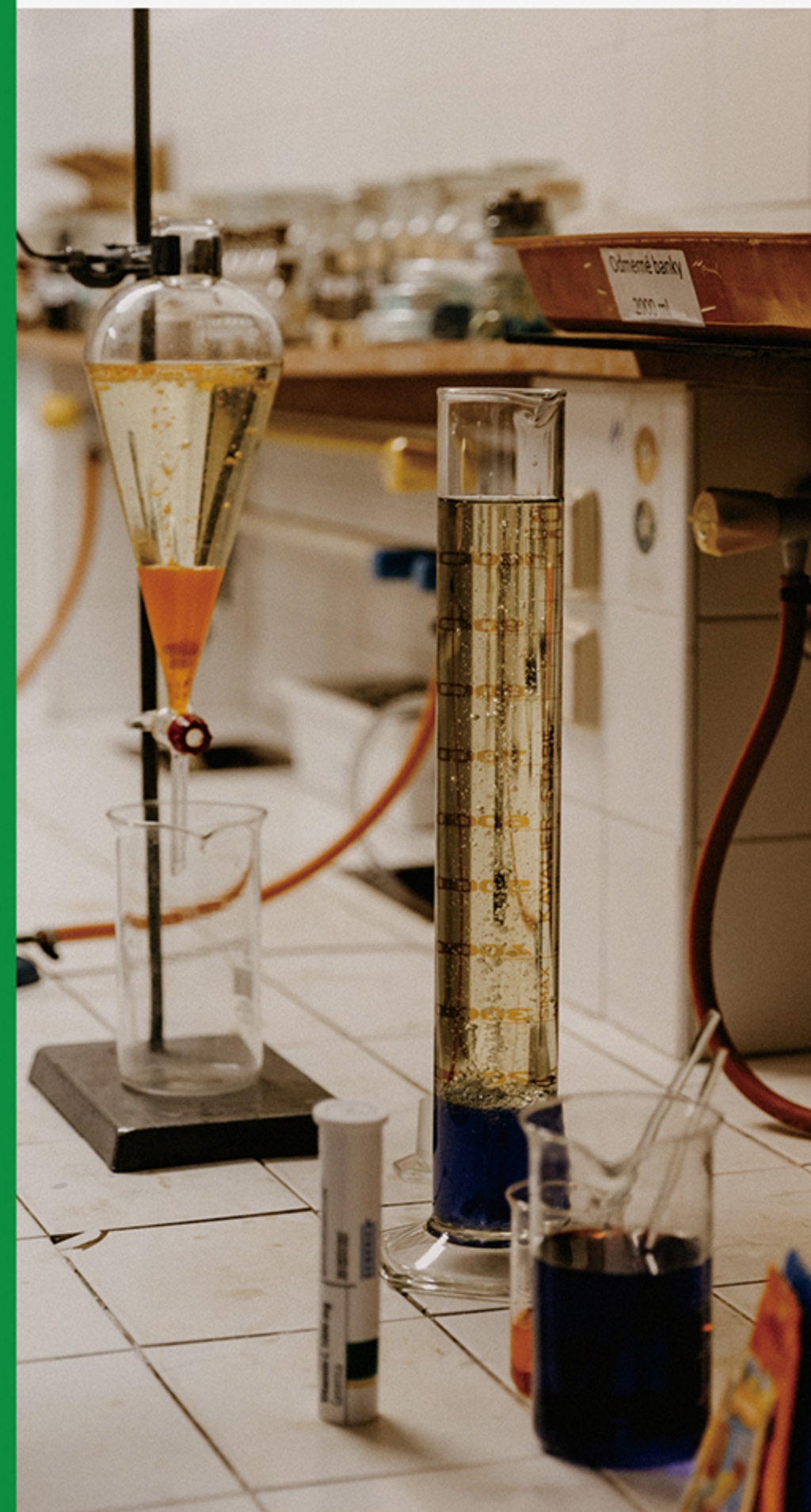
## Poster Presentations

Cho, H., Choi, I., Kim, S.K., Baik, S., & Ryu, C.S. (2022, April 21-22). Granisetron 7-hydroxylation assay for CYP1A1 induction in hepatic and respiratory cell [Poster session]. 2022 Spring International Convention of The Pharmaceutical Society of Korea, Cheongju-si, Korea.

Kim, Y. (2022, July 18-22). Physiological and Behavioral Effects of SiO<sub>2</sub> Nanoparticle In-gestion on *Daphnia magna* [Poster session]. Europe-Korea Conference on Science and Technology (EKC) 2022, Marseille, France.

Cho, H., Ryu, C., Lee, S., Kim, Y., & Kim, Y. (2022, July 18-22). Reproductive toxicity study of para-phenylphenol on *Daphnia magna* [Poster session]. Europe-Korea Conference on Science and Technology (EKC) 2022, Marseille, France

Sung, S., & Kim, Y. (2022, July 18-22). Synthetic RIG-I ligands that are effective to trigger antiviral and antitumor effects [Poster session]. Europe-Korea Conference on Science and Technology (EKC) 2022, Marseille, France







## Transcriptomic and physiological analysis of endocrine disrupting chemicals Impacts on 3D Zebrafish liver cell culture system

Chang Gyun Park <sup>a,c,1</sup>, Chang Seon Ryu <sup>a,1</sup>, Baekkyoung Sung <sup>a,b</sup>, Andreas Manz <sup>a,c</sup>, Hyunjoon Kong <sup>d</sup>, Young Jun Kim <sup>a,b</sup>

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### Abstract

In recent decades, extensive efforts have focused on developing in vitro platforms mimicking fish livers to better understand the acute or chronic effects of toxicants on lower aquatic vertebrates. Fish liver cell lines have emerged as a promising culture system for these in vitro platforms because they complement the currently limited in vitro tools that mostly consist of mammalian cell lines and adhere to the 3Rs: replacement, reduction, and refinement of living animal tests. However, monolayer cell lines have lower transcriptional and physiological responses upon exposure to toxic chemicals than freshly isolated primary cells. To overcome this challenge, we utilized a three-dimensional (3D) spheroid-based in vitro platform, in which hepatocyte cells had self-organized into spheroid forms via E-cadherin bonds. This platform exhibited augmented transcriptomic and phenotypic regulation of liver cells in comparison to monolayer cells. We examined the organoid platform using the zebrafish liver (ZFL) cell line as a model system. ZFL cells spontaneously clustered into 3D spheroids with long-term viability by optimizing cell seeding density on a non-adherent substrate. Interestingly, 3D ZFL spheroids treated with estrogenic chemicals were activated to synthesize a higher level of vitellogenin (Vtg) than monolayer cells. Whole-transcriptome sequencing analysis confirmed that 3D ZFL spheroids had greater transcriptional regulation of genes related to reproductive toxicological response and liver functions, such as the urea cycle, estrogen receptors, and vitellogenin, compared to monolayer cells. These results may contribute to the engineering of novel 3D in vitro platforms for screening harmful chemicals and improving understanding of the underlying liver toxicity mechanisms at the molecular and cellular levels.

Reprinted from Aquatic Toxicology, 245, Chang Gyun Park, Chang Seon Ryu, Baekkyoung Sung, Andreas Manz, Hyunjoon Kong, Young Jun Kim, Transcriptomic and physiological analysis of endocrine disrupting chemicals Impacts on 3D Zebrafish liver cell culture system, 106105, Copyright (2023), with permission from Elsevier.



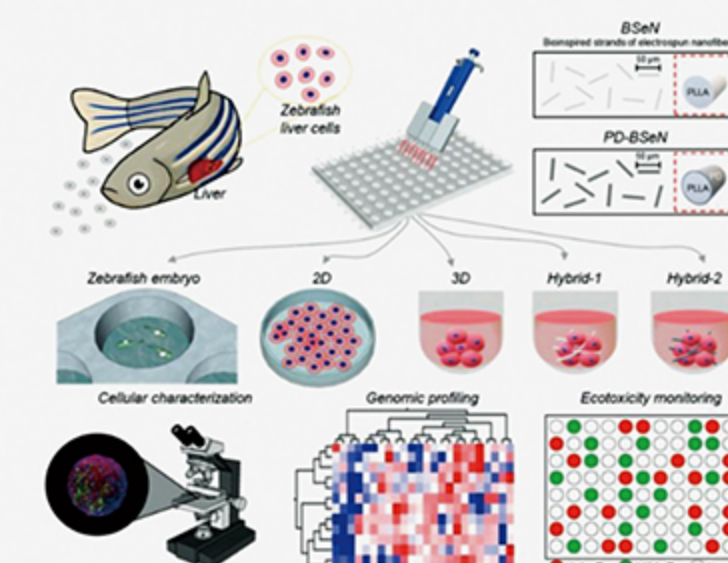
## Integration of Bioinspired Fibrous Strands with 3D Spheroids for Environmental Hazard Monitoring

Chang Gyun Park, Indong Jun, Sangmin Lee, Chang Seon Ryu, Sang-Ah Lee, Jaeho Park, Hyung-Seop Han, Honghyun Park, Andreas Manz, Heungsoo Shin, Young Jun Kim

### Abstract

Numerous methods have been introduced to produce 3D cell cultures that can reduce the need for animal experimentation. This study presents a unique 3D culture platform that features bioinspired strands of electrospun nanofibers (BSeNs) and aquatic cell lines to compensate for shortcomings in the current cell spheroid generation techniques. The use of BSeNs in 3D zebrafish liver cell cultures is found to improve liver and reproductive functions through spheroid-based in vitro assays such as whole transcriptome sequencing and reproductive toxicity testing, with optimized properties exhibiting results similar to those obtained for fish embryo acute toxicity (FET, OECD TG 236) following exposure to environmental endocrine-disrupting chemicals ( $17\beta$ -Estradiol (E2), 4-hydroxytamoxifen (4-HT), and bisphenol compounds (bisphenol A (BPA) and 9,9-Bis(4-hydroxyphenyl)fluorene (BPFL)).

These findings indicate that the beneficial effects of bioinspired materials that closely mimic ECM environments can yield efficient zebrafish cells with intrinsic functions and xenobiotic metabolism similar to those of zebrafish embryos. As a closer analog for the in vivo conditions that are associated with exposure to potentially hazardous chemicals, the straightforward culture model introduced in this study shows promise as an alternative tool that can be used to further eco-environmental assessment.



Park, C. G., Jun, I., Lee, S., Ryu, C. S., Lee, S. A., Park, J. H., Han, H. S., Park, H. H., Manz, A., Shin, H. S. & Kim, Y. J. (2022). Integration of Bioinspired Fibrous Strands with 3D Spheroids for Environmental Hazard Monitoring. Small, 18(22), 2200757 © 2023 John Wiley & Sons, Inc.





## Species Differences in Response to Binding Interactions of Bisphenol A and its Analogs with the Modeled Estrogen Receptor 1 and In Vitro Reporter Gene Assay in Human and Zebrafish

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<sup>2</sup> Universität des Saarlandes, Saarbrücken, Germany.

<sup>3</sup> Ecosystems and Environment Research Programme, Faculty of Biological and Environmental

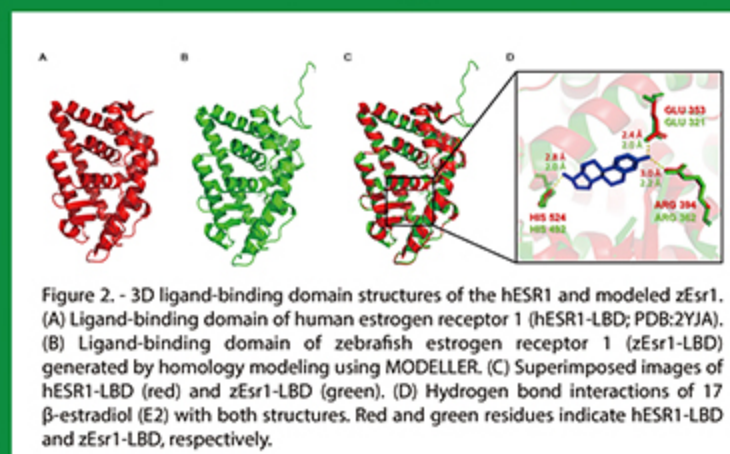
Sciences, University of Helsinki, Lahti, Finland.

<sup>4</sup> Helsinki Institute of Sustainability Science, Fabianinkatu, Helsinki, Finland.

### Abstract

Adverse impacts associated with the interactions of numerous endocrine-disruptor chemicals (EDCs) with estrogen receptor 1 play a pivotal role in reproductive dysfunction. The predictive studies on these interactions thus are crucial in the risk assessment of EDCs but rely heavily on the accuracy of specific protein structure in three dimensions. As the three-dimensional (3D) structure of zebrafish estrogen receptor 1 (zEsrl) is not available, the 3D structure of zEsrl ligand-binding domain (zEsrl-LBD) was generated using MODELLER and its quality was assessed by the PROCHECK, ERRAT, ProSA, and Verify-3D tools. After the generated model was verified as reliable, bisphenol A and its analogs were docked on the zEsrl-LBD and human estrogen receptor 1 ligand-binding domain (hESR1-LBD) using the Discovery Studio and Autodock Vina programs. The molecular dynamics followed by molecular docking were simulated using the Nanoscale Molecular Dynamics program and compared to those of the in vitro reporter gene assays. Some chemicals were bound with an orientation similar to that of 17 $\beta$ -estradiol in both models and in silico binding energies showed moderate or high correlations with in vitro results ( $0.33 \leq r^2 \leq 0.71$ ).

Notably, hydrogen bond occupancy during molecular dynamics simulations exhibited a high correlation with in vitro results ( $r^2 \geq 0.81$ ) in both complexes. These results show that the combined in silico and in vitro approaches is a valuable tool for identifying EDCs in different species, facilitating the assessment of EDC-induced reproductive toxicity.



Open Research from Park CG, Singh N, Ryu CS, Yoon JY, Esterhuizen M, Kim YJ. Species Differences in Response to Binding Interactions of Bisphenol A and its Analogs with the Modeled Estrogen Receptor 1 and In Vitro Reporter Gene Assay in Human and Zebrafish. Environ Toxicol Chem. 2022 Oct;41(10):2431-2443 with permission from SATAC (2023)

Getting partnership as Joint research organization for COVID-19 AOP

Project Name : CIAO



Modelling the Pathogenesis of COVID-19  
Using the Adverse Outcome Pathway Framework

Brief introduction

The CIAO project will help to make sense of the disparate information sources on COVID-19 pathogenesis by exploiting a well-established knowledge sharing framework. Knowledge from different disciplines and specialists will be consolidated in a way that is understandable and actionable by relevant stakeholders (e.g. medical professionals, public health officials and policy makers, managers in the healthcare sector, etc.). Moreover, this mechanistic knowledge will be used to develop an understanding of the biological modulating factors that determine different clinical outcomes and will be exploited to develop mathematical models that simulate the pathogenesis and health impact of COVID-19.

In regulatory toxicology, an Adverse Outcome Pathway (AOP) is a conceptual construct that portrays existing knowledge concerning the linkage between a direct molecular initiating event and an adverse outcome at a biological level of organisation relevant to risk assessment. The AOP Framework originates from regulatory toxicology, but molecular initiating events can be triggered by much more than chemicals. In the CIAO project, we consider the SARS-CoV-2 virus as the stressor. The AOP Framework is managed by the Organisation for Economic Co-operation and Development (OECD), but the CIAO project is an independent undertaking, making use of the OECD standards.

Partnership organizations

Parties involved

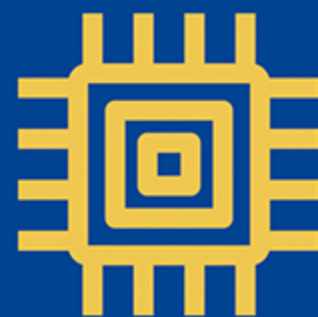






Dr. Jaeho LEE

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## Objectives

The Biosensor Group conducts multi-disciplinary research for the protection of our health and a sustainable environment.

Our primary focus is on projects involving airborne particulate pollutants which threaten our safety and health. In order to safeguard society's well-being and mitigate the risks posed by these pollutants, it is necessary to implement a warning system which issues a prompt alert as soon as they are detected.

We have also developed fundamental technologies capable of real-time notification of analysis results from collected samples, and aim to ultimately build a comprehensive system which integrates these technologies. At the same time, we are working on developing methods for quickly determining the potential effects of pollutants on our health.

In addition to our real-time monitoring system development, we are also conducting energy-related research to help promote environmental sustainability.

## R&D Areas

### Biosensors and Microfluidics

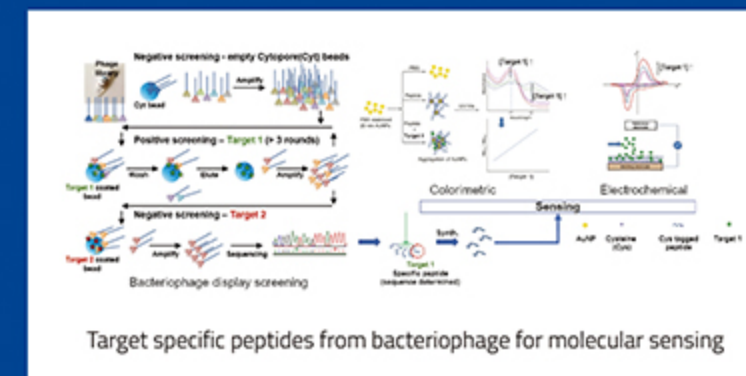
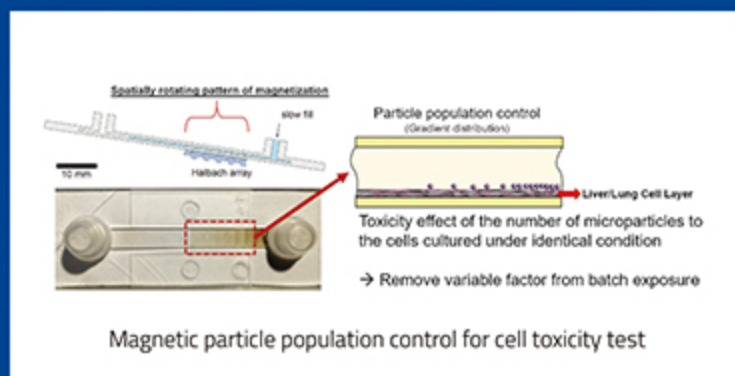
- Development of probe materials using chemical and biological methods
- Development of optical, electrical and electrochemical sensing methods
- Utilization of soft matter in microfluidic platforms for biological/biophysical applications

### Magnetic Materials

- Controlling and collecting magnetic particles in various fluidic environments

### Energy Storage

- Using microfluidics biomimicking for energy storage applications
- Fluid simulations for optimization of electrical energy and hydrogen storage



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Jeon, D. H., Kim, S., Kim, M., Lee, C., & Cho, H. S. (2023). Oxygen bubble transport in a porous transport layer of polymer electrolyte water electrolyzer. *Journal of Power Sources*, 553, 232322.

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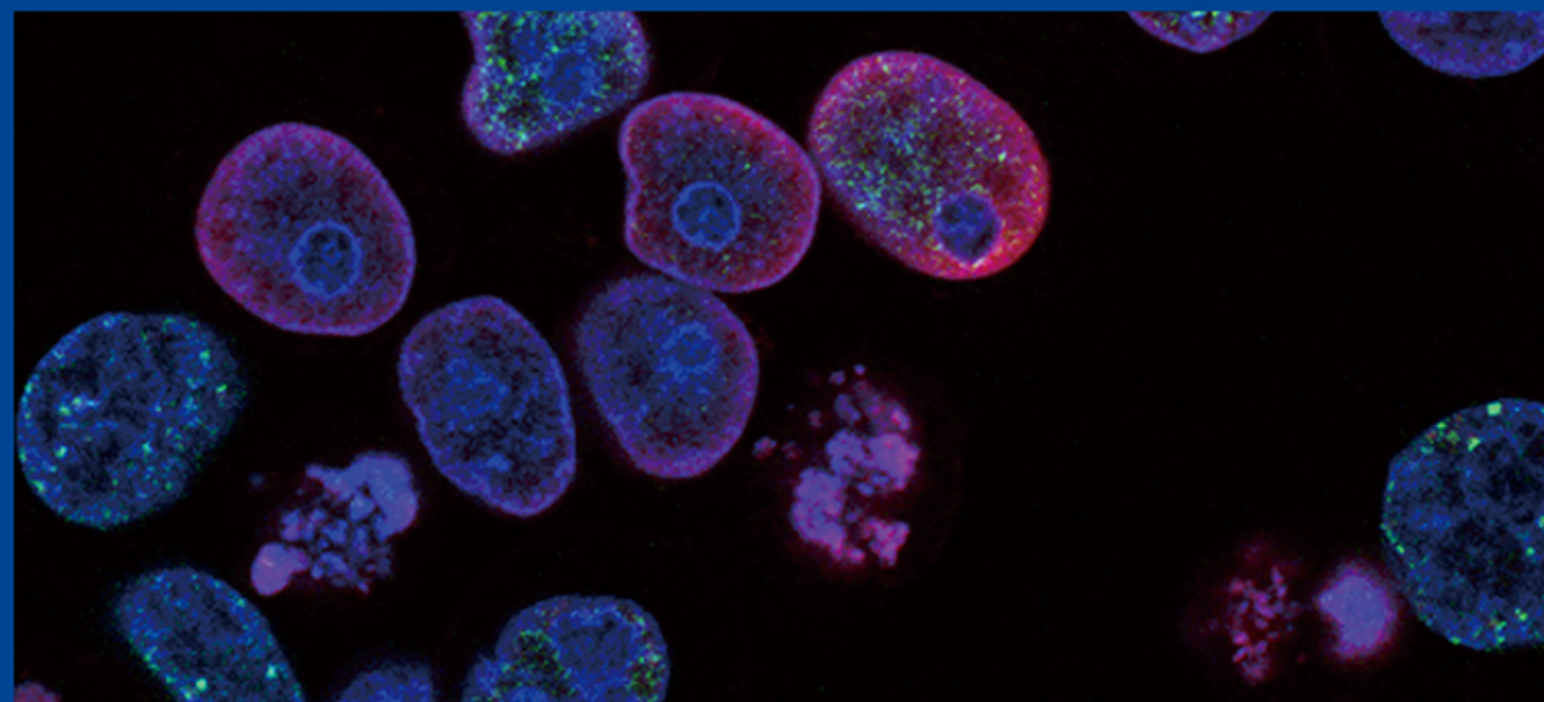
Kim, S., Jeon, D. H., Yoon, S. J., & Kim, D. K. (2022). Modeling Vanadium Redox Flow Batteries Using OpenFOAM. In: Beale, S., & Lehnert, W. *Electrochemical Cell Calculations with OpenFOAM* (pp. 169–192). Cham: Springer International Publishing.

## Oral Presentations

Abelmann, L. (2022, June 21). Sampling magnetic particulate matter [Lecture]. *International Workshop on Air Pollution Monitoring & Effects APME 2022*, Online hosted by Stockholm University.

Sung, B. (2022, July 6–8). In silico modelling of neuroendocrine dynamics: Comparative physiology and toxicology based on organ-on-a-chip systems [Conference presentation]. *International Conference on Mathematical Neuroscience (ICMNS) 2022*, Online hosted by Vrije Universiteit Amsterdam.

Abelmann, L. (2022, September 4–8). Performance and application of an open source automated magnetic optical density meter for analyzing magnetotactic bacteria [Conference presentation]. *7th International Meeting on Magnetotactic Bacteria (MTB) 2022*, Bayreuth, Germany.



## Poster Presentations

Sung, B. (2022, February 8–11). Mathematical modelling of the fish neuroendocrine dynamics [Poster session]. *13th Conference on Dynamical Systems Applied to Biology and Natural Sciences (DSABNS) 2022*, Bilbao, Spain.

Sung, B., Abelmann, L., & Manz, A. (2022, March 12). Microfluidic microgels for drug delivery applications [Poster session]. *HIPS Symposium 2022*, Saarbrücken, Germany.

Sung, B. (2022, June 9–10). Low-level chemiluminescence from epithelial cells triggered by acute exposure to airborne particulate matter: A mechanistic prediction model [Poster session]. *The 2nd Workshop in Mathematical and Computational Biology*, Muncie, IN, USA.

Sung, B. (2022, June 20–22). Cryo-electron microscopy of a thermotropic liquid crystal film dispersed with superparamagnetic nanoparticles [Poster session]. *Nordic Microscopy Society SCANDEM 2022 Conference*, Tampere, Finland.

Korkmaz, N., Hwang, C., Kessler, K. K., Silina, Y., Müller, L., & Park, J. (2022, June 21–23). Engineered Viruses for Selective Copper Metal Ion Binding and Sensing [Poster session]. *Engineered Living Materials 2022*, Saarbrücken, Germany.

Jeon, D. H., & Kim, S. (2022, June 22–24). Water Transport Simulation in a GDL of PEMFC using LBM [Poster session]. *HiPEM-TECH 2022*, Bad Zwischenahn, Germany.

Sung, B. (2022, July 19–22). Towards quantum information processing based on the aperiodic crystal of excimers: Mathematical modelling concept [Poster session]. *Europe-Korea Conference on Science and Technology (EKC) 2022*, Marseille, France.

Seo, Y. H., & Shin, I. (2022, July 19–22). Novel Electrochemiluminescence Emitter for Hydrogen Peroxide Detection [Poster session]. *Europe-Korea Conference on Science and Technology (EKC) 2022*, Marseille, France.

Abelmann, L., Fernandez-Castane, A., & Sung, B. (2022, September 4–8). Magnetic trapping of magnetosome crystals and magnetic nanoparticles on human liver cells for cell viability studies [Poster session]. *7th International Meeting on Magnetotactic Bacteria (MTB) 2022*, Bayreuth, Germany.

Sung, B. (2022, September 19–23). A theoretical model on the algebraic relaxation of photo-induced chemiluminescence from human skin [Poster session]. *12th European Conference on Mathematical and Theoretical Biology (ECMTB 2022)*, Heidelberg, Germany.

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Sung, B. (2022, February). Mathematical modelling of the fish neuroendocrine dynamics. In *Book of Abstracts, DSABNS 2022 Virtual 13th International Conference Dynamical Systems Applied to Biology and Natural Sciences* (pp. 345–346). DSABNS.

Magdanz, V., Klingner, A., Abelmann, L., & Khalil, I. S. (2022, July). Rigid-Body Rotation Versus Transverse Bending Wave Swimming of Magnetically-Functionalized Sperm Cells. In *2022 International Conference on Manipulation, Automation and Robotics at Small Scales (MARSS)* (pp. 1–6). IEEE.

van Renselaar, E., Keitel, B., Dinc, M., Mizaikoff, B., Susarrey-Arce, A., Gardeniers, H. J., ... & Khalil, I. S. (2022, July). Scaling Rules for Microrobots with Full Energetic Autonomy. In *2022 International Conference on Manipulation, Automation and Robotics at Small Scales (MARSS)* (pp. 1–6). IEEE.





## Aggregation-induced emission nanoparticles with improved optical absorption for boosting fluorescence signal of tumors in vivo

Young Hun Seo <sup>a</sup>, Sehoon Kim <sup>b,c</sup>

<sup>a</sup> Biosensor Group, Korea Institute of Science and Technology Europe, Campus E7.1, 66123 Saarbrücken, Germany

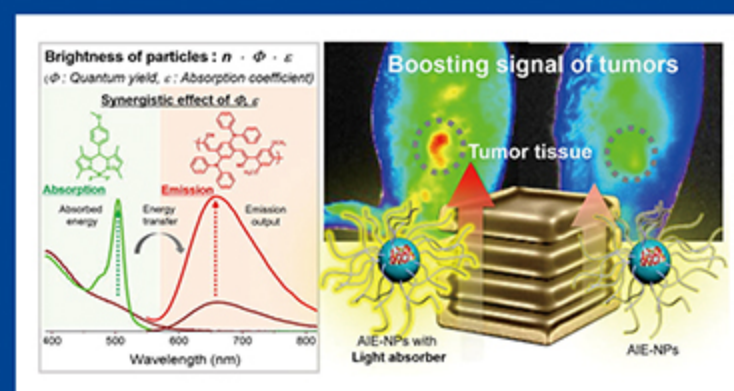
<sup>b</sup> Center for Theragnosis, Korea Institute of Science and Technology, 5 Hwarang-ro, 14-gil, Seongbuk-gu, Seoul 02792, Republic of Korea

<sup>c</sup> KU-KIST Graduate School of Converging Science and Technology, Korea University, Seoul 02841, Republic of Korea

### Abstract

Nanomaterial development has been extensively investigated for several decades to realize sensitive and accurate imaging of tumors in vivo. The manufacturing of nanoparticles with highly efficient tumor targeting and excellent optical properties is still an important research topic. The structure and composition ratio of materials that decisively contribute to the brightness and size of nanoparticles have a great influence on image sensitivity and tumor targeting efficiency. In this study, we developed aggregation-induced emission (AIE) nanoparticles with a widened light absorption window (nanoPMeOCN/BDP) to enable sensitive in vivo tumor imaging. The signal of nanoparticles is enhanced by integrating a high-density AIE polymer (PMeOCN) and light-absorbing fluorescent dye (BDP) in a nanoscopic space. BDP not only improves the light absorption of particles but also enhances the fluorescence signal of particles by effectively transferring absorbed energy to PMeOCN. The physically blended nanoPMeOCN/BDP show strong light absorption and improved sensitivity for the imaging of biological tissues because of their excellent optical performance compared to nanoPMeOCN of similar nanosizes (~19 nm in size).

In vivo imaging results further confirm that nanoPMeOCN/BDP can provide amplified signals with the successful accumulation of tumor tissue through the enhanced permeability and retention effect. We expect that the design strategy of nanoparticles with improved light absorption will provide a simple and general method for improving the accuracy of disease diagnosis.



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## In silico modeling of endocrine organ-on-a-chip systems

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### Abstract

The organ-on-a-chip (OoC) is an artificially reconstructed microphysiological system that is implemented using tissue mimics integrated into miniaturized perfusion devices. OoCs emulate dynamic and physiologically relevant features of the body, which are not available in standard in vitro methods. Furthermore, OoCs provide highly sophisticated multi-organ connectivity and biomechanical cues based on microfluidic platforms. Consequently, they are often considered ideal in vitro systems for mimicking self-regulating biophysical and biochemical networks in vivo where multiple tissues and organs crosstalk through the blood flow, similar to the human endocrine system. Therefore, OoCs have been extensively applied to simulate complex hormone dynamics and endocrine signaling pathways in a mechanistic and fully controlled manner. Mathematical and computational modeling approaches are critical for quantitatively analyzing an OoC and predicting its complex responses.

In this review article, recently developed in silico modeling concepts of endocrine OoC systems are summarized, including the mathematical models of tissue-level transport phenomena, microscale fluid dynamics, distant hormone signaling, and heterogeneous cell-cell communication.

From this background, whole chip-level analytic approaches in pharmacokinetics and pharmacodynamics will be described with a focus on the spatial and temporal behaviors of absorption, distribution, metabolism, and excretion in endocrine biochips. Finally, quantitative design frameworks for endocrine OoCs are reviewed with respect to support parameter calibration/scaling and enable predictive in vitro-in vivo extrapolations. In particular, we highlight the analytical and numerical modeling strategies of the nonlinear phenomena in endocrine systems on-chip, which are of particular importance in drug screening and environmental health applications.

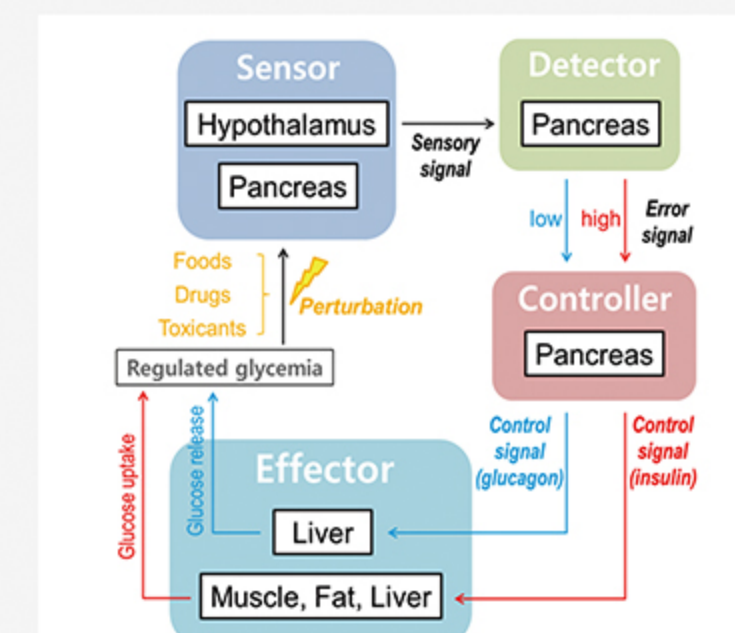


Fig. 1. Schematic diagram on the hormone-mediated feedback control of blood glucose levels in vivo.

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COOPERATION  
FOR THE FUTURE





## - COOPERATION AGREEMENTS -

1<sup>st</sup> Jan

Academic Cooperation On Ionic Liquids



Researcher exchange between partners for the studies of ionic liquids as electrolytes for high-temperature polymer membrane fuel cells

28<sup>th</sup> Feb

Partnership for European Joint research



Cooperative partnership for discovering & launching European research projects

14<sup>th</sup> Jun

Academic Cooperation On Environmental Resesearch



Joint Research Activities related to Biological effects of hazardous substances in the enviroment, Toxicity prediction based on High-Throughput-Toxico-Kinetics(KTTK)

20<sup>th</sup> Jul

Promotion of global S&T manpower education



Discovering and promoting mutual educational cooperation projects for researchers

27<sup>th</sup> Sep

Joint R&D for Alternatives to Animal Test



Cooperation for development of Alternatives to Animal Test and Test Guideline

18<sup>th</sup> Nov

Industry Support for Environmental Research



Analysis of international & European environmental regulations, hosting of a seminar on important issues, documentation of environmental policies, etc.

## - COOPERATION PLATFORM -

Open R&I Platform, KIST Europe Korea-Europe Horizon Initiative

Cooperation Initiative Support System



Contact Point

Global Cooperation Department  
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# REPRESENTATIVE EVENTS



## 1 Coordination of a meeting between GER-KOR on automotive industry structural changes brought on by hydrogen S&T policies

- Date/Place** 09<sup>th</sup> February 2022 / Webinar
- Topic** German-Korean exchange on strategies for structural change in the automotive industry
- Participants** 27

## 2 Supporting of cooperative talks between KOTSA and KÜS

- Date/Place** 16<sup>th</sup> May 2022 / Losheim am See, Germany
- Topic** Technical cooperation in vehicle test & monitoring areas between KOTSA (Korea Transportation Safety Authority) and KÜS
- Participants** 17



# REPRESENTATIVE EVENTS

## 3 Supporting of the '2022 Korea-Germany Collaborative Research Workshop' meeting for NST

- Date/Place** 31<sup>st</sup> May & 16<sup>th</sup> June 2022 / Webinar
- Topic**
  - General presentation on promoting international joint research funding programmes between GRIs and foreign research institutes utilizing KIST Europe which address global issues (infectious diseases, energy transition, climate change, cybersecurity, etc.)
  - Discussion on collaborative activities and future plans with relation to infectious diseases
  - Host : National Research Council of Science & Technology
- Participants** Approx. 50 from 8 organizations

## 4 Participation in EKC 2022

- Date/Place** 19<sup>th</sup>~22<sup>nd</sup> July 2022 / Marseille, France
- Main Organiser** ASCoF (Association des Scientifiques Coréens en France)
- Topic** "Pathways to Sustainability : The Role of Emerging Technologies"
  - Operation of the publicity booth with KIST
  - Running the S&T Session 'KIST Europe Introduction & KOR-EU Research Initiative Platform'
  - Poster presentation
  - MOU Ceremony with KIRD
  - Discussions on research matters with various organizations and individuals
- Participants** Approx. 700 scientists (KIST Europe staff : 20)





## REPRESENTATIVE EVENTS

### 5 Cooperation Talks with Delegation from Korea Conformity Laboratories

- Date/Place** 27<sup>th</sup> September 2022 / Saarbrücken, Germany
- Topic** Research cooperation on alternatives to animal testing, supporting KCL with establishing a branch in Europe, MOU ceremony
- Participants** 10



### 6 Participation in 2022 VeKNi Annual Committee

- Date/Place** 08-09<sup>th</sup> October 2022 / Essen, Germany
- Topic**
  - Introduction of KIST Europe and KOR-EU Research Initiative
  - Researcher networking
  - Providing scholarships for students
  - Participation in poster/oral sessions
- Participants** Approx. 50 from 8 organizations

## REPRESENTATIVE EVENTS

### 7 Visit by the KOSDAQ CEO Delegation

- Date/Place** 27<sup>th</sup> October 2022 / Saarbrücken, Germany
- Topic** Introduction of KIST Europe and gwSaar, seminar on EU market
- Participants** 24



### 8 Cooperation Talks with Delegation from KBIO Health

- Date/Place** 11<sup>th</sup> November 2022 / Saarbrücken, Germany
- Topic** Introduction of KIST Europe and discussion on joint research for alternatives to animal testing
- Participants** 8





## REPRESENTATIVE EVENTS

### 9 Cooperation Talks with Delegation from KITECH

- Date/Place** 15<sup>th</sup> November 2022 / Saarbrücken, Germany
- Topic** Introduction of KIST Europe status and discussion on mutual cooperation, European joint research projects  
Benchmarking cooperation on research for alternatives to animals testing
- Participants** 8



### 10 Visit by the COFRA Delegation

- Date/Place** 16<sup>th</sup> November 2022 / Saarbrücken, Germany
- Topic** Introduction of KIST Europe, discussion on European research administrative systems  
Seminar on Fraunhofer Gesellschaft and the structure of various German research centers
- Participants** 25



## REPRESENTATIVE EVENTS

### 11 Hosting of a Webinar for Industries

- Date/Place** 24<sup>th</sup> November 2022 / Saarbrücken, Germany
- Topic** General presentation on EU environmental regulation trends based on the European Green Deal  
Offering guideline how to comply for industries into the european market
- Participants** 41

### 12 Visit by Delegations from the Ministry of Science and ICT & Korea Innovation Foundation

- Date/Place** 13<sup>th</sup> December 2022 / Saarbrücken, Germany
- Topic** Introduction of KIST Europe, discussion on mutual cooperation
- Participants** 6







### Getting to KIST Europe

#### From Frankfurt Airport

Take the fast train (ICE/IC) or local train (RE/RB) from Frankfurt Airport to Saarbrücken Main Station. For more information, see: [www.bahn.de](http://www.bahn.de) (English version available)

#### Information for Navigation Systems

Stuhlsatzenhausweg 97  
66123 Saarbrücken, Germany  
GPS Coordinates:  
N 49° 15' 32,0" E 07° 02' 25,4"

## Imprint



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