# 第16回　高度医療都市を創出する未来技術国際シンポジウム

The 16th International Symposium for Future Technology
Creating Better Human Health and Society

# 真の異分野融合による技術革新

# Interdisciplinary fusion research for technological revolution

**日時：2024年12月20日（金）13:00—16:40**

**場所：岡山大学 共育共創コモンズ２階**

**ZOOM:** https://us06web.zoom.us/j/83695734809?pwd=ZFTAvgF9aQc4C7JvHNVt2wExzqChzH.1
**ID**: 836 9573 4809　**Passcode**: 685992

**Opening remarks: Prof. Tokumi Yokohira** (Dean, Graduate school of ISEHS)
**Welcome address: Prof. Yasutomo Nasu** (President, Okayama University)

## KEYNOTE LECTURES

FREE
参加無料
英語

- Prof. Toshio Yanagida (Osaka University, Japan)
- Prof. Hongzan Sun (China Medical University, China) *Zoom
- Prof. Yuta Nishina (Okayama University, Japan)

## YOUNG SCIENTIST SESSION

- Dr. Emilio Satoshi Hara (Okayama University Hospital, Japan)
- Dr. Jinta Arakawa (Okayama University, Japan)
- Dr. Siyao Du (China Medical University, China) *Zoom
- Dr. Lige Chaomu  (Okayama University Hospital, Japan)
- Dr. Xuefeng Bao (Okayama University, Japan)

**Closing remarks: Prof. Jiajia Yang** (Graduate school of ISEHS)

**Organized by** the Graduate School of Interdisciplinary Science and Engineering in Health Systems.
**Organizing chair:** Dr. Jiajia Yang
**主催**：岡山大学大学院ヘルスシステム統合科学研究科
**実行責任者**：楊家家　yang@okayama-u.ac.jp

岡山大学
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SUSTAINABLE DEVELOPMENT GOALS

# KEYNOTE LECTURE -1-

**Speaker:**
**Prof. Toshio Yanagida**
Graduate School of Frontier Biosciences, Osaka University, Japan

## 13:10 - 13:45

## Extraordinary Energy-saving Mechanism of Living Organisms

AI has evolved dramatically in recent years, but energy issues have become a serious challenge. On the other hand, the human brain is extremely energy-saving, consuming only 20 watts, which is orders of magnitude lower than AI. A cell consumes a few trillionths of a watt, which is the level of energy that a computer can only perform arithmetic operations such as 1+1=2 about once per second. What kind of energy-saving information processing algorithms are at work in living organisms? In recent years, it has been shown that information can be converted into energy (work) using the Szilard engine (a thought experiment of Maxwell's demon), and that the demon does not violate the second law of thermodynamics, but uses energy for information processing. The energy (minimum) is kBTln2 per bit. This is equivalent to less than one ten-millionth of the energy consumed by current computers, meaning that the demon has an energy-saving algorithm that is orders of magnitude higher. Here, we use cutting-edge single-molecule measurement technology to show that muscle molecular motors use Brownian motion to convert information into force (work) in the same way as the demon. We will then discuss the possibility that the devil's energy-saving algorithm actually works in living organisms and achieves unprecedented energy savings, as well as its application to energy-saving AI.

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# KEYNOTE LECTURE -2-

**Speaker:**

**Prof. Hongzan Sun**

Department of Radiology, Shingling Hospital, China Medical University, China

## 13:45 - 14:20

## Advances in Imaging Methods to Assess Thermogenic Fat

Thermogenic fat promotes the release of energy in the form of heat through the characteristically high expression of uncoupling protein 1 (UCP1), and its secretion of brown adipokine (batokine) is also involved in the regulation of systemic energy metabolism. Recent studies have confirmed that these functions of thermogenic fat are associated with the inhibition of tumour growth, the treatment of metabolic disorders, and the prediction of the onset and progression of childhood obesity. And the non-invasive assessment and monitoring of the amount and functional status of thermogenic fat may provide a more efficient tool for further in-depth exploration of relevant animal experiments and clinical studies. Imaging methods such as computed tomography, magnetic resonance imaging, positron emission tomography, single photon emission computerized tomography and contrast enhanced ultrasound have made great progress in this field, and this report reviews the imaging basis of thermogenic fat and the progress of imaging methods in evaluating thermogenic fat.

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# KEYNOTE LECTURE -3-

**Speaker:**

**Prof. Yuta Nishina**

Graduate School of Natural Science and Technology, Okayama University, Japan

## 14:35 - 15:10

## Synthesis and Functionalization of Two-Dimensional Nanocarbons

Two-dimensional (2D) nanocarbons, especially graphene-based materials, have gained widespread attention for their practical applications. However, due to the challenges in controlling their structures at the atomic and molecular levels, fundamental chemical research in this area still needs to be improved. With my expertise in both organic synthesis and carbon materials, I aim to advance this field by creating novel biofunctional materials. The synthesis of 2D nanocarbons can be achieved by oxidizing and exfoliating readily available graphite. I have developed three methods to produce 2D nanocarbons: chemical oxidation using potassium permanganate and sulfuric acid, electrochemical oxidation with a designed electrolyte, and direct exfoliation using polymer dispersants. Furthermore, surface modification of 2D nanocarbons enables the tuning of their characters, allowing for a range of applications such as adsorption of metal ions, energy storage devices, and potential anticancer agents.

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# YOUNG SCIENTIST SESSION

15:20 - 15:35

**Cell membrane-based biohybrid materials for bone tissue engineering**

Dr. Emilio Satoshi Hara (Okayama University Hospital, Japan)

The cell (plasma) membrane consists of numerous ligands, receptors, enzymes, and phospholipids that play important roles in "cell-cell" and "cell-extracellular matrix" interactions. We previously discovered that the plasma membrane nanofragments (PMNFs) act as nucleation site for bone formation in vivo and can induce rapid mineralization in vitro within 1-2 days (ACS Biomater Sci Eng, 2018; J Mater Chem B, 2018). In this talk, I will present our recent approaches utilizing the plasma membrane as a core material for the development of new technologies applied to bone tissue engineering (Adv Mater, 2022; Adv Mater Technol, 2023; Sci Technol Adv Mater, 2023; IEEE Biosensors, 2023; Acta Biomater, 2024).

15:35 - 15:50

**Prediction of the fatigue crack initiation sites on medical Ti-6Al-4V alloy by considering crystallographic orientation**

Dr. Jinta Arakawa (Okayama University, Japan)

In this study, the fatigue crack initiation behavior and fatigue crack initiation life of the Ti-6Al-4V alloy were quantitatively evaluated based on slip line length and out-of-plane component of Schmidt factor. As the results, in crystal grains where fatigue cracks initiated, the slip system that contributes to crack initiation could be identified by considering the out-of-plane component of the Schmidt factor (SFsinΩ), and the fatigue cracks were initiated by the basal slip of the primally α phase in all specimens. Furthermore, regarding the prediction of the location of fatigue crack initiation, it is clear that the grains that are candidates for fatigue crack initiation could be estimated based on the relationship between the slip line length of the basal slip system that contributes to crack initiation in each grain and SFsinΩ.Finally, the fatigue crack initiation life could be estimated using a parameter of P that combines crack initiation driving force Pi and micro crack propagation driving force Pp.

# YOUNG SCIENTIST SESSION

15:50 - 16:05

**Application and progress of quantitative MR in breast cancer imaging**

Dr. Siyao Du (China Medical University, China)

Breast MRI has gained significant traction over the past three decades, largely due to its proven high sensitivity in detecting cancer. The current clinical standard employs dynamic contrast-enhanced (DCE-MRI) sequences, which enable detailed morphological and semi-quantitative kinetic evaluations of breast lesions. The incorporation of more functional and quantitative parameters, such as pharmacokinetic features from high-temporal-resolution DCE-MRI, apparent diffusion coefficient (ADC) and diffusion heterogeneity index from diffusion-weighted MRI and its advanced models, as well as relaxation times from synthetic MRI, is showing great potential. These advancements are set to enhance MRI's capability in differentiating benign from malignant breast tumors, molecular typing, assessing treatment effects, and predicting prognosis in breast cancer. Additionally, the field of radiomics, which involves quantitative image analysis, has reached an advanced level. The future development trend of breast MRI is to integrate large-scale multicenter studies with multi-omics data, which is expected to achieve the interpretation of biological mechanisms of radiomics signatures.

16:05 - 16:20

**Medical care system in Inner Mongolia in the first half of twenties century**

Dr. Xuefeng Bao (Okayama University, Japan)

This talk focuses on the role of Khorchinbilik (1917-1968), who returned to Mongolia in 1942 after completing five years of study in Japan, in the modernization of health care in the early years of the Inner Mongolia Autonomous Region. Previous studies have confirmed that after his return to Mongolia, he even served as the head of the Inner Mongolia Autonomous Region's Health Administration, where he was primarily responsible for the prevention of bubonic plague and the development of Mongolian medicine. It is possible that his activities after his return to Mongolia were to study modern medicine in Japan and use this knowledge to change the healthcare situation in Inner Mongolia. However, there are many ambiguities, this paper will focus on the healthcare work he led, especially his efforts in preventing the plague and developing Mongolian medicine, as well as the role he played in the projects he implemented. The paper will utilize new historical documents to shed light on the role he played in the initiatives and projects he led to prevent plague and develop Mongolian medicine.

# YOUNG SCIENTIST SESSION

16:20 - 16:35

**Is knockout mouse useful to study a disease model?**

Dr. Lige Chaomu (Okayama University Hospital, Japan)

The knockout mouse model is a crucial tool for studying disease mechanisms and developing new therapies. By removing specific genes, researchers can replicate certain features of human diseases, enabling deeper insights into how these genes contribute to disease processes. Knockout models have been extensively used in areas such as genetic disorders, cancer, and neurological diseases. These models help identify gene functions and their impact on biological systems, offering valuable information for discovering therapeutic targets and testing treatments. However, the limitations include species differences, which may cause discrepancies in disease manifestation between humans and mice. Additionally, single-gene knockouts may not fully represent complex diseases involving multiple genes and environmental factors. Despite these challenges, knockout mouse models remain essential in biomedical research, providing key insights into gene function and disease pathogenesis.