MANA NEWS LETTER

CONVERGENCE

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International Center for Materials Nanoarchitectonics(MANA)

Leader's Voice

Contributing to the Future of Humankind with a Sincere Attitude

Yoshio Nishi

Asking the Researcher

Atomic Switch Networks:

a Biologically Inspired Approach to Neuromorphic Computation

James K. Gimzewski

Atomic Switch Networks:

a Biologically Inspired Approach to Neuromorphic Computation

Atomic Switch Networks (ASN) are biologically inspired, self-organizing devices comprising of massively interconnected networks. MANA Satellite Director at UCLA, Professor James Gimzewski talks about how he discovered synaptic behavior of ASN and his path to put artificial brain into reality based on collaboration between MANA and UCLA. In between, he reveals how drones and yoga inspires him and how science has to develop in the future.

◉ Interviewer : Akio Etori, Science Journalist

Inspired by a Brain

Professor James Gimzewski begins by saying, “There are many limitations to what a conventional computer can do.” However, he adds, “the human brain is able to manage and handle very complex situations even in a very noisy and error-prone environment.” In fact, scaling conventional computer to emulate the human brain has never been easy. With wires as thin as 10 nanometers being used, today’s conventional computer is reaching its ultimate limit. Therefore, inspired by the human brain, Professor Gimzewski attempted to develop a device resembling synapses and neurons. “The first step actually was to build such artificial synaptic connections using something called atomic switches,” states Professor Gimzewski. Incidentally, atomic switches were discovered by Professor Aono of MANA. It is a novel switching device, which works on the basis of movement of metal atoms/ions associated with their redox processes due to an applied potential.

Discovery of Synaptic Behavior of the Switch

Professor Gimzewski recalls that on a visit to MANA, he saw a young student working on atomic switch which would go on or off in a precise manner. He then asked “What happens if you just put enough energy so it’s almost on or almost off?” This led them into observing the phenomenon and their data revealed that the switch “started to have a memory of the past switches.” Since in UCLA, Professor Gimzewski worked on biological problems with nanotechnology, he saw a “strange connection between this atom switch behavior and a synaptic behavior.” This led him to emulate properties of individual synapse in this device, and the experiment worked wonderfully (Fig. 1).

Constructing Self-Assembled Network with Artificial Connections

The next summer he decided to attempt at building artificial brain by using these synthetic synapses. So, he looked at pictures of brains and neurons, especially by Santiago Ramón y Cajal, which looked like a fractal-like spaghetti connections. Another person in his group helped him to make these fractal-like structures using silver nanowires. Then the atomic switches were added by exposing it to sulfur. He then conducted series of experiments putting electrical energy through the device and watched how it behaved. (Fig. 2)

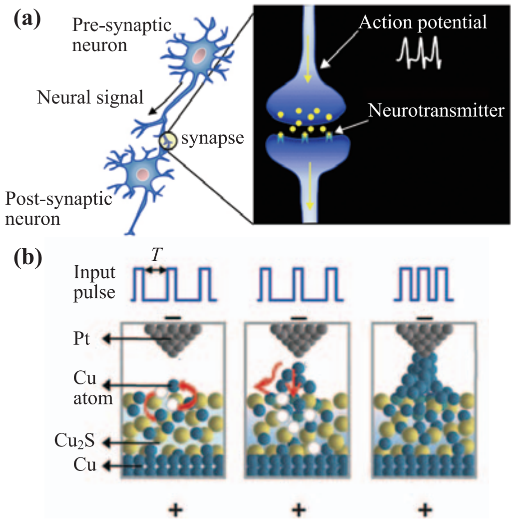

Fig. 1 Schematic illustration of synaptic activity.
(a) A biological synapse.
Neurotransmitters are released from a presynaptic cell when an action potential reaches it, and assist ion channels for signal transmission. Frequent stimulation by action potential results in a persistent increase in the synaptic connection.

(b) A Cu_2S gap-type atomic switch with synaptic operation.
Cu_2S gap-type atomic switch is constructed using a Cu_2S solid electrode and a counter Pt electrode with a nanogap made between them. The Cu+ ions, which were uniformly distributed at the initial state, diffuse toward the sub-surface of Cu_2S when a voltage is applied between the electrodes such that the Cu_2S is at positive bias, and then precipitate to form Cu atoms on the surface due to a solid electrochemical reaction. The interval (T) of the input voltage pulse stimulation shorter, the precipitated Cu atoms form a thicker and more stable bridge between the electrodes.

James K. Gimzewski

Principal Investigator and Satellite Director, MANA
Distinguished Professor of Chemistry, UCLA

Profile

Prof. Gimzewski completed his Ph.D. in Physical Chemistry at the University of Strathclyde, Glasgow, Scotland, UK in 1977. After he served as a group leader at IBM Zurich Research Laboratory, he has worked as a distinguished professor of Chemistry at UCLA. From 2008, he joined MANA (NIMS) as PI/Satellite Director. He was elected as a “Fellow of the Royal Society” in 2009.

Path to put Artificial Brain into Reality

ASN exhibits some characteristics that are almost identical to the human brain in terms of electrical activity. Professor Gimzewski achieved self-organization behavior with his ASN system. Self-organization is a unique behavior of human brain synapse. As a next step, Professor Gimzewski wants to “give that brain experiences and in a way observe how that brain reacts and from that reaction teach it like you would teach a child.” His ASN device has managed to learn simple things and although its behavior is similar, its reaction has been non-deterministic. This is unlike a regular computer which always has the same reaction to a given input. ASN is also capable of performing machine-learning tasks such as T-maze used in understanding animal learning behavior. Similar to, say, a rat, ASN device is able to remember its path to the wall and then most of the time it does turn left (where the animal gets rewarded). Therefore, the collective interactions between these atomic switches result in unique, emergent properties that have shown significant potential for neuromorphic computing.

Developing Talents

Then, Professor Gimzewski talked about his favorite undergraduate class ‘Introduction to Nanotechnology.’ Students from any background can apply for this class, but they have to be very qualified. This class is very interactive. The course covers everything from esthetics to arts including looking into the future. In this regard, Professor Gimzewski says “…imagine the impossible; imagine 10 years from now, the impossible, and I make them aware also of the environment of the past technologies, of how they are unsustainable for our society.” In the end, the students give their final exam by writing a book together.

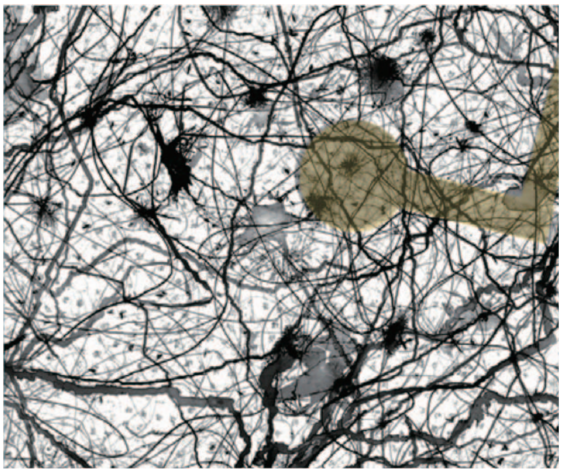

Fig. 2 A self-assembled network of Ag nanowires
A self-assembled network of Ag nanowires coated in Ag_2S with underlying Pt measurement electrodes (yellow) generates atomic switches at nanowire intersections.

Talking about his pursuits, Professor Gimzewski says he has two hobbies; flying drones and yoga. Flying drones relates intimately to his work because it has three-dimensional space involving the brain. It also gives him inspiration and he says, “It also makes me think of my brain project because eventually I would like to put it inside the drone.” He also likes to do Kundalini yoga which can “modify your mind and your emotions through it.” He has also started to learn Zen and says that’s important not only just to be a scientist “but also to realize the importance that you are connected to everything. It’s the opposite of this computer.” He feels that the human mind goes on and doesn’t stop at a point. In fact, he believes that “your whole body is part of your brain and the people around you and the environment around are really part of you.”

Science has to Change

Pondering over the future of science, he feels that the essence of science is internationalism. That is why, the goals of California NanoSystems Institute (CNSI) in UCLA are similar to MANA in terms of developing and understanding nanotechnology for the sustainability of both countries. In the past, both countries were successful with microelectronics, but it’s time for new technologies to be competitive in the global economy today. MANA and UCLA are successfully making an important contribution to each other in this context.

Professor Gimzewski, however, believes science has to change. According to him, there are three most important developments in science. First was Newton’s Three Laws of Motion, which is an absolute deterministic behavior. Next is Quantum Mechanics, which says that outcomes are probabilistic, not deterministic. The last and the most important thing that science has to change is complexity. He says, “We cannot determine the future. We know that now. Everything is interconnected, not in just the Buddhist sense, but in the real sense.” The world “follows laws that are nondeterministic and science has to develop a new language to deal with that. If it can, then science is very important for future, essential. If it can’t, then science has failed.”

Creation of Therapy-Oriented Biomaterials and Nanoarchitectonics for Maximizing Their Functions

Kohsaku Kawakami
MANA Scientist
Nano-Life Field

The role of material nanoarchitectonics in the medical field

In Japan, medical costs have increased rapidly in recent years, and now exceed ¥40 trillion, approaching half of the national budget. Development of very early diagnosis and treatment technologies for chronic diseases that require long-term treatment is essential for controlling swelling medical costs. Although Japan has advanced therapeutic technologies that are among the best in the world, there are also still no small number of medical treatments and drug administration methods which impose a large physical and psychological burden on the patient. For example, while biopharmaceuticals have increased rapidly in recent years, methods for administering them are basically limited to injection, and administration methods with a smaller burden on the patient are needed. We are engaged in research with the aim of contributing to very early diagnosis/treatment of chronic diseases and to patient-oriented drug therapy from the standpoint of materials science. Diverse functions are demanded in materials which are introduced into the body to treat diseases. While efficacy in treating the disease is of course necessary, safety is also extremely important. Various functions are necessary in order to satisfy both of these requirements, including a function for avoiding recognition by the immune system, a function that acts only on the target site and a function that enables rapid metabolism after medication has completed its purpose. Nanoarchitectonics, which is a technology for assembling element molecules, is extremely natural and is a useful approach for designing materials that possess these many functions.

Designing therapeutic molecular materials and maximizing their functions

One material that we created is BCC (β-cyclodextrin-grafted chitosan), in which cyclodextrin, a cyclic oligosaccharide of natural origin, is grafted to chitosan, which can be obtained from crab shells, etc[1]. BCC is designed so as to interact strongly with the tyrosine and phenylalanine moiety of peptide. Biomedicines represented by insulin cannot be administered orally due to the problems of stability against digestive enzymes and permeability across gastrointestinal tract membrane. However, both stability against enzymes and membrane permeability could be greatly improved by creating a complex of insulin and BCC. Moreover, while insulin absorption occurs rapidly from a molecular complex that maintains a solution state, sustained insulin absorption was confirmed from a nanoparticlized complex created by ionic crosslinking of that complex (Fig.). Although many materials for promoting the oral absorbability of biomedicines have been proposed, adjustment of effects by utilizing the material assembly method is a novel approach. This result can be considered one example of the realization of a medical application of nanoarchitectonics.

BCC also has the function of removing cholesterol from biomembranes. Because hardening of the arteries (arteriosclerosis) is caused by accumulation of cholesterol on the walls of blood vessels, use of BCC as a material for treating arteriosclerosis is expected. However, selective treatment limited only to the parts related to the disease is necessary, as cholesterol itself is an essential molecule in living organisms. Since the pH of the inflammation site is low, first, we created a peptide material that acts on biomembranes under a weakly acidic condition. Because this peptide takes an amphipathic helical structure only under weak acidity, and furthermore, the above-mentioned amino acid residue is introduced, a complex with BCC is formed. This enhances the cholesterol removal effect of BCC only under acidic conditions, and thus opened the way to treatment of arteriosclerosis[2]. This material was assembled based on a detailed design so that each of the three elements, chitosan, cyclodextrin, and amphipathic peptide, can demonstrate their respective functions to the fullest extent.

In addition, we have also created a succession of other nanoarchitectonics component materials oriented toward medical treatment, including an implantable material which releases a drug on demand in response to pressure from the patient's own hand, a new drug carrier that consists of only a biomembrane component and others. In view of the ongoing diversification of medical technologies, it appears that materials research will also play an increasingly large role in the medical field in the future.

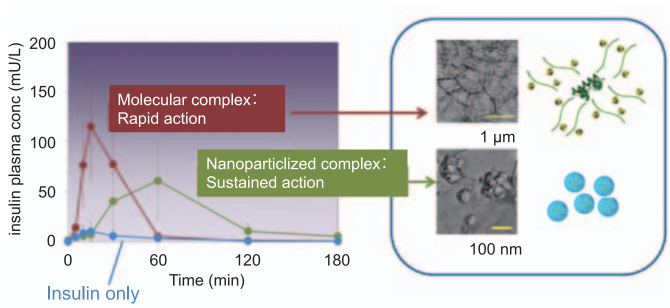

Fig. : Insulin plasma concentration profiles after intestinal administration of BCC/insulin molecular complexes in rats (left) and a TEM pictures of the complexes (right). Blue: Insulin only, red: BCC/insulin molecular complex, green: BCC/insulin nanoparticlized complex.

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Leader's Voice

Yoshio Nishi

Interviewed by Science Journalist Akio Etori

Profile

Yoshio Nishi

Professor of electrical engineering, Stanford University. Prof. Nishi received a PhD from the University of Tokyo, and in 1962 he joined Toshiba R&D working mainly on Si based CMOS devices and technology. In 1986 he joined Hewlett-Packard, and in 1995 he moved to Texas Instruments Inc, as Senior Vice President and Director of R&D. In 2002 he switched from industry to academia as a faculty member of Stanford University. His specialty is physics and engineering of semiconductor devices. He is IEEE Fellow from 1987, and received numerous awards, including 2002 Robert Noyce Medal. He also serves as an Evaluation Committee member of MANA.

Huma

Making English a common language is essential for internationalization

— Prof. Nishi, how do you see the development of WPI-MANA?

There have been various twists and turns along the way, but overall, MANA has made extraordinary progress. The activities of MANA as such, that is, materials development and leading-edge exploratory research in fields based on that work, have made a very important contribution to scientific progress in nanoscience. MANA has also grown to the level where the results of research in MANA, for example, the atomic switch, can actually be applied to systems like the brain type computer and their potential can be verified. From view point of Stanford University, I also feel that MANA is doing excellent job in terms of of attracting outstanding researchers from Western Europe and the United States, for which making English as a common language was enormously effective.

— Even now, attracting top-flight researchers from other countries seems to be an important issue in Japan.

After all, the problem of language is a large one. Even looking at my own students, in a world-wide comparison of organizations with excellent research capabilities, what language can be used to complete the necessary communicative procedures for research activities when placed in that position will be an issue. For instance, even when doing trivial matters such as sending purchase order of parts, or making a Shinkansen reservation to attend conference, if English could be used for such occasions, the daily activity would be much easier and smoother for those coming from foreign country.

Frankly speaking, while there is no problems in technical discussions with research colleagues as most people can speak English, there may still exist a number of miscellaneous administrative matters and support/technical service required, which tend to have been done in Japanese language. If time is lost as a result of such trifling matters, even assuming it's only several days, that will eventually accumulate into a large loss, and will become an obstacle to research activities as a whole. I think it's important to recognize that the barrier of language is far higher than is thought by Japanese who are living in Japan.

Contributing to society through materials research

— It has now been 28 years since you moved to America. Can you tell us about your own work?

Because there is no mandatory retirement system in America, I'm on 100% active duty all along. I currently have 11 doctoral students in my lab, and I'm engaged in discussion with them year-round, while also teaching at the same time. Always striking a balance between research and teaching is an article of faith with me.

For the past several years, I've been grappling with the development of nonvolatile resistance change memory. Among the transition metal oxides, for instance, the stoichiometry sometimes fails, and oxygen vacancies form. If that happens, the electron clouds in the surrounding metal atoms will mutually intersect, and their oxides, which were intrinsically insulators, will pass electricity. In my research, I investigate that behavior by theoretical calculations and confirm experimentally whether that actually occurs.

While I was at Toshiba, I also wrestled with the problem of the work of this system, that is, what happens when two different substances are in contact to each other. Using electron spin resonance absorption measurements, I was the first in the world to discover the phenomenon in which oxygen vacancies form in silicon MOS transistors at the interface between silicon and the silicon oxide, leaving Si dangling bond, and electrons are trapped in those vacancies. Study of the behavior of such dangling bonds of atoms, followed by behavior of electrons, you might say, is something that seems to be my life's work.

— Could you describe the future of your own research, and its relation to society?

Serious relation is the accumulation of various data that humankind needs. In big data, data central and the like, which are frequent topics, basically, most of the data are stored in huge amount of conventional electronic charge storage-type memories, such as flash memory, but this type of memory is already approaching to its limit. However, if it was possible to build a system that can utilize new phenomenon where electrical conductivity changes by applying programming voltage i.e. "1" or "0", in nanoscale, it would realize non-volatile resistive switching memory which has a high speed programming and reading, with an order of magnitude smaller power consumption.

Environmental information from every part of the world will be detected by sensors,

Contributing to the Future of
nkind with a Sincere Attitude

and the data acquired by those sensors will be accumulated. If such a system can be created, we can advance to a stage where the collected data are widely useful for us humans. Examples include monitoring and accumulation of long-term weather information, environmental information both nature made and human made, medical data and the like.

"Human integrity" and "teamwork."

— Could you discuss the strengths of human resources development at Stanford University?

In Japan, there seem to be quite high barriers against collaboration and communication between individual researchers or between laboratories, but in America, and particularly at Stanford University, there's virtually nothing like that. For example, students of other professors are welcome in discussions in the inner circle of our laboratory; the opposite is also true, and there's absolutely no need to ask me for permission.

Although each student in the doctoral course has a total of three research advisors, it's not necessary to select those people from the same department, or even from the same university. When a student wants to expand his or her knowledge while doing research, that student just visits people who are doing a good job in that field and requests guidance. A PhD is not a mere specialist trapped in the narrow confines of his or her work, but possesses adequate horizontal breadth . . . We are mindful of that kind of teaching, and students actually receive that kind of education.

For that reason, I feel that it is extremely good that you also have that kind of environment at MANA, and you have horizontal collaboration, so that, for example, when somebody wants to do research with someone at NIMS who isn't affiliated with MANA, or with someone from another university, they can throw themselves into it, without asking the permission of their superior in each individual case.

— What things are you aware of for developing outstanding young people in that manner?

I communicate that fact that, while they're at university, their research is basically individual work, but there are different standards of value proposition in the real world. Perhaps nobody questions your research ability, but what they do ask, first of all, is that do you have high level of human integrity or not? And equally important, is that are you willing to work in a team or not? Sometimes there are people who have graduated from top class universities, but for that reason, they simply can't display an attitude of doing things together with others.

The case of people who would join company, but become university professors, the situation would be the same. When a student is looking for work, prospective employers ask me for a reference, but the ultimate questions that I'm asked at that time are, after all, the two things I just mentioned, i.e. human integrity and the willingness to work in a team. This is simply reflecting complexity of today's science and engineering in which progress can be sizable only having a number of brains collaboration together with mutual trust.

Researchers who follow an honor code will create the future.

— Finally, how do you see the direction of nanotechnology research in the future? Will nanotechnology lead humankind in a good direction?

First and foremost, we need to think how individual research studies can contribute to the future society. Though each researcher should think this theme individually, it is also necessary for MANA to be able to express that viewpoint more clearly. When looking at the research that you're doing from the macro scopic perspective, the question you should ask would be what kind of impact it may create in its magnitude and also time scale. In that, for example, if the future development looks unfortunately undesirable, making a judgment to stop with good grace, and going on to the next project, is not necessarily the job of the research manager, but should be done by the researcher him/herself. It is important for individual researcher by considering various criteria for deciding your fate by yourself, I think.

Generally speaking, I believe, nanotechnology can surely contribute to humankind. For example, in the field of medicine, the environmental and energy field. However, unlike the pure sciences, how we use nanotechnology is a problem. But while opinions may differ depending on the person, it is my conviction that, fundamentally, our society must be inherently good. In Europe and America, there is a cultural climate that highly evaluates the attitude that people should always act in the light of their own morality or pride, which we refer to as following an "honor code". In that sense, I truly want to base my actions on the belief that all people are inherently good, and I want to consider how that aspiration can contribute to society in the future of science and technology. The future of humankind is definitely not something that we can leave to others.

Prof. Nishi in his young days

Novel Device Structure Emitting White Light

Creating light with a color rendering index by taking advantage of unique electronic structure featured in silicon nanocrystals

Naoto Shirahata

Independent Scientist

Light source technologies, an increasingly familiar presence in modern life

With some solids, the substance itself emits light when an electric current is passed, and it is possible to obtain light of the desired photon energy by selection of such substances. Devices incorporating those substances are called solid-state light-emitting diodes (LED). Representative examples include LEDs, semiconductor lasers and organic EL (electroluminescent devices). Although the appearance of the blue LED, which gained wide recognition as a result of the 2014 Nobel Prize in Physics, triggered a revolution in the lighting industry, LED technology is not limited simply to lighting, but is also directly related to realizing mega-volume information technologies by manipulation of the spatially coherent beam emitted by lasers. It can be said that modern people who use numerous mobile devices each have an existence as a base that receives and transmits information via light, and at the same time, those optical technologies have become increasingly familiar precisely because so many people now own “light sources.”

Spectrum formation based on additivity

In solid-state LED, it is necessary to add together different spectra in order to form a light-emitting spectrum with an excellent light rendering property, including white, etc. While the electronic structures of substances that emit light with high efficiency are generally advantageous for light emission, with those substances, it is difficult to place pairs of substances with different bandgaps in adjoining positions. This is because spectrum additivity (property that the spectrum of a mixture becomes equal to the sum of the spectra of its component substances) is not materialized due to fluorescence resonance energy transfer or self-quenching. At present, the technique of patterning is used to overcome this difficulty. In this method, proximity between pairs of different substances is avoided by micro-processing, but this does not completely solve the problem.

We discovered a new mechanism for realizing additivity of spectra, in which skillful use of silicon nanocrystal (ncSi) is effective. Because ncSi has a unique electronic structure, it has the distinctive feature of an extremely large Stokes shift between excitation and emission and absorbs virtually no visible light. Based on this fact, as the visible light spectrum is not an object of light absorption for ncSi, we hypothesized that addition of spectra with no energy loss should be possible. We fabricated a device structure (Fig.) using ncSi and verified this hypothesis by showing experimentally that the blue-green emission spectrum and red emission spectrum can be added with no loss of photon energy. We also succeeded in controlling color rendering based on tuning of the light-emitting layers.

Toward the creation of light sources that satisfy environmental, resource and functional requirements

Quantum confinement effect become remarkable in the single nanosize region, and the phenomenon of high efficiency light emission exceeding 60% which appears in ncSi is truly an example of this. Until now, the structures of Si LEDs utilizing the quantum properties displayed by ncSi had been limited to the red-orange visible light spectrum region and near-infrared. However, as a result of this research, white light could also be added to those spectra. Although the essence of this achievement lies in the mechanism for spectrum formation, we believe that the concept of spectrum additivity described above can also be used widely. We expect that the day when we can add “functionality” to the intrinsic environmental and resource performance of Si is near.

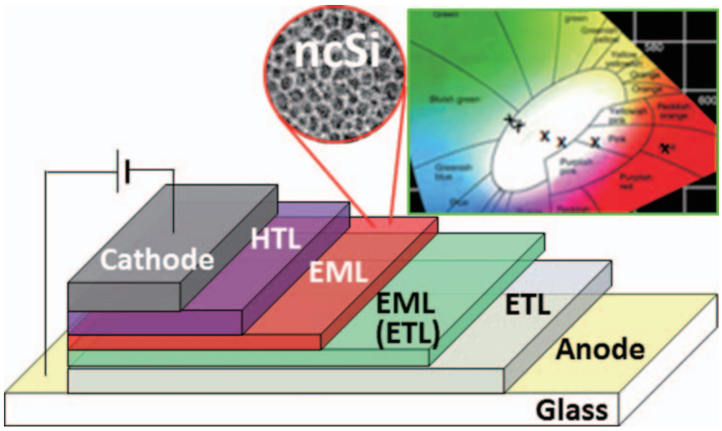

Fig. : Prototype of the white light emitting diode (WLED) fabricated in this research and a CIE chromaticity diagram.
ETL: Electron transportation layer, EML: Emission layer, HTL: Hole transportation layer.

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Omotenashi *: Our Mantra - MANA Administrative Section -

For a researcher, the greatest joy in life is to produce outstanding research results. To support researchers working in an international environment, we take the "conflict of cultural differences" seriously and are creating a new culture.

Through operation of the International Center for Young Scientists (ICYS), which was launched in 2003 prior to MANA, NIMS experienced first-hand the importance and difficulty of a culture and spirit that nurture international research. Researchers can only contribute to producing excellent results and building a basis of new research culture by mutual understanding through conversation. However, unexpected problems occurred when large numbers of foreign researchers were invited to live and work in Japan.

The staff of the MANA Administrative Section is proficient in English and provides strong support for administrative procedures required for research-related paperwork, as well as technical support, etc. Our staff also work proactively to solve the diverse problems that can be called the "conflict of cultural differences." Of course, this does not simply mean solving any and every kind of problem clearly; pursuing the best possible measure without compromise is precisely providing omotenashi to researchers working at MANA, and is a necessary and indispensable mission of the Administrative Section from the viewpoint of producing excellent research results.

As a result of these efforts, MANA received a high evaluation from the FY2014 WPI Program Committee as a "role model for the internationalization of WPI centers." Thus, the MANA Administrative Section is one invaluable asset of NIMS which was cultivated through the WPI Program.

Column1

While a researcher was away, his landlord contacted us, saying a dog in his apartment was barking incessantly. Although there was no choice but to enter the apartment and rescue the dog, the dog's owner, who intended to leave the dog's care to a friend while he was away, was enraged by the violation of his privacy. We convinced him that it is also important to consider noise problems.

Column2

A new researcher asked us to purchase exactly the same chemicals and equipment as he was used to using, but many of the hoped-for items were difficult to obtain in Japan. At such times, the technical support staff in the Administrative Section politely listens to the researcher's request and offers a solution that makes it possible to obtain equal or better items in Japan.

Joel Henzie, Independent Scientist, MANA

Aono-san, Bando-san, Fujita-san and all the staff have created a strong research culture here at MANA. Few places exist that offer the opportunity to do research in an environment with such streamlined operations and administration, giving scientists time to focus on their research and make big discoveries. It would be a great loss if we allowed the culture of MANA to decline. Moving forward I think researchers should follow the old maxim: be bold and mighty forces will come to your aid. The WPI generously helped to create the research culture at MANA, and it is up to us to think big and keep it going.

* *Omotenashi* is a concept that indicates a kind of hospitality, even though no simple equivalent word exists in English. Omotenashi means a Japanese style of service which is accompanied by thoughtfulness and solicitude, devotion to the needs of the other person, and consideration of even the smallest details.

NEWS & TOPICS

Recent Events

MANA International Symposium 2015

The MANA International Symposium 2015 was held at Epochal Tsukuba in Tsukuba City, Japan over a 3-day period from March 11 (Wednesday) to March 13 (Friday), 2015. The MANA International Symposium is held each year to present research achievements at MANA to the Japanese and international scientific communities. This year's event was the 8th in the series.

This 2015 Symposium featured Special Lecture entitled “Background of the discovery of carbon nanotubes” by Prof. Sumio Iijima, as well as Invited Talks by 14 distinguished scientists from Japan and other countries. Research results at MANA were also announced in a total of 14 oral presentations and 133 poster presentations, and 6 young scientists who made excellent poster presentations won the MANA International Symposium 2015 Poster Award. The Symposium attracted more than 400 participants over the 3-day period, with lively question-and-answer sessions and exchanges of ideas.

MANA Grand Challenge Meeting 2015

The annual event, MANA Grand Challenge Meeting, was held in Nasu, Japan over a 2-day period from February 25 to 26, 2015.

The Grand Challenge Meeting is an event that includes discussions and presentations about the next MANA research themes and directions we will take. Lively presentations and discussions by the participating researchers were held with no research field boundaries. The meeting was a truly significant event that reflected the slogan posted in various places in the MANA Building, “The fruits of your research are proportional to the number of your conversations with others.”

News

Arrival of New Administrative Director

Dr. Tomonobu Nakayama, who served as Principal Investigator in the Nano-System Field, arrived as the Administrative Director of MANA on May 1, 2015, in conjunction with the assumption of the office of Executive Vice President of NIMS by the former Administrative Director, Mr. Takahiro Fujita.

A short message from the new Administrative Director: MANA’s Administrative Office provides services for distinguished researchers from all over the world to allow them to show their ability fully in their research. Therefore, we want visit the research sites as much as possible.

Tomonobu Nakayama
Administrative Director, MANA

Awards

Satoshi Ishii, MANA Scientist, “Konica Minolta Imaging Science Encouragement Award”: “Invention of ultrathin flat lens”(2015.3)

Jin Kawakita, MANA Scientist, “The Japan Institute of Metals and Materials Meritorious Award (Material Chemistry)” (2015.3)

Mitsuhiro Ebara, MANA Scientist, “Silver Award of the Tanaka Precious Metals Research Grants”: “Development of New Materials for ‘Treatment of Persistent Cancers’ Preventing Recurrent and Metastatic Cancer” (2015.3)

Takashi Nakanishi, Independent Scientist, “Award for Excellence at the ‘Beauty in Science and Technology Panel Exhibition’” (2015.4)

New Face

MANA Scientist
Ken Sakaushi

MANA Scientist
Daiming Tang

MANA Scientist
Rudder Wu

ICYS-MANA Researcher
Karolin Jiptner

ICYS-MANA Researcher
Thi Kim Ngan Nguyen

Emerging MANA Researcher

Satoshi Tominaka

Dr. Satoshi Tominaka studied overseas in Italy during his student years, and also studied in England after joining MANA. Thus, he says that he could feel the depth of the history of scientific research in Europe "with his skin." He notes that a broad perspective and an attitude that communicates the significance of research and the reliability of science to the general public is also necessary in Japanese researchers. He says, "I feel that the future will be difficult without doctorate holders who can present a total vision for strengthening Japan's science and technology."

Dr. Tominaka is grappling with the development of fuel cells. In addition to chemistry, various other fields are also related to this work, including fluid engineering and materials science among others. In research in composite fields, researchers in different fields are generally in charge of their own areas of specialization and try to fill the boundary regions between those fields. However, Dr. Tominaka strives to be conversant not only with his own field of chemistry, but also with physics. "There absolutely are ideas that are impossible without knowing both. The question is how to achieve that. My challenge is to use myself." In recent years, he has been involved in research on platinum-free catalysts with the aim of realizing a fuel cell that does not require the use of scarce metals as raw materials.

Dr. Tominaka's approach to experimental results is extremely precise. He laughs when he says, "I work on the assumption that the things we see with our eyes and the data that are output by devices are not necessarily correct. It's really tiring!" He exhaustively repeats discussions of studies, proposals of hypotheses and their verification. He is continuing to face the data by this slow-but-steady approach in order to "do research that will still be meaningful 100 years from now."

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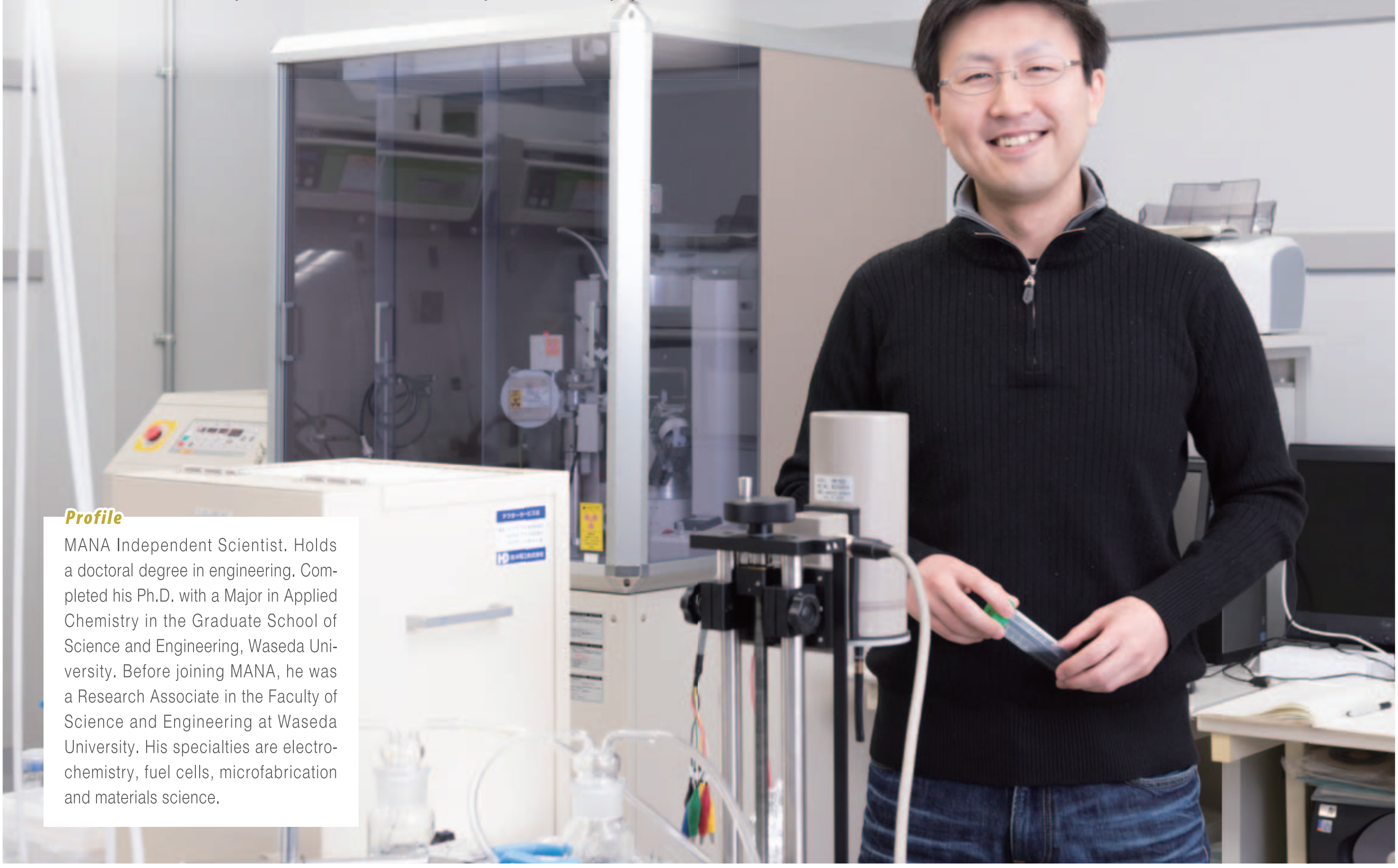

Profile

MANA Independent Scientist. Holds a doctoral degree in engineering. Completed his Ph.D. with a Major in Applied Chemistry in the Graduate School of Science and Engineering, Waseda University. Before joining MANA, he was a Research Associate in the Faculty of Science and Engineering at Waseda University. His specialties are electrochemistry, fuel cells, microfabrication and materials science.

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"**CONVERGENCE**" is the keyword used to symbolically describe the entire project of MANA, where outstanding researchers from around the world assemble and converge in the "melting pot" research environment to bring together key technologies into nanoarchitechtonics for the creation and innovation of new functional materials.

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