NIMS Award 2022 Goes to Prof. Teruo Okano,

Prof. Kazuhiko Ishihara and Prof. Donald E. Ingber

National Institute for Materials Science (NIMS)

Overview

The National Institute for Materials Science (NIMS) (Kazuhiro Hono, President) has selected the following scientists as the winners of the NIMS Award 2022.

Prof. Teruo Okano

- Emeritus Professor and Specially Appointed Consultant, Tokyo Women's Medical University, JAPAN
- Distinguished Adjunct Professor, Department of Pharmaceutics and Pharmaceutical Chemistry and Director, Cell Sheet Tissue Engineering Center, School of Medicine and College of Pharmacy, University of Utah, USA

For "Development of cell sheet engineering using temperature-responsive polymers and its application to regenerative medicine"

Prof. Kazuhiko Ishihara

- Specially Appointed Professor, Graduate School of Engineering, Osaka University, JAPAN
- Emeritus Professor, The University of Tokyo, JAPAN

For "Pioneering work in the development of biomimetic polymer biomaterials and their medical applications"

Prof. Donald E. Ingber

- Founding Director and Core Faculty Member, Wyss Institute for Biologically Inspired Engineering, Harvard University, USA
- *Judah Folkman Professor of Vascular Biology*, Harvard Medical School and Boston Children's Hospital, USA
- *Hansjörg Wyss Professor of Bioinspired Engineering*, Harvard John A. Paulson School of Engineering and Applied Sciences, USA

For "Proposal of the cellular tensegrity model and the invention of organ-on-a-chip technology"

Prof. Teruo Okano

Prof. Kazuhiko Ishihara

Prof. Donald E. Ingber

The three scientists will be receiving the NIMS Award 2022 for their outstanding achievements on an international level in the field of "Functional Materials," specifically "biomaterials research/science leading to innovative progress of medical technologies": Prof. Okano for the "development of cell sheet engineering using temperature-responsive polymers and its application to regenerative medicine," Prof. Ishihara for the "pioneering work in the development of biomimetic polymer biomaterials and their medical applications," and Prof. Ingber for the "proposal of the cellular tensegrity model and the invention of organ-on-a-chip technology."

The Award Ceremony and a series of the Award Winning Lecture will take place at the Tokyo International Forum on November 14, 2022, as a part of NIMS WEEK 2022.

[NIMS Award]

Since 2007, the NIMS Award has been given to researchers around the world in recognition of their outstanding achievements in materials science and technology. This year's recipients were selected by a selection committee comprised of staff members at NIMS and scientists from other organizations based on nominations from top scientists around the world in the area of "Functional Materials," specifically "'biomaterials' that lead to breakthroughs in healthcare technology."

[NIMS WEEK]

NIMS WEEK is an annual event hosted by NIMS consisting of an Academic Symposium and a Technology Showcase. The event was held online for the past two years as a measure to prevent the spread of COVID-19 but will be held in person this year for two days from Monday, November 14 to Tuesday, November 15 at the Tokyo International Forum. The academic symposium on the first day will be organized under the theme of "Biomaterials for Well-being" and consist of the NIMS Award ceremony and lectures by the award recipients, invited lectures, and presentations by the NIMS researchers. The technology showcase on the second day will consist of exhibitions of the latest findings in materials research for the purpose of technological transfer of NIMS research findings. Poster presentations are also scheduled to be given throughout the two days by the NIMS researchers and graduate students studying materials science at NIMS.

NIMS Award 2022 Winners

Awardee 1: **Prof. Teruo Okano**
- Emeritus Professor and Specially Appointed Consultant, Tokyo Women's Medical University, JAPAN
- Distinguished Adjunct Professor, Department of Pharmaceutics and Pharmaceutical Chemistry and Director, Cell Sheet Tissue Engineering Center, School of Medicine and College of Pharmacy, University of Utah, USA

Awardee 2: **Prof. Kazuhiko Ishihara**
- Specially Appointed Professor, Graduate School of Engineering, Osaka University, JAPAN
- Emeritus Professor, The University of Tokyo, JAPAN

Awardee 3: **Prof. Donald E. Ingber**
- Founding Director and Core Faculty Member, Wyss Institute for Biologically Inspired Engineering at Harvard University, USA
- *Judah Folkman Professor of Vascular Biology*, Harvard Medical School and Boston Children's Hospital, USA
- *Hansjörg Wyss Professor of Bioinspired Engineering*, Harvard John A. Paulson School of Engineering and Applied Sciences, USA

Awardee 1

Prof. Teruo Okano

- Emeritus Professor and Specially Appointed Consultant, Tokyo Women's Medical University, JAPAN
- Distinguished Adjunct Professor, Department of Pharmaceutics and Pharmaceutical Chemistry and Director, Cell Sheet Tissue Engineering Center, School of Medicine and College of Pharmacy, University of Utah, USA

[Research field] Regenerative medicine, biomaterials, polymer science

[Research achievement title]

Development of cell sheet engineering using temperature-responsive polymers and its application to regenerative medicine

[Research summary]

Inventing smart cell culture dishes coated with nano-leveled thickness of temperature-responsive polymers, Prof. Okano has developed a world-leading technology that allows for easy harvesting of cells as sheets simply by lowering the temperature and without cell-damaging enzymatic treatment. The technology has been applied to regenerative medicine, achieving the innovative therapy where transplanting the cell sheets to diseased tissue and organs. In particular, the heart of a patient with severe heart failure enables the patient to recover enough by cell sheets to walk without an artificial heart.

[Impact on the academic and industrial sectors]

The cell sheet technology, which started as materials science research, now leads innovation in the field of regenerative medicine. Clinical trials are being conducted not only for the treatment of heart failure, but also for the regeneration of corneal and periodontal tissues, prevention of stenosis after esophageal cancer resection, among others. Further development is expected as the world's first, cutting-edge medical technology originating from Japan.

Awardee 2

Prof. Kazuhiko Ishihara

- Specially Appointed Professor, Graduate School of Engineering, Osaka University, JAPAN
- Emeritus Professor, The University of Tokyo, JAPAN

[Research field] Biomaterials, biomedical polymers

[Research achievement title]

Pioneering work in the development of biomimetic polymer biomaterials and their medical applications

[Research summary]

Prof. Ishihara has contributed to the development of biomimetic polymers inspired by cell membrane surface structure and function. He has also shown that super-hydrophilic biomimetic polymers can dramatically improve the functionality of medical devices that are implanted in the body for an extended period, such as artificial hearts and vascular stents, by inhibiting protein adsorption and cell adhesion, and has continued to demonstrate the technology's innovative potential for use in surface treatment of a range of medical devices.

[Impact on the academic and industrial sectors]

Prof. Ishihara's achievements range from the molecular design of the polymers, establishing the method of synthesis, and basic research to the application of medical devices, thereby making a significant contribution to the advancement of medicine. For over 25 years, the biomimetic polymers have been used for the surface treatment of various medical devices such as contact lenses, artificial hearts, artificial lungs, catheters, vascular stents, cerebral aneurysm treatment systems, and artificial hip joints. The research achievements are highly valued both in academia and in industry. They have contributed to the growth and improvement of biomaterials science over the years, with their impacts spreading to a wide range of fields, including biomedical engineering and interface science.

Awardee 3

Prof. Donald E. Ingber

- Founding Director and Core Faculty Member, Wyss Institute for Biologically Inspired Engineering at Harvard University, USA
- *Judah Folkman Professor of Vascular Biology*, Harvard Medical School and Boston Children's Hospital, USA
- *Hansjörg Wyss Professor of Bioinspired Engineering*, Harvard John A. Paulson School of Engineering and Applied Sciences, USA

[Research field] Biologically inspired engineering

[Research achievement title]

Proposal of the cellular tensegrity model and the invention of organ-on-a-chip technology

[Research summary]

Inspired by the similarity between biological cells and the *tensegrity* architectures, the systems that stabilize their overall structure by balancing tensile and contractile forces through establishment of an internal prestress, Prof. Ingber showed the significant role that mechanical forces play in tissue and organ formation as well as cancer

progression. Inspired by these insights and leveraging approaches from microchip manufacturing, Prof. Ingber created the organ-on-a-chip technology and demonstrated its applications to drug discovery and personalized medicine using these miniaturized organ mimics instead of experimental animals.

[Impact on the academic and industrial sectors]

Prof. Ingber's research had a tremendous impact on various fields, such as mechanobiology, tissue engineering, and translational medicine. He also pioneered a new academic discipline called "biologically inspired engineering" and became the founding director of the Wyss Institute at Harvard University, which develops new engineering innovations based on this concept. Prof. Ingber also founded seven companies in fields ranging from organs-on-chips, 3D printing, and tissue engineering to medical devices, point-of-care diagnostics, and computer-assisted drug discovery. His achievements have been recognized not only in academia, but also in the world of art with his work being exhibited at many museums including MoMA, with their impacts spreading widely to multiple industries.

<Reference> NIMS Award winners of the past five years and their achievements (Affiliation is at the time of the award)

2017 **Prof. John Ågren** (Royal Institute of Technology, Sweden)
"Development of kinetic simulation packages for computational thermodynamics"
Prof. Bo Sundman (Royal Institute of Technology, Sweden)
"Development of thermodynamic calculation packages for computational thermodynamics"
Prof. Kiyohito Ishida (Tohoku University, Japan)
"Alloy design and development of structural materials based on thermodynamics of phase diagrams and microstructures"

2018 **Dr. Masato Sagawa** (Daido Steel Co., Ltd., Japan)
"Invention and practical application of neodymium magnets"
Prof. Terunobu Miyazaki (Tohoku University, Japan)
"Development of tunneling magnetoresistance elements capable of generating giant magnetoresistance at room temperature and application thereof to spintronics devices"

2019 **Prof. Gerbrand Ceder** (University of California Berkeley, USA)
"Pioneering data-driven materials research based on the first-principles calculations"
Dr. Pierre Villars (Materials Phases Data System (MPDS), Switzerland)
"Development of Pauling File, inorganic materials database"

2020 **Prof. Hiroshi Julian Goldsmid** (The University of New South Wales, Australia)
"Pioneer work on bismuth telluride thermoelectric material and its application for large-capacity optical communication systems using the Peltier cooling phenomenon"
Prof. Kunihito Koumoto (Nagoya University, Japan)
"Development of environmental-friendly inorganic thermoelectric materials"

2021 **Prof. Tsuneya Ando** (Tokyo Institute of Technology, Japan, University of Tokyo, Japan)
"Fundamental theoretical studies on quantum states of low-dimensional materials"
Prof. Allan H. MacDonald (University of Texas at Austin, USA)
Prof. Pablo Jarillo-Herrero (Massachusetts Institute of Technology, USA)
"Pioneering work of new quantum physics by twistronics"

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