NIMS Award 2020 Goes to
Prof. Hiroshi Julian Goldsmid and Prof. Kunihito Koumoto

National Institute for Materials Science (NIMS)

Overview

National Institute for Materials Science (NIMS) (Kazuhito Hashimoto, President) has selected the following scientists as the winners of the NIMS Award 2020.

Prof. Hiroshi Julian Goldsmid
(Emeritus Prof.,
The University of New South Wales)

Prof. Kunihito Koumoto
(Prof. Emeritus, Nagoya University
Senior Researcher, Nagoya Industrial Science Research Institute
Distinguished Adjunct Professor, King Abdulaziz University)

The NIMS Award 2020 will be given to two scientists who have conducted groundbreaking research in the field of "materials for thermal energy conversion and thermal management." Prof. Goldsmid identified bismuth telluride as a practical material for Peltier cooling for the first time in the world in 1954. Bismuth telluride is still the preferred thermoelectric material with sufficiently high energy conversion efficiency near room temperature today. Prof. Koumoto pioneered a new class of thermoelectric materials based on the principle of "nanoblock integration" which paved the way to not only high performance environmental-friendly thermoelectric materials but also flexible inorganic-organic hybrid thermoelectric materials. Both research results have had a profound influence on society through commercialization and innovation of thermoelectric devices playing essential roles in the core technology to support the IoT Society.

The Award Ceremony and the Award Winning lecture will take place as a part of NIMS WEEK 2020, which will be held online on November 27.

【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 "Materials for Environment and Energy."

【NIMS WEEK】

NIMS WEEK is an annual event hosted by NIMS consisting of an Academic Symposium and a Showcase. The participants can encounter "cutting edge materials research" through a variety of activities, such as the NIMS Award symposium to honor the award recipients and the exhibitions of the latest materials research at the NIMS Showcase. However, NIMS WEEK 2020 will be held online for the first time ever on Friday November 27, 2020, due to safety concerns regarding COVID-19. Details will be announced later on the NIMS official website. (It may also be cancelled/postponed or its programs may be changed due to unforeseen circumstances related to COVID-19.)

NIMS WEEK 2020
NIMS Award 2020 Winners

Awardee 1: Prof. Hiroshi Julian Goldsmid (Emeritus Professor, The University of New South Wales)
Awardee 2: Prof. Kunihito Koumoto (Professor Emeritus, Nagoya University / Senior Researcher, Nagoya Industrial Science Research Institute / Distinguished Adjunct Professor, King Abdulaziz University)

Awardee 1

Prof. Hiroshi Julian Goldsmid (Emeritus Professor, The University of New South Wales)

[Research field] Thermoelectric energy conversion

[Research achievement title]
Pioneer work on bismuth telluride thermoelectric material and its application for large-capacity optical communication systems using the Peltier cooling phenomenon

[Research summary]
Prof. H. J. Goldsmid identified bismuth telluride as a practical material for Peltier cooling for the first time in the world in 1954. Bismuth telluride is still the preferred thermoelectric material for application to Peltier devices to make progress in large-capacity long-haul optical communication worldwide. In addition, he validated the existence of a bipolar component in thermal conductivity in 1958. His observation of the phonon-drag phenomenon and experiments with the thermomagnetic effect in 1959 were one of the first trials in the world. He has achieved much excellent academic performance on boundary scattering of phonons, thermal conduction and thermoelectric energy conversion to contribute to the foundation and advancement of thermoelectric physics and technologies.

[Impact on the academic and industrial sectors]
Bismuth telluride is still the preferred thermoelectric material with high energy conversion efficiency near room temperature. The identification by Prof. H. J. Goldsmid was a good opportunity to promote drastic improvement of thermoelectric cooling technologies. As mentioned above, he has many research achievements on experimental physics focusing on phonon conduction, thermal conduction and thermoelectric phenomena. These excellent achievements laid the foundation for the science and technology of thermoelectric energy conversion and substantially contributed to technological progress and development of devices. Also his research achievements significantly contributed to the formulation of the basic grounds for IoT society and therefore Society 5.0 through the actualization of large capacity which is more than three orders of magnitude larger than conventional ones and long-haul transmission of optical communication.

Awardee 2

Prof. Kunihito Koumoto (Professor Emeritus, Nagoya University / Senior Researcher, Nagoya Industrial Science Research Institute / Distinguished Adjunct Professor, King Abdulaziz University)

[Research field] Inorganic materials science

[Research achievement title]

Development of environmental-friendly inorganic thermoelectric materials

[Research summary]

Led the world firstly by focusing on developing high-performance thermoelectric materials based on environmental-friendly materials such as oxides and sulfides. He then proposed the idea that high-performance thermoelectrics can be realized by creating periodic structures based on different nanoblocks, thereby reducing thermal conductivity while preserving electrical conductivity. Such principles were applied to $SrTiO_3$, which typically had low thermoelectric performance, to achieve a room temperature ZT=2.4. This principle was further applied to an inorganic/organic superlattice (TiS_2/Hexylamine) to achieve ZT=0.32 at room temperature to 100°C. ZT=0.32 is equal to the best in the world as a flexible thermoelectric device.

[Impact on the academic and industrial sectors]

In contrast to conventional thermoelectric materials, which generally contain toxic and rare elements, he found the importance of and potential for high performance of environmental-friendly materials and led the paradigm shift in the development of thermoelectric materials. Previously only low-performance organic materials had been studied as flexible thermoelectric materials. However, he achieved innovative research results by fabricating hybrid superlattice structures by intercalating organic materials into the van der Waals gap of layered sulfides, thereby developing flexible high-performance inorganic/organic hybrid thermoelectric materials. Furthermore, by developing such high-performance nanostructured thermoelectric materials, he accelerated applicative research toward IoT energy harvesting and contributed largely to the development of environmental-friendly thermoelectric materials expected to be used by industry.

<Reference> NIMS Award winners of the past five years and their achievements

2015 **Prof. Harald Rose** (University of Ulm, Germany)
Prof. Maximilian Haider (KIT, CEOS GmbH, Germany)
Prof. Knut Wolf Urban (Research Centre Juelich, Germany)
"Theoretical study, development and popularization of the aberration corrector for electron microscopes, and its application to materials science"

2016 **Dr. Koichi Mizushima** (Toshiba Research Consulting Corporation, Japan)
Dr. Akira Yoshino (Asahi Kasei Corporation, Japan)
"Discovery of anode material for the lithium ion battery (LiCoO2) and development of the lithium ion battery"

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** (UC 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"

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