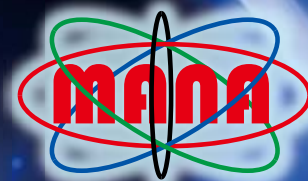




MANA



International Center for
Materials
Nano**a**rchitectonics



National Institute for Materials Science



International Center for Materials Nanoarchitectonics

A Message from the Chief Project Officer



**President, National Institute for
Materials Science (NIMS)**

Chief Project Officer, MANA

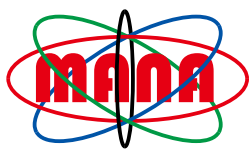
Teruo Kishi

On the establishment of a International Research Center at NIMS

The National Institute for Materials Science (NIMS), in cooperation with five other institutions has been selected to participate in the World Premier International (WPI) Research Center Initiative which was launched recently by Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT). NIMS was one of five institutions selected nationwide, and was the only Independent Administrative Institution (IAI). NIMS's International project, which we will introduce here, is called the International Center for Materials Nanoarchitectonics, or MANA (from Materials NanoArchitectonics). MANA will bring together outstanding researchers from Japan and other countries to conduct advanced materials research contributing to a sustainable society under a number of top scientists from NIMS.

The new MEXT program is expected to create world- class research centers with "global visibility." To achieve this goal in the MANA project, we must improve the research system in NIMS. We are therefore committed to devoting our full efforts to creating a research system that will contribute to true internationalization, the establishment of a tenure track for outstanding young researchers, fostering of young independent researchers and young leaders.

As the host institution for MANA, NIMS will naturally give the activities of the new project its full backing. At the same time, we will also make every effort to ensure that NIMS itself becomes one of the world's preeminent research institutes through the activities of MANA. Expect great things from MANA – and from NIMS – in the future.



International Center for Materials Nanoarchitectonics

A Message from the Director-General



Fellow, NIMS
Director-General, MANA

Masakazu Aono

Launching the International Center for Materials Nanoarchitectonics (MANA)

Technology has brought enormous benefits to humankind, including human welfare, but on the other hand, it is continuing to create serious problems of global scale. If we are to respond successfully to this critical challenge, we must realize a variety of innovative new technologies in a wide range of fields, including the environment and energy, information technology, medicine, and biotechnology, among others. However, the requirements placed on the materials necessary for realizing these innovative technologies have rapidly become more sophisticated in recent years. As a result, a new paradigm of materials development is now necessary.

For development of all categories of “materials”, regardless of whether their dimensions are macro, micro, or nano, irrespective of types such as inorganic, organic, bio, and the like, and going beyond the levels of substance, material, and system, we believe that the research concept which we express by the term “materials nanoarchitectonics”^{*} is important. We believe that the coming age will see the development of a succession of materials with innovative functions far exceeding the bounds of our imagination today by freely controlling the arrangement of nanostructural units as organic chemistry is continuing to create an unimaginable variety of substances by freely controlling the arrangement of limited types of atoms. We at MANA intend to be the leaders in this as one of the world’s top research centers.

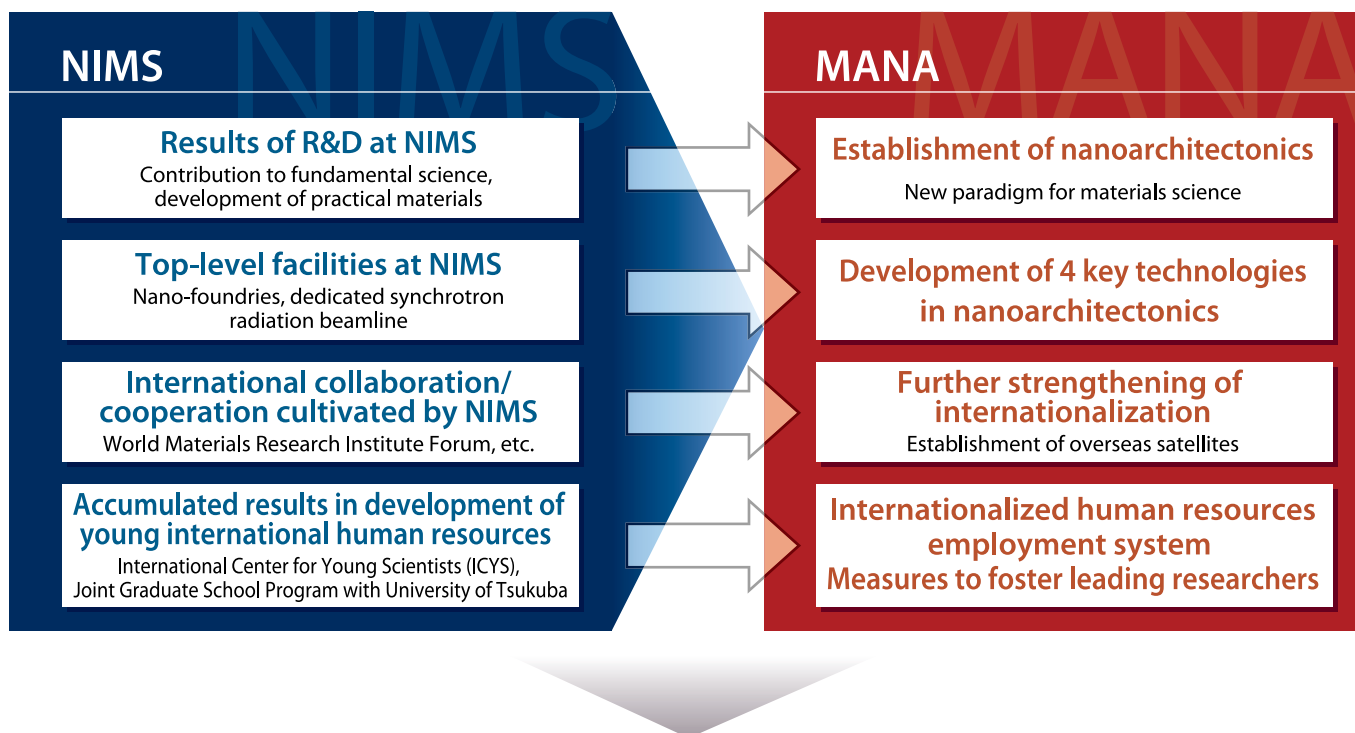
We sincerely request your generous support as we begin this exciting project.

^{*}The word nanoarchitectonics was first used at the International Symposium on Nanoarchitectonics Using Suprainteractions organized by the author and co-workers in 2000 here at Tsukuba, Japan.

MANA – A Driving Force for the Future at NIMS

NIMS and the MANA Concept

To give concrete form to the concept of “nanoarchitectonics” by creating a paradise for capable young researchers, NIMS is establishing a World Premier International (WPI) Research Center for nanotechnology and nanomaterials.



(Photo courtesy of the Japan Maritime Public Relations Center)

In 10 years ...

MANA will be the world's core research institute in nanotechnology and nano-materials research, and

Led by **MANA**,

NIMS will evolve into the world's top materials research institute.

Systemic Reform through MANA

Four targets for improvement of the research system at NIMS

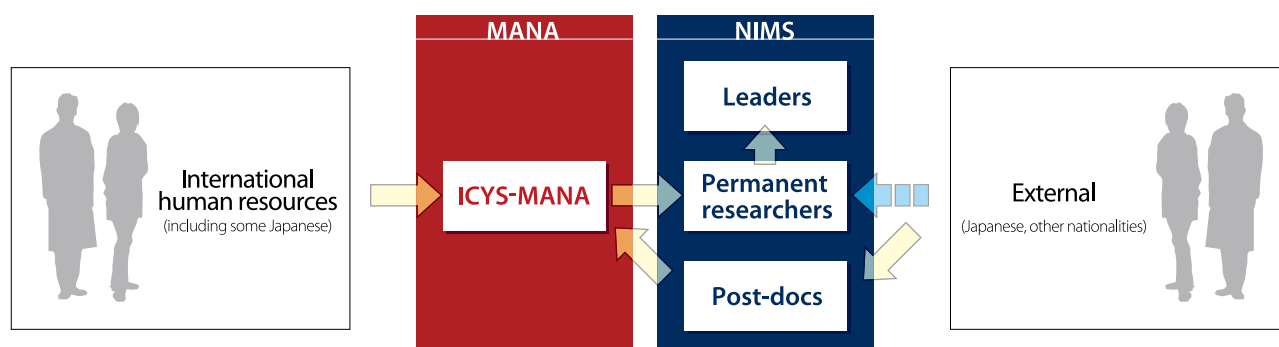
In order to create one of the world's premier research centers with "global visibility," systemic reform at NIMS will be promoted through MANA, with a particular focus on the following four points.

Internationalization

MANA will achieve internationalization at all levels, beginning with use of English as a common language and preparation of all documents in bilingual form. This experience is expected to have a ripple effect on NIMS itself, transforming NIMS itself into an international core research institute in the true sense.

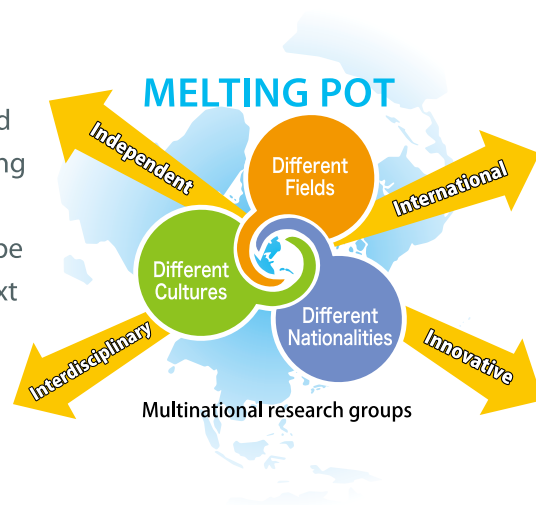
Introduction of tenure track

MANA will play a key role in a total reform of the researcher employment system in NIMS. Specifically, when MANA reaches full-scale operation, it is expected to be possible to select some permanent researchers and research leaders for NIMS from the human resources developed in MANA.



Human resources development

MANA will form a "melting pot" of diverse nationalities, cultures, and scientific fields, and as such, will be an ideal environment for fostering young researchers through mutual competition in a free and frank atmosphere. This will develop the young research leaders who will be the driving force for the materials science and technology of the next generation.



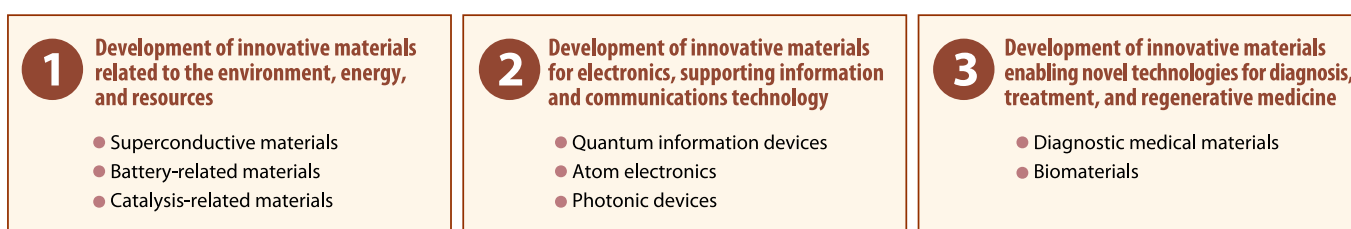
Reform of the Administrative Sector

MANA's effect will not be limited to the research division. It is also expected to contribute to reform and efficient operation of the Administrative Sector. MANA represents a bold, radical experiment in the employment and merit-based treatment of outstanding planning and administrative personnel. Successful parts of this experiment will be actively expanded to NIMS.

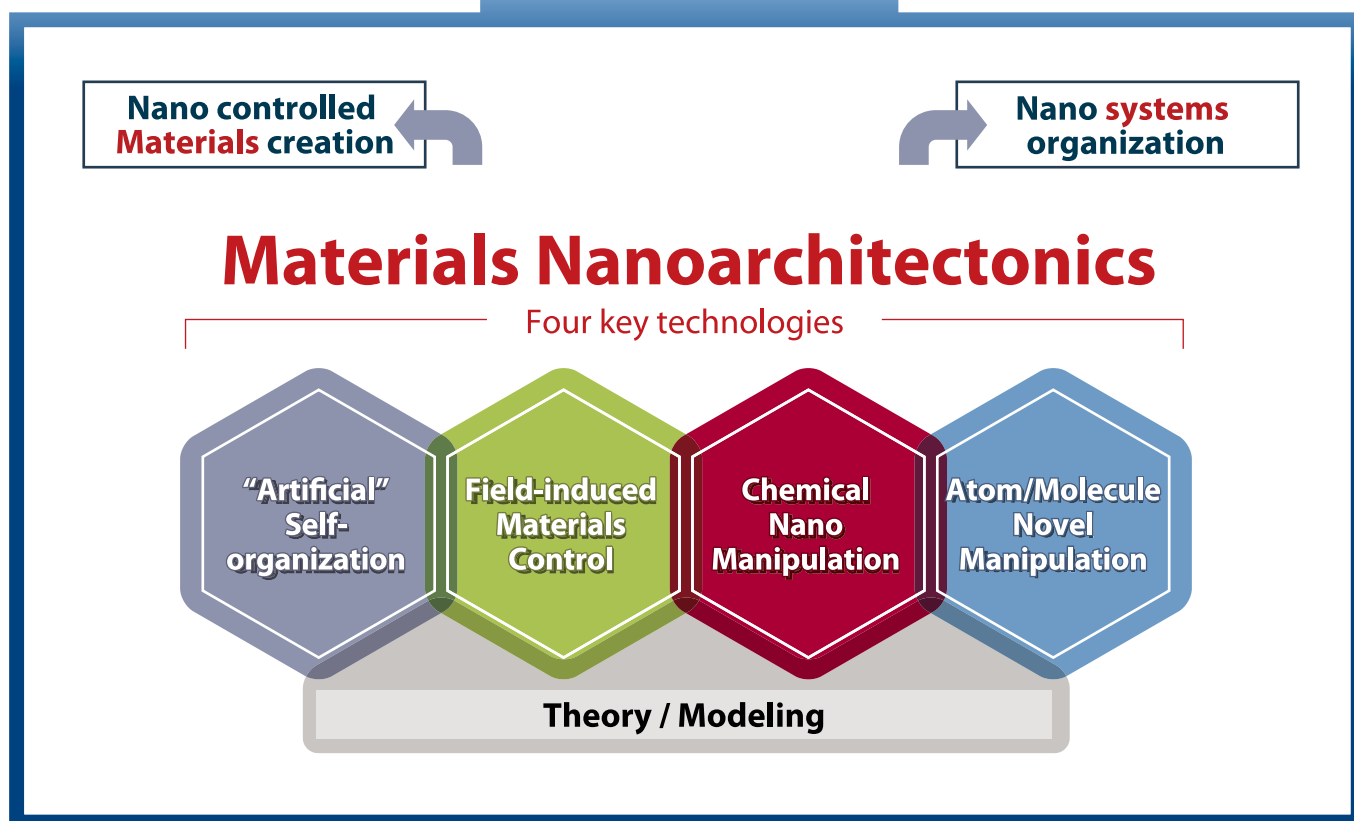
MANA's Research Targets

As one of the world's top research centers

The ultimate objective of MANA is to bring together outstanding researchers from around the world, with a particular emphasis on young scientists for the future, to develop and provide to society innovative materials for realizing sustainable development based on the new materials development technology system called materials nanoarchitectonics in an internationally-open environment.



New paradigm for materials development



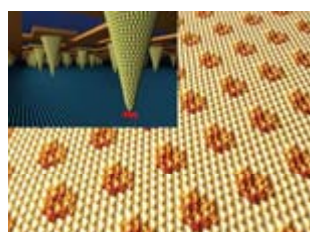
What is **Materials** Nanoarchitectonics?

A new paradigm of materials development

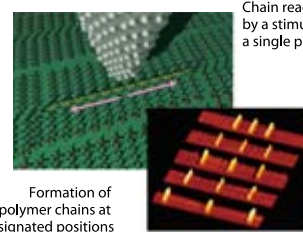
Materials nanoarchitectonics is not limited to the creation of single nanostructures and elucidation of their functions. Rather, it is a research concept which attempts to extract and use the ultimate functions of materials based on a profound understanding of the mutual interaction between individual nanostructures and arbitrary arrangement of those nanostructures. The technologies used to realize this concept can be divided into the following four large groups.

Atomic/Molecular Novel Manipulation

Introduction of a variety of novel manipulation techniques in methodologies for controlling the positions and bonding states of individual atoms and molecules using the proximity probe of the scanning tunneling microscope, atomic force microscope, etc.



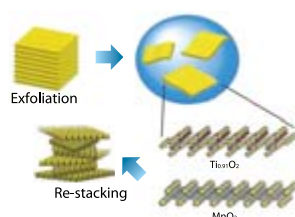
Control of chemical reactions at the molecular level.



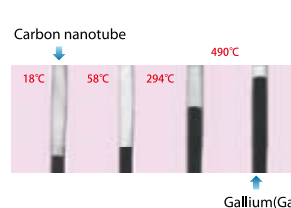
Straight-chain formation reaction by atomic/molecular level stimulation.

Chemical NanoManipulation

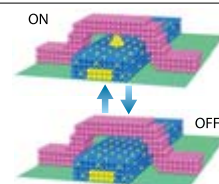
Manipulation of nanoscale materials in chemical equilibrium and nonequilibrium states in liquid or solid phases, or a combination thereof, by temporally and spatially skillfully-differentiated use.



Technology for free layer-stacking of nanosheets by chemical nanostructure manipulation.



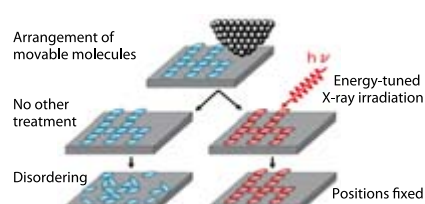
Realization of a nano-thermometer by injection of Ga atoms into carbon nanotubes.



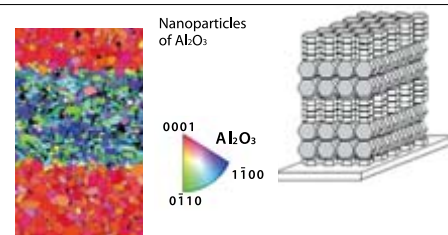
Atomic switch utilizing local electrochemical reaction.

Field-Induced Materials Control

Control of materials at the nano scale, skillfully exploiting the state change of materials under electric fields, magnetic fields, electromagnetic fields (light, X-ray), strain fields, etc.



Technology for anchoring targeting molecules on surfaces using X-ray irradiation with specific energy.



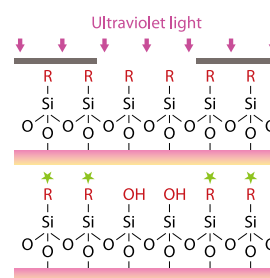
Technology for free control of the arrangement of crystal orientation of nanoparticles under gigantic magnetic fields.

"Artificial" Self-Organization

Introduction of unprecedented new "artificial" control in self-organization methods, taking advantage of the intrinsic mutual interaction of atoms and molecules instead of forced manipulation of individual atoms and molecules.



Novel development of control methods for self-organization.



Intensive application of self-organized membranes for nanoarchitectonics.

The purpose of nanoarchitectonics is to produce new functions in materials as a whole by using a combination of the above-mentioned technologies to realize intended arrangements of nanoscale structural units consisting of groups of atoms or molecules, in other words, nanostructures.

A Complete Research Environment

NIMS's research environment – a reason for international pride

Independent/Cooperative Research Environment

While respecting the independence of researchers, NIMS provides a “melting pot” environment of different scientific fields, cultures, and nationalities.

Based on the know-how accumulated in the operation of the International Center for Young Scientists (ICYS), a complete support staff supports researchers.

3D System

Young researchers in MANA will be involved in interdisciplinary research in a system with double affiliations (MANA and a satellite or affiliated institution), double specializations, and double Mentors for consultation on research. As a result, these young scientists can gain a truly international sensibility with a wide field of vision.

Mentor System

Outstanding Principal Investigators in MANA will provide advice on research while respecting the autonomy of young researchers to the fullest possible extent.



Eliminating the Barriers of Language and Nationality

By adopting English as a common language, we have created a system which enables research with no language handicaps for non-Japanese speakers.

- English-language orientation for non-Japanese researchers
- Information on external funds in English
- Use of English for information on Web and intranet in MANA
- English-language support by administrative staff and research support staff
- Use of English in documents related to administrative procedures, etc.
- Research/daily life guidebook in English

(Japanese language class is also established in NIMS.)

NIMS Facilities

MANA researchers will be able to use many of NIMS's world-renowned facilities, beginning with advanced medium- and large-scale devices.



Photo supplied by Japan Synchrotron Radiation Research Institute (JASRI)

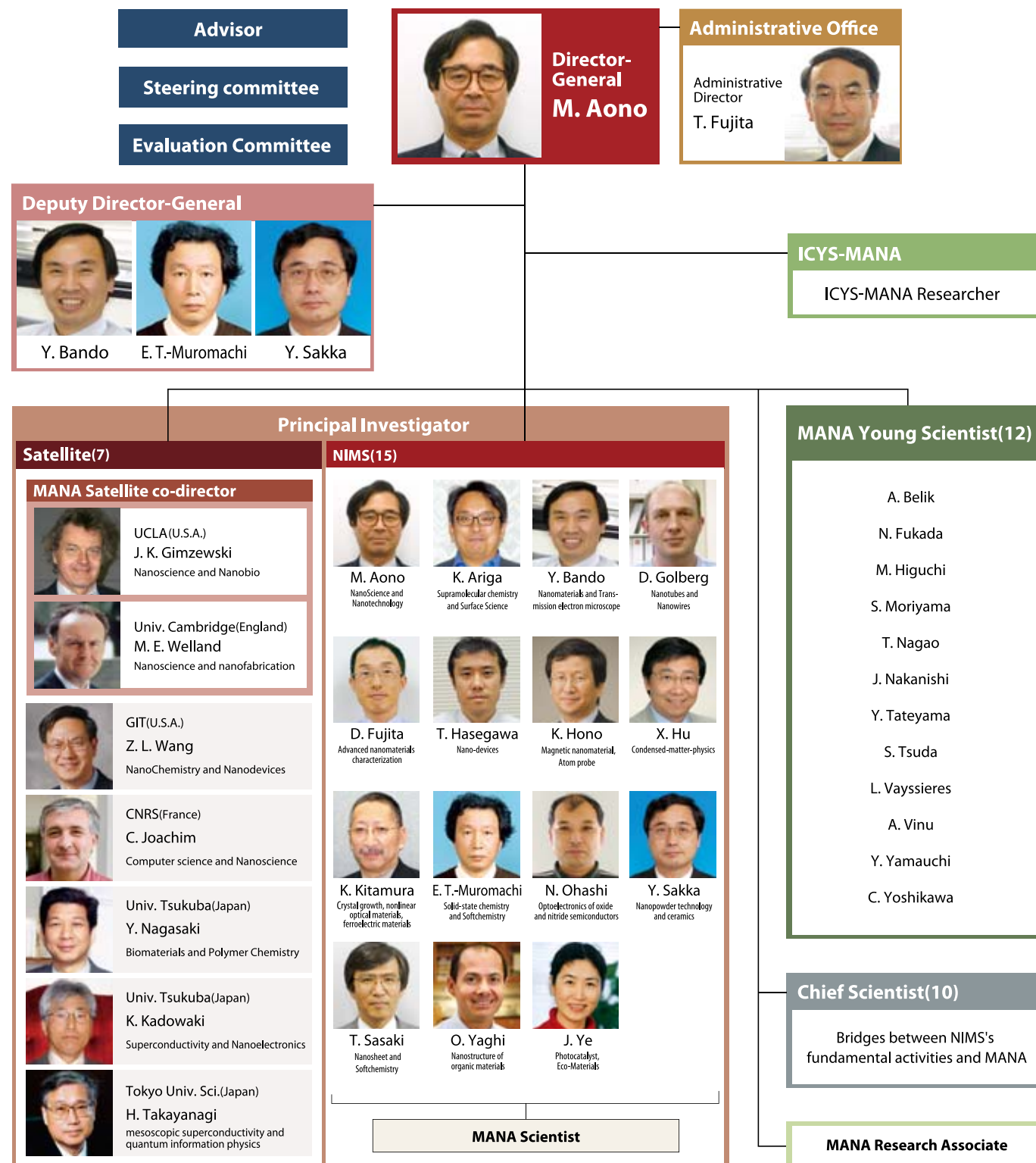
- ① ② Nano-foundries
- ③ 10⁶V ultra-high voltage electron microscope
- ④ Dedicated beamline for synchrotron radiation research at SPring-8
- ⑤ 930MHz NMR Magnet



Organization of MANA

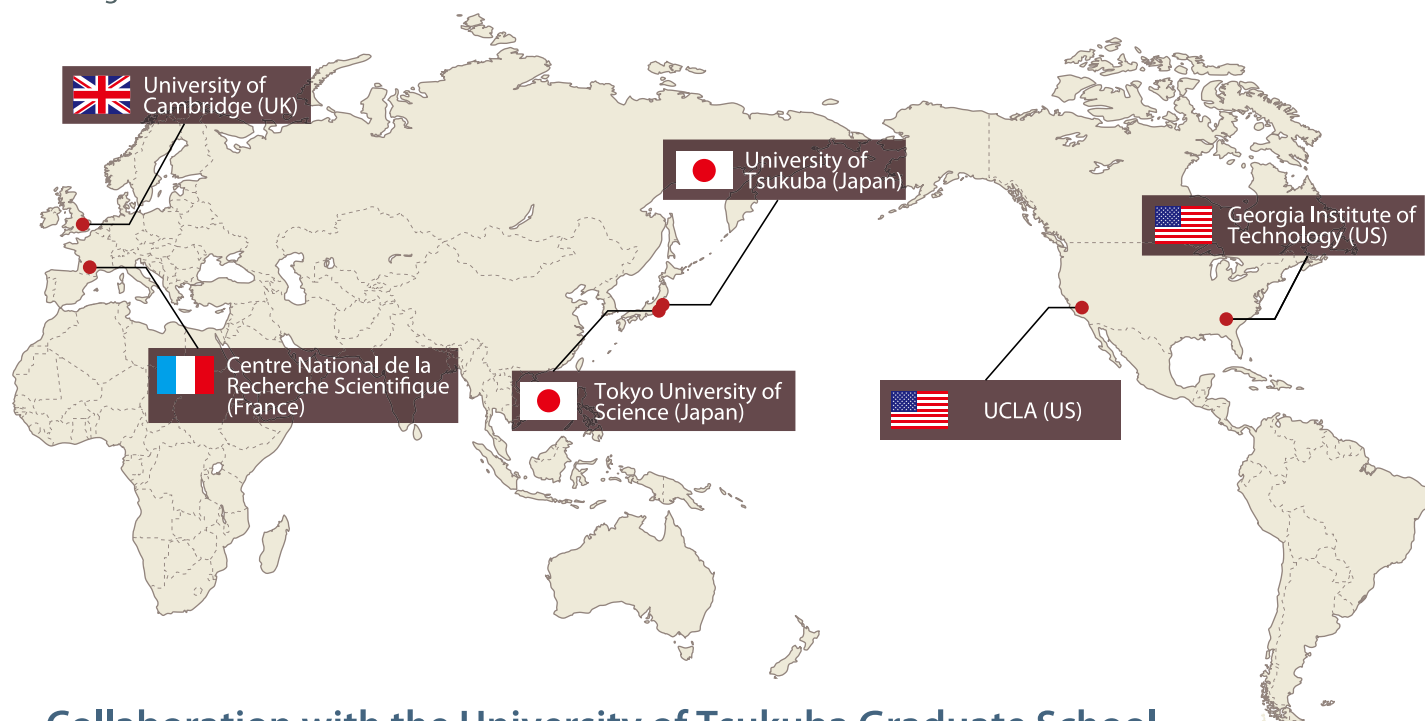
An open-minded collaboration between leading Senior Researchers and young scientists

MANA will bring together world-class researcher to do advanced research. Collaboration between top-level researchers and promising young scientists in a free and frank atmosphere will open the horizon for novel materials research.



Satellites

The home research institutes of Senior Researchers who are invited to participate in MANA from institutions other than NIMS are called “satellites.” MANA will efficiently promote research at the world’s highest level through active collaboration with these satellites. At the same time, foreign satellite institutes will also function as overseas bases for NIMS.



Collaboration with the University of Tsukuba Graduate School

MANA will actively utilize the system of the Doctoral Program in Materials Science and Engineering, Graduate School of Pure and Applied Sciences, University of Tsukuba, which is administered jointly by NIMS and the University of Tsukuba, to secure talented graduate students, including non-Japanese students, who account for more than half of the students in this Doctoral Program. These graduate students will be treated as NIMS Junior Researchers, and will be able to devote themselves fully to academic research with no worries about school/living expenses.

Active Use of the International Joint Graduate School Program

NIMS has already concluded International Joint Graduate School agreements with a number of universities in other countries, under which it receives foreign graduate students. Taking advantage of this system, MANA will allow talented graduate students to participate in research under the guidance of MANA’s Senior Researchers.

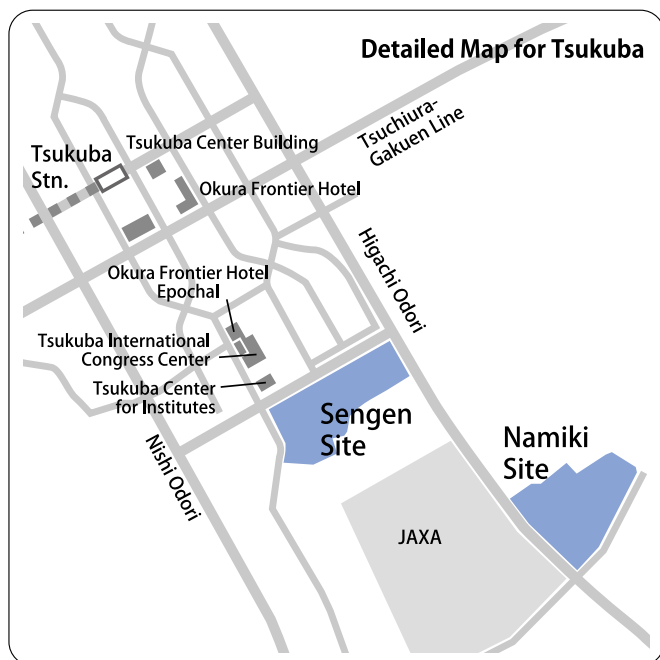
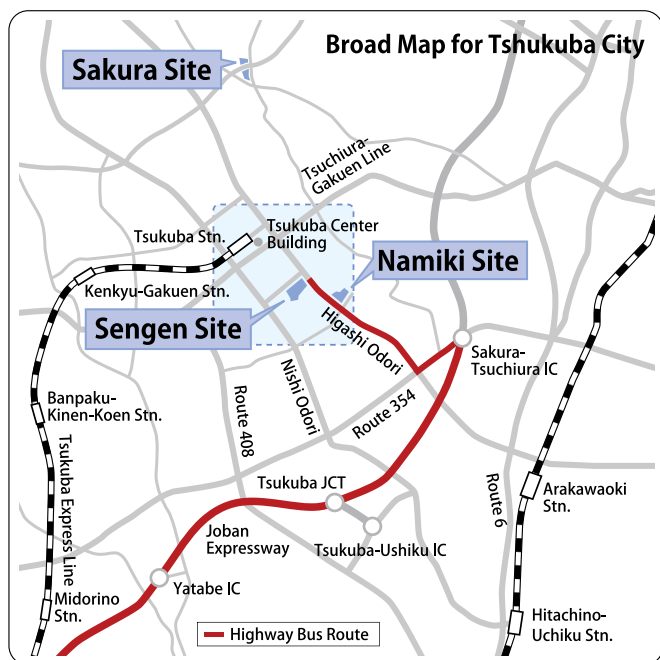
Universities with which NIMS has signed International Joint Graduate School agreements

- | | |
|---|--|
| ● Charles University (Czech Republic) | ● University of New South Wales (Australia) |
| ● University of Queensland (Australia) | ● Warsaw University of Technology (Poland) |
| ● University of Sydney (Australia) | ● Anna University (India) |
| ● University of Western Australia (Australia) | ● Jawaharlal Nehru Centre for Advanced Scientific Research (India) |
| ● University of Melbourne (Australia) | ● Xi'an Jiaotong University (China) |

World Nanomaterials Research Institute Forum

NIMS/MANA plan to sponsor an international forum that will bring together the Heads of all of the world’s nanomaterials research institutes with the aim of constructing an international nanomaterials research network through this program.

Access and Contact to MANA



[Namiki Site]

- Tsukuba Express Line; get off at Tsukuba Station; take Route Bus heading to "Arakawaoki Station"; off at "Busshitsu Kenkyujo Station"; and 1 minute walk.
- JR Joban Line; get off at Arakawaoki Station; take Route Bus heading to "Tsukuba Center"; off at "Namiki 1-chome"; and 1 minute walk.
- Highway Bus for "Tsukuba Center Route" from JR Tokyo Station; get off at "Namiki 1-chome", and 1 minute walk.



WPI Research Center
International Center for
Materials Nanoarchitectonics (MANA)



National Institute for Materials Science

International Center for Materials Nanoarchitectonics

1-1 Namiki, Tsukuba, Ibaragi, 305-0044
 TEL : +81-(0)29-860-4709 FAX : +81-(0)29-860-4706
 E-mail: mana@nims.go.jp

<http://www.nims.go.jp/mana/>