Emerging MANA Researcher

Waka Nakanishi

Dr. Nakanishi says that her journey on the road to becoming a researcher began with the childhood question, "How can medicine work, when the drug you take is so small?" After mastering pharmacology, the feeling that she wanted to pursue more fundamental principles became stronger, and she changed her course from the doctoral program in pharmacology to chemistry. Now she considers it an advantage that she can design, synthesize, and provide new molecules with the desired functions in diverse fields, from life science to materials science, based on the foundation of synthetic organic chemistry.

Although this is her second year since arriving at MANA, she has the impression that "it's easy to do joint research with other fields, utilizing one's own expertise." One example is the development of a nanomachine using a self-assembly function originating from the molecular structure. Technologies for synthesizing submicron-sized machines are still in the early stages of development worldwide, but she is working in cooperation with researchers in a variety of fields, including nanostructured materials, protein engineering, and others.

Dr. Nakanishi also has the face of the mother of two children who go to nursery school. By taking advantage of the NIMS support system for researchers engaged in parenting, she can keep an environment where she can devote her total attention to her research. Smiling softly, she says "It's a great help that I was assigned an assistant" and "Time management has become very demanding since I had children." And she adds, "Even being a girl, when one feels that science is interesting, it's important to create a society where she doesn't have to abandon the road to continue research."

Profile

MANA Scientist, MANA Supermolecules Group, Supermolecules Unit, Nanomaterials Field. Dr. Nakanishi received her doctorate (Ph.D., Chemistry) from the University of Tokyo, School of Science in 2005. Prior assuming to her present position in 2013, she was an Assistant at the Graduate School of Pharmaceutical Sciences, Chiba University and a Lecturer at the Graduate School of Science, Tohoku University. Her specialty is organic chemistry.

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Outreach Team
International Center for Materials Nanoarchitectonics (MANA)
c/o National Institute for Materials Science (NIMS)
1-1 Namiki, Tsukuba, Ibaraki, 305-0044 Japan
Phone : +81-29-860-4710
Facsimile : +81-29-860-4706
Email : mana-pr@ml.nims.go.jp
URL : http://www.nims.go.jp/mana/

"**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.

Cover : MANA Principal Investicator, Katsuhiko Ariga and young researcehrs at WPI-MANA Building

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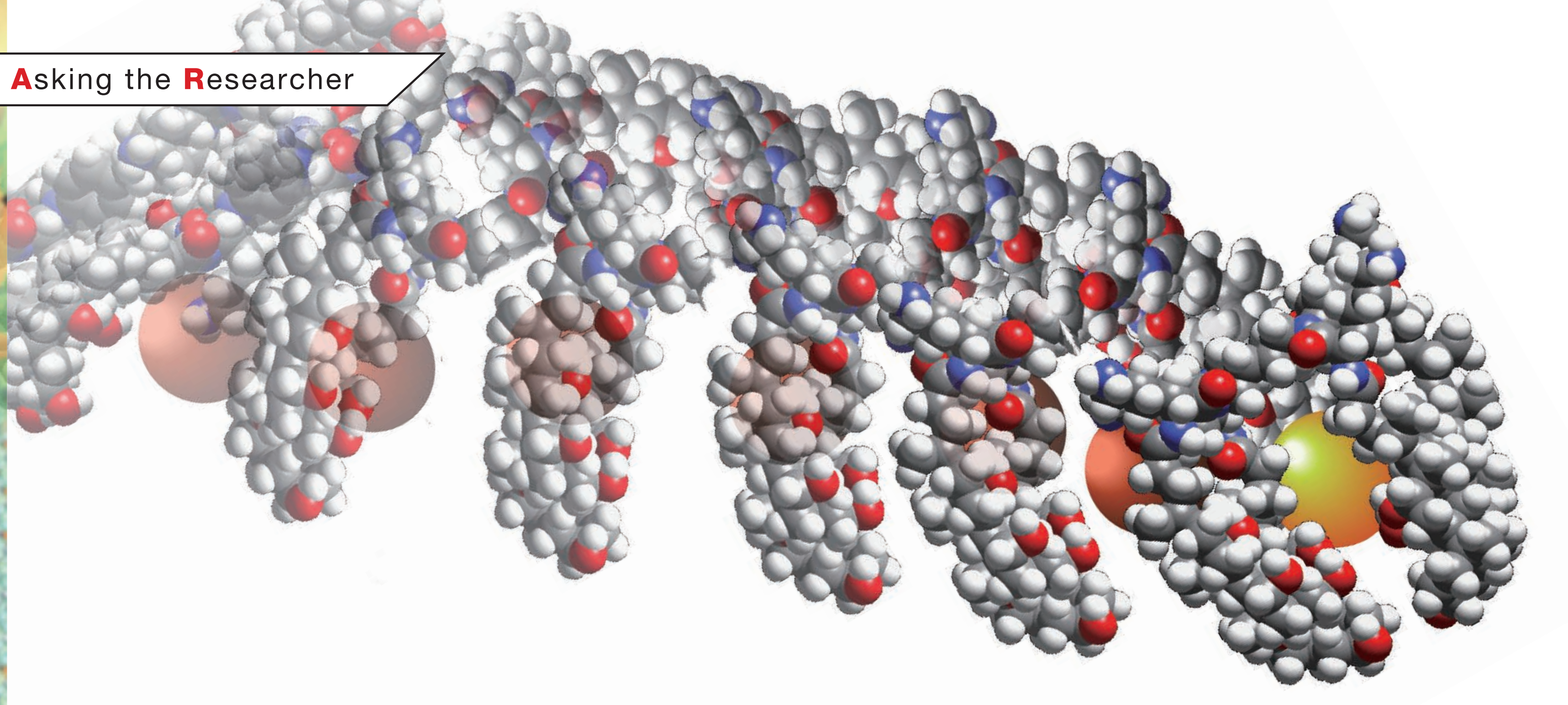


The Future of Science, Perspective in Supermolecules

Katsuhiko Ariga

MANA Principal Investigator, Unit Director, Supermolecules Unit, Nano-Materials Field

"Supermolecules" are structures which are created by assembling molecules, and demonstrate novel functions that cannot be obtained from the individual molecules. MANA Principal Investigator Dr. Katsuhiko Ariga is one of the world's leading front-line researchers in nanomaterials and supramolecular chemistry, and is also passionately devoted to providing information to society from a scientist's point of view. In this interview, Dr. Ariga talks about supermolecular research and the future evolution of science and technology.

Profile

Dr. Ariga completed his Ph.D. in engineering at the Tokyo Institute of Technology Graduate School of Engineering in 1987. After working for the Tokyo Institute of Technology, the University of Texas at Austin, the Japan Science and Technology Agency (JST), the Nara Institute of Science and Technology, etc., Dr. Ariga joined NIMS in 2004. He has held his present position since 2007. He is a Fellow of the English Royal Society of Chemistry and was selected as one of 101 Japanese in Thomson Reuters' "World's Most Influential Scientific Minds."

◉ Interviewer : Akio Etori, Science Journalist

What is "supramolecular" chemistry?

"The ultimate materials may actually be the biological materials that have created us. Living organisms are autonomous and can also reproduce. They respond to stimuli from the outside world. The mechanism that makes biological activity possible is not the product of a serial arrangement of individual molecules; it's the result of judgments and responses by the total organism, in which various molecules are interrelated," says Dr. Ariga. For example, in the flagellar motors of bacteria, a machine-like system is created naturally when an extremely large number of protein molecules come together. The result of this process, in which molecules come together to form assemblies that manifest functions not possible in single molecules, is called a "supermolecule." "The lipids, proteins, and saccharides that make up living organisms are all combinations of many individual molecules and have the mechanism of supermolecules which can display feedback functions."

Dr. Ariga began full-scale research on supermolecules at the beginning of the 1990s, and he participated as Group Leader in the Japan Science and Technology Agency's International Cooperative Research Project (ICORP) [a1] "Supermolecules Project," which began in 1992. He also participated in the symposium "Supramolecular Chemistry: 100 Years of the Lock-and-Key Principle," which was held in Mainz, Germany in 1994. The main topic of that international symposium was the fact that "lock-and-key principle," which was proposed in connection with enzyme reactions, etc., grew into the concept of supermolecules over its history of almost 100 years, and was the subject of the Nobel Prize in 1987. Dr. Ariga says that he senses that a new current arose in supermolecules, with that 100-year anniversary as a turning point.

In actuality, following this, heightened expectations were placed on supermolecules in the life science and medical fields. The fact that supermolecules would play an important role in nanotechnology was also recognized. As a result, even greater attention was focused on supramolecular chemistry. Dr. Ariga became a key person at MANA and is leading the development of innovative supermolecule-based materials which are without precedent anywhere in the world.

"Technology that is useful" and "Science that pursues dreams."

Dr. Ariga says that he is "conscious of two concepts" in research. "One is 'technology that is useful' and the other is 'science that pursues dreams.' Living as a scientist who does research that only he is doing, that only he can do, and continuing that research based on free conception become a motivation."

As an example of Dr. Ariga's "technology that is useful," the development of a technology for visualizing radioactive cesium can be mentioned. After this research was announced in the media at the end of 2012, reagents were marketed by private companies within six months and reached practical application with exceptional speed. With radiation detectors and other physical techniques, it is not possible to see the presence of cesium visually, and there are limits to spatial resolution. In contrast, Dr. Ariga realized a technique for visualizing cesium with micrometer level resolution by designing a fluorescent probe, "Cesium Green," which is a supermolecule that distinguishes only cesium (Fig. 1).

In the spring of 2014, the intracellular distribution of cesium was successfully visualized (Fig. 2) by utilizing Cesium Green in plants that had absorbed cesium. Various other applications are also expected in the future, such as detection of the cesium distribution in foods which have been contaminated by radiation, and in animals and humans which have ingested those foods.

Fig. 1 Molecular structure of the cesium probe, "Cesium Green," for detection of cesium. When the supermolecule contains cesium, it emits a green light.

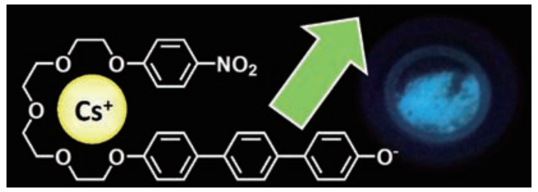
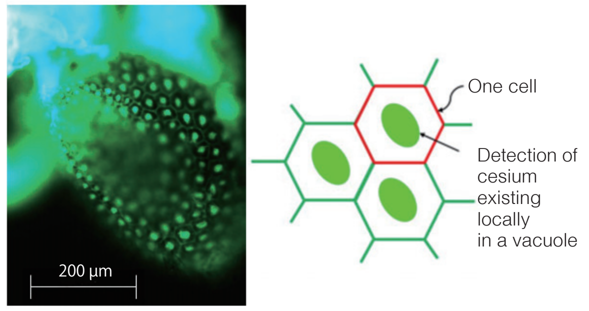


Fig. 2 Fluorescent image of a seed leaf of cress thale (*Arabidopsis thaliana*) obtained by dripping a Cesium Green methanol solution. Bright fluorescent light can be observed from parts that are considered to be vacuoles in cells.

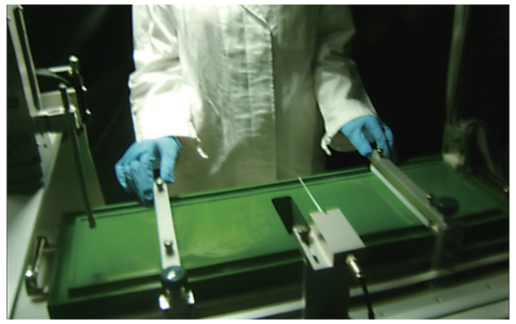


On the other hand, the creation of "hand-operating nanotechnology" is an example of "science that pursues dreams." In 2010, Dr. Ariga developed a "Supermolecular system for grasping molecules with the human hand" (Fig. 3). This makes it possible to bend or stretch a molecular machine by pushing it with the human hand, and to capture and release different small molecules in water.

This was realized by Dr. Ariga's original concept of reducing the movement of molecules from the 3-dimensional world to the 2-dimensional world. In other words, if molecules are arranged as a supramolecular thin film, and the spatial dimension in the height direction is brought infinitely close to zero, it is possible to couple large in-plane material-level movements and the molecular level action in the film direction. If the film is manually compressed from the side, the open molecular machine will try to take the smallest possible structure. As a result, it will assume a cavity structure, and in this process, it will capture molecules in the water (Fig. 4).

It is also conceivable that the same phenomenon can also be realized not only in water, even by using a film that can be expanded and contracted freely, and Dr. Ariga is now developing a portable type system. The day when ordinary people can easily perform nanotech operations by hand, from sensing and capture of poisons to transmission of electrical signals via chemical substances, may not be far off!

Fig. 3 Supramolecular system for grasping molecules with human hand.



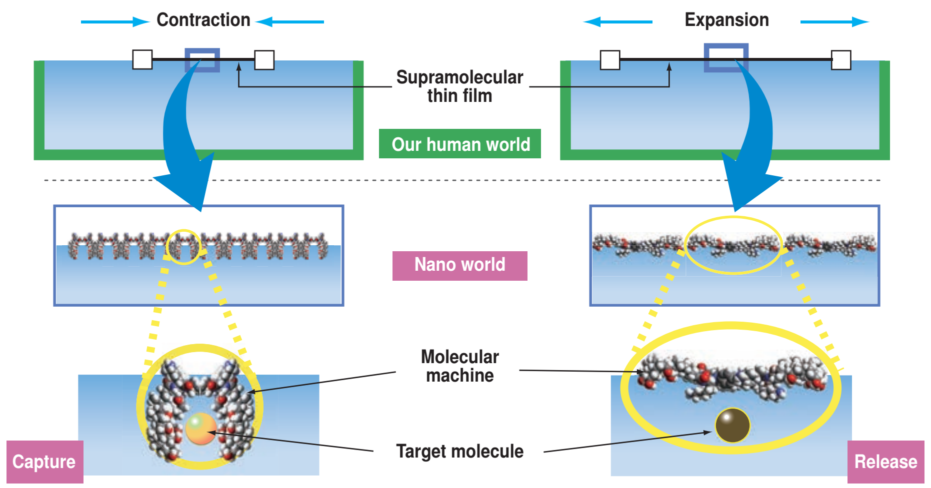
To the science and technology of the future by "nanoarchitectonics"

In June of this year, Dr. Ariga published a book entitled "Materials Revolution: Nanoarchitectonics" for general readers (introduced on p. 11 of this issue of Convergence). As Dr. Ariga says, "Since the concept of nanotechnology is becoming stereotyped, here, we must achieve a breakthrough."

"We need to change our paradigm from the viewpoint of conventional nanotechnology, which considered the functions of individual nanoscale structures separately, to a total viewpoint that focuses on unknown functional linkages that are produced by accumulating interactions without knowing what will occur, which is due to the unique indeterminacy of the nano size. In our exploration of the nanoscale world, we have come to the time when we must aim at a change from simple technology, i.e., nanotechnology, to a total architecture, in other words, nanoarchitectonics." In this connection, it's worth mentioning the Dr. Ariga and Dr. Richard Feynman, who is the father of nanotechnology, share the same birthday.

Dr. Ariga also wants the more general public to understand how important science is. This is because he hopes that society will recognize not only science and technology that are immediately useful, but also, as an investment in the future, science that does not fear failure. Dr. Ariga believes that it is precisely this recognition of science by society that will nurture an environment in which scientists with new ideas can devote themselves wholeheartedly to their research. "Even if people call you foolish, follow your dream. And if you sometimes seem to be a heretic, pursue what only you can do. For Japanese science and technology to make further progress, we have to create a society where that's accepted."

Fig. 4 Mechanism of the supramolecular system for grasping molecules with the human hand. When a supramolecular thin film on the surface of water is made to contract or expand by the movement of the human hand in our human world, corresponding to this, the molecular machine captures or releases a target molecule in the nano world.



Tomonobu Nakayama
Principal Investigator / Nano-System Field

Scanning Probe Microscopy with Multiple Probes
– from Nanocharacterization to Nanosystem Operation

Scanning tunneling microscope revolution

The first scanning tunnelling microscopes (STMs) developed 30 years ago provided images with a scale of detail that catalysed a new field of scientific endeavour in nanotechnology. Now, research at MANA is contributing significantly to developments of the technology to produce a potent tool box for simultaneously mapping the topography and electrical properties of individual nanomaterials. These devices not only reveal valuable information on nanomaterial properties for designing new systems through nanoarchitectonics, but also make it possible to explore the emerging functionalities of the created systems.

Masakazu Aono, Tomonobu Nakayama and their colleagues successfully developed a double-probe scanning tunnelling microscope (DP-STM) for the first time in the late 1990s. Each probe was mounted on a piezo actuator to allow independent control of their positions (Fig. 1). Successful use of the DP-STM hinged on having an accurate knowledge of the location of each probe, which the team achieved by harnessing the STM imaging capabilities of the common area on the sample with different probes. They also achieved significant reduction of the interprobe distance down to the order of 10 nm while retaining sufficient mechanical stiffness by adding a tungsten oxide nanorod to the apex of each probe.

Two probes are better than one

The ability to measure electrical properties between accurately controlled points using a double-probe STM has provided valuable tools for seminal electronic studies of nanosystems. Systematic studies of the length dependence of carbon nanotube conductance demonstrated the transition to 'ballistic' transport - where electrical resistance is essentially zero - as the distance between the two points is reduced. While this kind of electrical property is important for application, it could not be measured with a single probe STM.

Multiple probes, multiple benefits

It might seem that measurement like that described above can also be realized by fabricating fixed electrodes by lithography. However, it is impossible to make measurements while changing the position of fixed electrodes on the same nano-object. More than anything else, today, when various nanomaterials and nanostructures are being created using diverse materials, multi-probe STM which makes it possible to place multiple probes that function as electrodes in contact with a specimen at arbitrary positions, and to change those positions as necessary, is considered an indispensable technique for the study of nanosystems. Researchers at MANA also demonstrated multiple-probe scanning probe microscopes (MP-SPMs) that can operate both as STMs or atomic force microscopes with carefully designed tuning fork probes (Fig. 2). These developments further extend the range of environments which the multiple probes can be used, bringing a powerful versatility to studies of nanoscale systems. Furthermore, MP-SPM will be used as an interface to nanosystems such as neuromorphic networks for example. MANA is extending the possibilities of MP-STM beyond the limits of measurement, and making efforts to establish new technologies that will operate nanosystems realized by nanoarchitectonics.

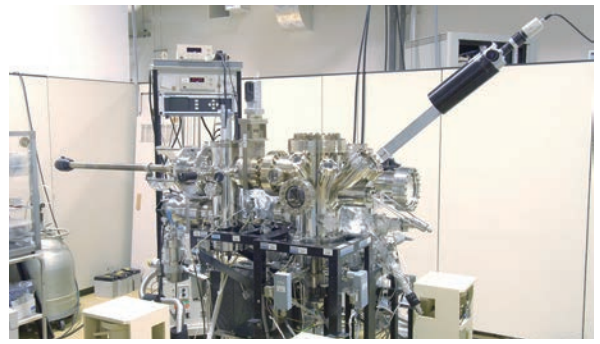


Fig. 1: The world-first double-probe scanning tunnelling microscope further improved at MANA.

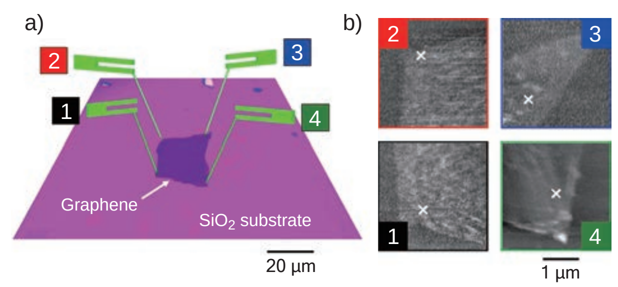


Fig. 2: Schematic diagram of a quadruple-probe atomic force microscope with tuning fork probes (TFP) enabling measurement of the properties of graphene with nanoscale precision. a) Schematic diagram of the four TFPs approaching a monolayer graphene flake measured by QP-AFM. The middle part shows the graphene flake, which is laid on a SiO_2 substrate. b) AFM images (3×3 µm^2 each) obtained at each corner of the graphene by using the four TFPs.

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Leader's Voice

Innovate in Japan with a Global Perspective

Teruo Kishi

◉ Interviewer : Akio Etori, Science Journalist

MANA- confronted the challenges of internationalization head-on

— Prof. Kishi, you are the former President of the National Institute for Materials Science, and you were also one of the true parents of MANA. It has now been more than 7 years since MANA was launched. Do you feel that MANA is growing as originally hoped?

Yes, and in fact, MANA's efforts have far exceeded my expectations in some areas. From what I see, the way MANA has established directions for research, for example, in creating the 4 Research Fields of "Nano Materials," "Nano Systems," "Nano Power," and "Nano Life," and identifying the 5 key tools of nanoarchitectonics that support those fields, can be considered extremely good. The Director-General, Prof. Aono, has really worked hard in this regard. Where the research system is concerned, the achievements of the Chief Operating Officer, Prof. Bando, were also quite large. Prof. Bando nurtured the original International Center for Young Scientists which NIMS inaugurated in 2003, and made its successor organization, the International Center for Young Scientists, or ICYS, the foundation for training young MANA researchers. Internationalization is an important keyword in Japan, and MANA has confronted the challenges of internationalization head-on.

In this way, MANA has become the greatest treasure of NIMS, not only standing shoulder to shoulder with Japan's first class universities, but also enjoying a global reputation. Objectively, as well, I think that MANA's presence is evident.

— What research at MANA do you give particularly high marks? Will MANA produce a Nobel Prize?

I haven't kept up with all the developments at MANA recently, so it's difficult to talk about evaluation, but for example, I hope that Dr. Takayoshi Sasaki's research results in nanosheets can contribute to the energy and biomaterials fields. In superconductivity, the fact that MANA has produced hits somehow is interesting. In high temperature superconductivity, in other words, how to bring it closer to materials that can be used at room temperature, is a challenge, and I hope that this will be realized sometime. Likewise, in the field of polymers, Dr. Katsuhiko Ariga's group and other groups are making a variety of efforts, and I feel that they are headed in a good direction. Atomic switches are also moving toward practical application.

If an achievement wins the Nobel Prize, there's a tendency in Japan to consider it perfect, but to begin with, there are fields where it's easy to win the Nobel Prize, and others where it isn't. For that reason, it's difficult to say anything. In any case, in research, there are eight ways to succeed and eight ways to fail, so to speak, and success isn't all that easy. If we were successful every time, science would make too much progress. (Laughs) Considering that, I think MANA is putting up a good fight under the new concept of "nanoarchitectonics," and producing good results across the board in basic research fields. Of course, the basic researches with a clear purpose will lead to the innovation in the next generation.

Time to "reset" Japan as a whole

— How do you feel about Japan's WPI Program?

Since the foundation of the WPI Program is basic research, there's an impression that its feet are planted more firmly on the ground than programs that aim directly at innovation. I feel that the WPI Program has succeeded, in the sense of providing a driving force for the country's basic research, because a strong system was created when the program was started up.

The original five WPI centers, including MANA, were only launched in 2007, but I hear that there is debate about whether to extend their support period or not, and I'm somewhat anxious about that. Because new research buildings have been purposely built and outstanding research environments were created, I hope that those concerned will also provide an appropriate support period. This situation can also be seen in the competition between centers, but since the respective WPI centers are involved in research in completely different fields, I feel that an evaluation is difficult. It's like asking about the relative superiority of two things that can't be compared, like which is better, a Persian cat or a bulldog?

— Could you tell us your thinking on science and technology policy in Japan?

There are two things that I'd like to recommend to the current government. One is strengthening the Council for Science, Technology and Innovation. At present, the fields of space, nuclear power, marine sciences,

Profile

Teruo Kishi

Advisor of the National Institute for Materials Science (NIMS) and Professor Emeritus of the University of Tokyo. Prof. Kishi received the degree of Doctor of Engineering from the School of Engineering of the University of Tokyo in 1969. His specialty is high reliability materials. Among his various positions, he has served as Assistant Professor and Professor of University of Tokyo, Director of the Research Center for Advanced Science and Technology (RCAST), University of Tokyo, and Director General of the National Institute for Advanced Interdisciplinary Research, Agency of Industrial Science and Technology (AIST), Ministry of International Trade and Industry (MITI). He was President of NIMS from 2001 to 2009. He is currently Chair of the Japanese Society for Strength and Fracture of Materials, President of the Innovative Structural Materials Association, and Director of the Cross-ministerial Strategic Innovation Promotion Program, Cabinet Office, Government of Japan.

and large-scale machinery and equipment are outside the purview of this council and as a result, they only have influence on one-third of Japan's science and technology budget. These fields should also be brought together to create a "total" council in the true sense. The second thing is to raise the question of what to do about large scientific research cities. Of course, Tsukuba where NIMS is located, Keihanna or Kansai Science City, and also Okinawa should be considered.

Looking back on the past, until the 1980s, Japan was playing catch-up. Around 1990, there was strong pressure from the United States to put greater effort into common infrastructural technologies, and in response, Japan enacted the Science and Technology Basic Law in 1995. Almost 20 years have passed since that time, and I think that Japan now has a full-blown case of systemic fatigue. One cause of that fatigue, after all, is the rise of China, but after 20 years, and the accompanying systemic fatigue, it's time to "reset" Japan as a whole.

People often mention "review of Independent Administrative Institutions or IAIs," and the like, but in addition to R&D related IAIs, Research Institutes and Centers of Japanese National Universities and National Joint-Use Research Facilities exist throughout Japan. In this situation, no large improvement can be expected by focusing only on the IAIs. For example, in addition to NIMS, there are also other large research centers in the materials field, namely, the Institute for Materials Research and the Institute of Multidisciplinary Research for Advanced Materials, both of which are at Tohoku University, and it is necessary to think about these research centers in a total way. This doesn't mean merging their organizations, but the role of the respective organizations should be studied, while considering the research and development strategy of Japan as a whole. Unless we do this, we can't hope to compete with rivals like the United States and China.

— Looking at the development of science and technology in Japan, the issue of preventing research misconduct is currently receiving considerable attention. You served as the Chair of the Reform Committee for Prevention of Research Misconduct at RIKEN. Could you give us your opinion on the situation in which Japan now finds itself?

Frankly speaking, I have the impression that research misconduct is on the increase in Japan as a whole. Although research is originally a process of producing and publishing research results, there is a tendency for simply publishing papers to become the purpose of research. An attitude of cutting corners and trying to publish as many papers as possible probably tends to encourage actual misconduct. This seems to show the effects of falling into the pay-for-performance system and the general rush to win competitive funding. Perhaps that's the kind of period we live in at present, but it is an extremely difficult problem.

Global human resources development and exchanges of human resources

— Where young researchers are concerned, what is important for human resources development?

The largest problem for Japan today is the quality of people with doctoral degrees. The tendency among outstanding people to stop at the master's degree and not to go on to the doctoral level is also driving this situation. If researchers don't aim in an independent direction from an early stage, they'll never be able to stand on their own two feet. However, since there's a tendency in Japan not to question authority, that's difficult. In the educational system in doctoral programs, I think we should introduce the kind of systems that are used in other countries and create a system on that basis, for example, by increasing the number of academic advisors to two, and not including the advisors in the examination of the doctoral dissertation.

If I could advise on the side of a young person, an attitude of returning to the starting point and doing new things and trying things that others aren't doing is necessary. It's also a problem that the post-doctoral period is too long, and it would be better if people didn't hesitate to go into private companies.

— Finally, what is your advice for the future growth of MANA?

MANA has realized the leading international environment in Japan. However, it would be good if the world's real super-elite researchers could come to MANA more frequently on sabbaticals, whether it's for 3 months, or for 1 month. In comparison with Oxford and Cambridge and similar institutions, I feel that the global exchange of human resources is still a bit insufficient. I hope that MANA will become a place that materials and nanotechnology researchers feel they must visit at least once.

Tsukuba is a key area, including from the viewpoint of strengthening Japan's innovation and industrial competitiveness. In this, MANA should give its best efforts to basic and fundamental research, without losing the focus of its position, while also making actively preparations to ensure a smooth transition to practical application whenever researchers produce good results. In the future, I hope that you will continue to play an active role, as a division that supports the foundations of NIMS.

Prof. Kishi in his young days

Francoise M. Winnik
Principal Investigator / Nano-Life Field

Quantum Dot for Bioimaging: Opportunities and Concerns

Features of QDs

Semiconductor quantum dots (QDs) are brightly luminescent nanoparticles that have found numerous applications in bioanalysis and bioimaging, where they offer non-trivial advantages: the brightness needed for sensitive detection, the photostability needed for tracking dynamic processes, the multiplexing capability required to elucidate complex mechanisms, and the nanoscale interface needed for biomolecular engineering of probes and sensors. Researchers anticipate that QDs will be increasingly used, not only in clinical applications, but also in various manufactured products. For example, QD-solar cells have emerged as viable contenders to complement, or replace, dye-sensitized solar cells. CdTe/CdS thin film cells have already captured approximately 10 percent of the global market. Unfortunately not enough is known about how the novel and technologically-attractive properties of QDs correlate with the interactions that take place at the nano/bio interface. The academic, industrial, and regulatory communities are actively seeking answers to the growing concerns on the impact of nanotechnology on humans.

The cytotoxicity of QDs: current mechanistic understanding

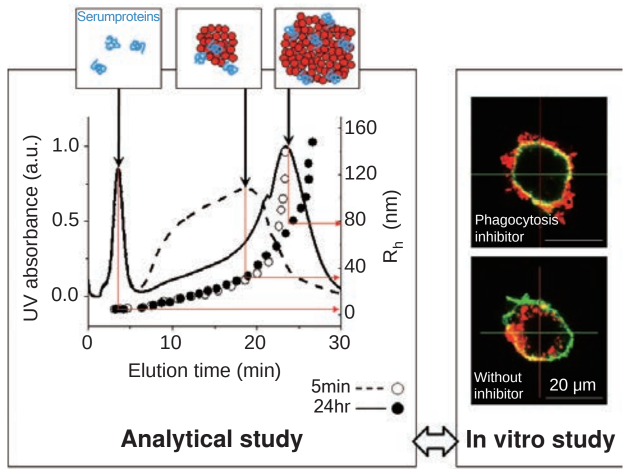
Since the early 2000's, we have contributed to the understanding of the mechanisms by which semiconductor QDs can damage cells, including oxidative stress elicited by reactive oxygen species (ROS) and the minute amount of cadmium ions leached in the QDs environment. We have demonstrated the role of the QDs ligands in guiding the uptake and release of QDs by cells. Currently, we, and others, are gathering evidence that nanomolar concentrations of cadmium-containing QDs may exert genotoxic, epigenetic, and metallo-estrogenic effects that could cause long lasting, even trans-generational, damages.

Prior to biological investigations with these materials, an indispensable step must be the full characterization of nanoparticles (NPs), including their concentration, size, charge, and ligand stability in biological media and in the presence of serum proteins. In this area, we have promoted the use of asymmetrical flow-field flow fractionation (AF4) to monitor the aggregation status of QDs in serum and biological media and to define the "biological identity" of QDs, which drives the interactions of QDs with cells, affects their cytotoxicity, and is often very different from the identity of pristine QDs.

Towards safer in-vivo imaging with silicon nanoparticles

Recently, in collaboration with N. Shirahata (MANA Independent Scientist), we undertook to prepare water-dispersible silicon nanoparticles (SiNPs) in view of their low inherent toxicity compared to heavy elements semiconductor QDs. Like QDs, SiNPs exhibit high brightness, tunable light emission, great stability against photo-bleaching, and are amenable to conjugation with biomolecules. In addition, SiNPs of suitable size and surface chemistry exhibit near IR emission allowing deep-tissue imaging, a requirement for in-vivo imaging.

This journey in the world of photoemissive NPs led us from frustrations as we were faced to the pervasive cytotoxicity of the first generation QDs to opportunities for safe in-vivo imaging by taming the chemistry of SiNPs.



In-vitro and analytical detection of the extent of QD agglomeration in serum-containing media

Left: Asymmetric Flow Field Flow Fractionation (AF4) of red QDs dispersed in serum shows the presence of large aggregates; Right: in vitro experiments, which point to phagocytosis as major QD internalization mechanism, confirm the formation of QD aggregates.

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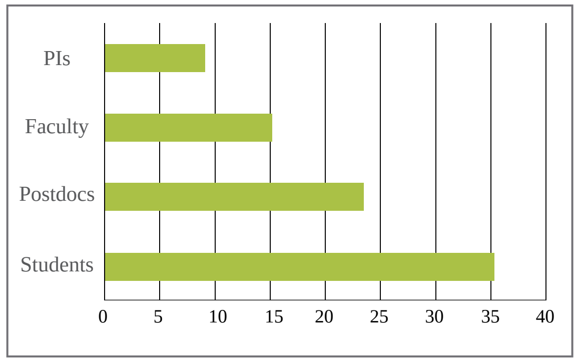
Female Researchers, Come On!

The creation of a "melting pot" environment where diverse human resources gather is one of the missions of MANA. Many people know that more than half of MANA researchers are non-Japanese, but in reality, MANA is also devoting great effort to training female researchers.

■ MANA also has many female researchers.

At MANA, female researchers comprise 21% of the total. This is still lower than in the United States and European countries, but it is high in comparison with the Japanese average of 14.4%.* The percentage of female researchers at MANA is also higher among younger researchers, with women accounting for more than 1/3 of Junior Researchers.** This is precisely because MANA is committed to training young female researchers who will be responsible for science and technology in the next generation.

* Source: 2014 White Paper on Science and Technology.
** Students of graduate schools (Joint Graduate Schools) that have concluded cooperation agreements with NIMS; Junior Researchers are paid salaries based on participation in NIMS research work



Share of female researchers at MANA (%)

■ NIMS has created a framework for female researchers.

NIMS, which is the host institution of MANA, is also committed to hiring permanent female research staff. Beginning in fiscal year 2013, NIMS established a new framework for permanent research staff, for which only female researchers can apply. In the first year, a large number of female researchers applied from countries around the world. Among those applicants, Dr. Takako Konoike was hired and assigned to MANA as an Independent Scientist. In the year and half since April 2013, a total of 8 new permanent researchers were assigned to MANA, and of these, 4 were female.

■ Consideration of work-life balance.

NIMS has created an employment environment where it is easy to work and employees can satisfy the demands of both work and parenting, and has received certification as a "Parenting Support Employer." In fiscal year 2006, NIMS established a "Support system from employees engaged in parenting/nursing care" that provides support to researchers who are raising children or caring for elderly parents by assigning assistants to those researchers. The system is available not only to permanent researchers, but also to post-docs. During fiscal years 2013-2014, a total of 10 MANA researchers used this system.

NIMS also has a unique system called the "Rechallenge Support System" which supports persons who gave up research due to parenting or nursing care but now wish to finish an academic degree. This program is available to persons affiliated with graduate schools with which NIMS has concluded cooperation agreements, and enables such persons to complete their degrees while working at NIMS.

Dr. Mamiko Kawakita (Senior Engineer, Research and Analysis Office, NIMS)

After I received my master's degree, I worked in a private-sector company as an IT specialist, but when my first child was born and my husband was assigned to work overseas, I moved to Germany and became a full-time homemaker. After my second child was born, I resumed my studies while working at MANA, and in 2010, I received my doctorate in Materials Science and Engineering from the Graduate School of Pure and Applied Sciences, University of Tsukuba. Returning to research is not simple in today's Japan. In fact, it was more difficult than I imagined for a woman to return to work while raising children and doing housework. However, I was always blessed with people who understood and supported me, and I was able to realize this big step up in my career. MANA is a wonderful place with an environment that accepts and utilizes diverse human resources.

News

Selection of 5 MANA Researchers as "Highly Cited Researchers for 2014"

"Highly cited researchers" are authors of papers whose number of citations is in the top 1% in each research field in the Reuter Thomson Essential Science Indicators database. The following five MANA researchers were selected as members of this elite group in 2014.

<Materials science>


Katsuhiko Ariga (MANA Principal Investigator)


Yoshio Bando (MANA Chief Operation Director)


Dmitri Golberg (MANA Principal Investigator)


Zhong Lin Wang (MANA Principal Investigator)

<Chemistry>


Zhong Lin Wang (MANA Principal Investigator)


Omar Yaghi (MANA Principal Investigator)

(Listed in alphabetical order)

Publication of "Materials Revolution: Nanoarchitectonics" by MANA Principal Investigator Katsuhiko Ariga

MANA Principal Investigator Katsuhiko Ariga recently published an introductory book, "Materials Revolution: Nanoarchitectonics" (Iwanami Science Library, ISBN978-4-00-029627-4 C0343), which presents the new paradigm of materials development called "nanoarchitectonics" to general readers. Dr. Ariga's book introduces cutting-edge materials science research being developed at MANA, including atomic switches that will open the way to brain-type computers, photocatalysts aimed at realizing artificial photosynthesis, biomaterials that contribute to medicine, and many more topics in a way that is easy to understand for non-scientific readers. The new book has been very warmly received, and publication of an English edition is being studied.

Cover of the new book by Dr. Ariga, MANA Principal Investigator

Awards

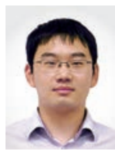
Kazuhito Tsukagoshi, MANA Principal Researcher, and Katsuyoshi Komatsu, "JSAP Paper Award, The Japan Society of Applied Physics" (Sept. 2014)

New Face


MANA Scientist
Satoshi Ishii


Independent Scientist
Liwen Sang


ICYS-MANA Researcher
Kota Shiba


ICYS-MANA Researcher
Xuebin Wang


ICYS-MANA Researcher
Hamish Hei-Man Yeung

Events

MANA Holds "Summer Science Camp 2014"

From July 29 to 31, MANA held the "Summer Science Camp 2014," which is a camp-type program in which high school students live and study together for 3 days. A total of 16 young people, including 8 male and 8 female students, was selected from all parts of Japan, and enjoyed "hands-on" practice in observation with the electron microscope, development and processing in the clean room and other topics under the title "Hear, See, and Create: Experiencing Nanoscience." The camp also featured a social gathering with young MANA researchers from other countries, giving the participating high school students a full taste of the state-of-the-art international research environment at MANA.

TEM observation by camp participants