Case study II: Nanotech Roadmap in Japan

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The concepts that seeded nanotechnology were first discussed in 1959 by renowned physicist Richard Feynman in his talk *There's Plenty of Room at the Bottom*, in which he described the possibility of synthesis via direct manipulation of atoms.

The term "nano-technology" was first used by Norio Taniguchi in 1974, though it was not widely known.
(May 27, 1912 – November 15, 1999) was a professor of Tokyo University of Science.

He coined the term *nano-technology* in 1974 to describe semiconductor processes such as thin film deposition and ion beam milling exhibiting characteristic control on the order of a nanometer: "Nano-technology' mainly consists of the processing of separation, consolidation, and deformation of materials by one atom or one molecule."
Research Center for Nanoscience and Nanotechnology
PHOTOCATALYSIS

Pioneering Discoveries for a Cleaner Planet
Research that Changes the World for the Better

Professor Akira Fujishima, Ph.D.
Tokyo University of Science, President

President Fujishima is known for significant contributions to the discovery and research of photocatalytic and superhydrophilic properties of titanium dioxide (TiO₂). President Fujishima has been the recipient of many prestigious awards and honors.
Science and Technology Plans of Japan

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<td>1st S&amp;T Basic Plan</td>
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<td>Formulation of a New Research System</td>
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<td>Japan, the Innovator</td>
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<td>17.6 Trillion Yen (Results)</td>
<td>21.1 Trillion Yen (Results)</td>
<td>25 Trillion Yen (Estimated)</td>
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4 Prioritized Promotion Fields
- Life Science
- Information & Communication
- Environment
- Nanotechnology & Materials

* Council for Science and Technology Policy
4th Science and Technology Basic Plan

- Recovery and rebirth from the disaster
- Green innovation
- Life innovation
- Nanotech & Materials R&D as key technologies
Materials R&D for Recovery and Rebirth from the Disaster

Structural materials for safer social infrastructure

Ultra-high-strength bolts

Weathering steels (atmospheric corrosion resistant)

Welding technologies & materials

Ar-MIG welding

Double-walled welding wire

Inner (Inconel)

Outer hoop (Steel)
Materials R&D for Green Innovation

Energy saving devices for high-level information society

Energy saving white LED illumination

SiAlON phosphors

Diamond LED

Atom transistor
Materials R&D for Life Innovation

Scaffolds for Regenerative Medicine

Collagen Structures: high biocompatibility

Shape Memory Materials with Biodegradability

heating
Materials R&D for Critical Materials Issues

Hybrid / Electric Vehicle

Magnet without rare earth element (Dy)

Ferrite magnet

Neodymium magnet

EFTEM Nd map 200nm
Overview of Nanotechnology Platform

The objective of the nanotechnology platform program is to establish a reliable nationwide research infrastructure (Platform) for scientific innovation by the alliance of 25 institutes which have cutting edge equipment and research know-how.

Role of Nanotech. Platf. Center

① Coordination and Promotion of the program
② User Contact, Information Service, Organizing WS and Symposium
③ Collaboration with Private Sectors, Increasing New User,
④ Researchers Exchange Program, Education and Training
Three platforms in NIMS

**Microstructural Characterization**
Advanced characterization facilities for nanomaterials
- Advance d TEM
- High-res XRD & XPS in Spring-8
- NMR
- HM-STM
- He-IonSEM
- TOF-SIMS

**Nanofabrication**
Fabrication and processing with nanometer-to-millimeter scale for a variety of materials

**Molecule & Material Synthesis**
Organic molecule preparation, cell cultivation, bio-imaging, organic and macromolecular materials synthesis, and instrumental analysis
Core Members of TIA-nano

Keidanren (Japan Business Federation)  AIST  NIMS  University of Tsukuba  KEK
Location of members at Tsukuba-city
Organization of TIA-nano

Executive Board
Chairman: Teruo Kishi

Steering Board
Chairman: Michiharu Nakamura
University of Tsukuba
NIMS, AIST, KEK, Keidanren

Adviser
Prof. Nishi: Stanford Univ
Prof. Hirayama: NY state Univ

Inspector
Prof. Takayanagi: Tokyo University of Science

Observer
Cabinet Office
MEXT
METI

Secretariat
Secretary-General: Hiroshi Iwata
University of Tsukuba
NIMS, AIST, KEK, Keidanren

Innovation Coordinator
AIST (Dr. Akimune)
NIMS (Dr. Watanabe)
U. Tsukuba (Dr. Niwa)
KEK (Dr. Ikeda)

Industry Board
Director-General Board
Research Director Board

Carbon Nanotube Nano-Material Safety WG
Nano-Green WG
N-MEMS WG
Power Electronics WG
Nano-Electronics WG
Net working School WG
Intellectual Property WG
Under-One Roof WG
### Core Research Domains & Core Infrastructures

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<tr>
<th>6 Core ResearchDomains</th>
<th>Nanoelectronics</th>
<th>Power Electronics</th>
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<tr>
<td>• Nano CMOS</td>
<td>• Backend device</td>
<td>Integrated R&amp;D frame from SiC wafer, device to power system</td>
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<td>• Silicon-photonics</td>
<td>• New material</td>
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<td>• Carbon-electronics</td>
<td>• Advanced lithography (EUVL)</td>
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<td>• Spintronics</td>
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<th>Nanotech Open User Facilities</th>
<th>Networking School of Nanotechnology</th>
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<tr>
<td>• Promoting verification of integrated CMOS devices</td>
<td>• Promoting industrialization of advanced SiC power devices</td>
<td>Open user research facilities in AIST and NIMS (nanocharacterization, nanoprocessing, etc.)</td>
<td>Function of next generation human resource development through All-Japan university confederation headed by the University of Tsukuba</td>
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<td>• Promoting commercialization of new technology for N-MEMS devices based on needs and seeds</td>
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### Core Research Domains
- Nanoelectronics
  - Nano CMOS
  - Silicon-photonics
  - Carbon-electronics
  - Spintronics
- Power Electronics
  - Backend device
  - New material
  - Advanced lithography (EUVL)

### Core Infrastructures
- N-MEMS
  - High-value-added niche MEMS and mass production integrated N-MEMS
- Carbon Nanotubes
  - R&D framework of CNT mass production and CNT composites for wide applications
- Nano-Green
  - R&D framework for green innovation driven by nanotechnology
- Nano-Material Safety
  - Integrative data center and research frame for nano-material safety

### 3 Core Infrastructure
- Nanodevice Research Foundry
- Nanotech Open User Facilities
- Networking School of Nanotechnology
Our goal is to fast-track medical R&D that directly benefits people not only by extending lifespans but also by improving quality of life.
What is AMED?

- The Japan Agency for Medical Research and Development (AMED) engages in research and development in the field of medicine, establishing and maintaining an environment for this R&D, and providing funding,
- in order to promote integrated medical R&D from basic research to practical applications,
- to smoothly achieve application of outcomes,
- and to achieve comprehensive and effective establishment / maintenance of an environment for medical R&D.
Providing a one-stop service for research expenses, AMED consolidates budgets for research expenses, which had previously been allocated from different sources -- the Ministry of Education, Culture, Sports, Science and Technology, the Ministry of Health, Labour and Welfare, and the Ministry of Economy, Trade and Industry.

In addition to making possible an integrated approach to providing research funding and establishing / maintaining research environments, the unification of points of contact and procedures for research expenses can be expected to reduce the administrative burden on institutions and researchers receiving allocations for research expenses.
AMED aims to achieve the world's highest level of medical care / service

and to form a society in which people live long, healthy lives by promoting integrated research and development, from basic research to practical application,

and by establishing and maintaining an environment therefor, and linking this to various forms of growth in medical R&D.
Departments of AMED

Department of Research Promotion
  Division of Drug Research
  Division of Regenerative Medicine Research
  Division of Cancer Research
  **Division of Neurological, Psychiatric and Brain Research**
  Division of Rare / Intractable Disease Research
  Division of Infectious Disease Research
  Division of Emerging Research

Department of Industrial-Academic Collaboration
  Division of Medical Device Research
  Division of Industrial-Academic Collaboration
Departments of AMED

Department of International Affairs
  Division of International Collaboration

Department of Research Infrastructure
  Division of Research Infrastructure

Department of Clinical Research and Trials
  Division of Clinical Research and Trials
  Office of Regulatory Science and Clinical Research Support

Department of Innovative Drug Discovery and Development
List of Programs

- Strategic Research Program for Brain Sciences (SRPBS) / Brain Mapping by Integrated Neurotechnologies for Disease Studies (Brain/MINDS)

- Comprehensive Research on Aging and Health

- Science Research Grants for Dementia R&D

females: 86.61 years
males: 80.21 years
Estimated prevalence of cognitive disorders (dementia) is 15% (N=4,260,000) of Japanese of 65 years old and over.

Estimated prevalence of Mild cognitive impairment (MCI) is 13%(N=3,800,000) of Japanese of 65 years old and over.

In total, 28% of Japanese of 65 years old and over suffer from cognitive disorders or MCI.
Cognitive disorders increase

Number (x1000) of Cognitive Disorder in Japan

Expected value
This project promotes priority research projects from the viewpoints of understanding the actual state of dementia and its prevention, diagnosis, treatment, and care.

(1) Cohort studies to investigate the etiology of dementia and the development of methods of treatment, diagnosis, and prevention

(2) Research on familial dementia

(3) Research on the development of dementia drugs through drug repositioning

(4) Research on the development of novel methods of prevention, diagnosis, and treatment for dementia patients
Acknowledgements

- Mr. Masahiro Takemura, National Institute for Materials Science (NIMS), Japan Science and Technology Agency (JST)

- Prof. Teruo Kishi, the former president of National Institute for Materials Science (NIMS)