

## **Nano-Bio Efforts in Asia**

*-Summary on Nano-Bio Government Policy in China, Korea, Japan and Taiwan-*

The application of Nanotechnology in Biomedical areas including diagnostics, medicine, and related areas has been strongly emphasized in the national nanotech programs/initiatives in Asian countries. Government efforts have been made to coordinate national programs and promote cross disciplinary collaborations. In Japan, Korea and Taiwan, the fusion of IT, BT and NT is particularly explicit in their S &T policy. The Nano-Bio related projects in Asia including China, Japan, Korea and Taiwan cover topics such as Diagnostics (molecular detection including biochips, lab-on-a-chip, and protein-chips; sensing; gene delivery; and imaging), Targeted Drug Delivery Systems (DDS), Regenerative Medicine (Stem cell and tissue engineering), and Nano Medical Devices.

Chinese central government has invested about USD230M in Nanoscience and technology during its 10<sup>th</sup> Five Year Plan (2001-2005) and Nano Biology is one of the key areas in its nanotech programs. Although China has no integrated or coordinated national programs in NanoBio during the 10<sup>th</sup> Five Year plan. Various funding agencies including Ministry of Science and Technology (MOST), National Science Foundation of China (NSFC) and the Chinese Academy of Sciences (CAS) have research projects on Nano Biology and Medicine which consist of 10% of the government funded projects. Currently China is planning the 11<sup>th</sup> five year plan which will start 2006, and the funding for nanotechnology is expected to increase very substantially (up to 10 times increase) from the 10<sup>th</sup> five year plan (2001-2005) where the total nanotech government investment was about 2Billion RMB (250 oku yen/5Y). The Chinese provincial governments have been very supportive of nanotechnology R & D and we estimate the provincial government funding for nanotechnology is between 50-100% of the central government funding. Nanobiotechnology program will be launched as a coordinated national program. The National Center for Nano Science and Technology (NCNST) is currently the coordinating the Nano Biology, Medicine and Devices program which includes Nanomaterials Synthesis, Design, Control, and Properties Integration; Self-assembly and Microprocessing Engineering Integration; Nanostructure Functionality and Biosensing; Targeting Drug Delivery Systems; Nanomaterials and Nano BioEffects. One of the novel research areas in nanobio in China is Nano Chinese Medicine which has the advantage of low toxic side effects, high efficiency, better targeted delivery etc.

Korea launched the 10 Year Plan for the Promotion of Nanotechnology in 2001 with about USD1.485 billion committed from the government (USD983.5M) and industry (USD501.5M) for the period of 2001-2010 aiming to become the top 5 Nanotechnology countries in the world. Its ambitious nanotechnology program focuses on infrastructure/facilities building, strategic R & D and education. Korea has a strong focus on IT in its science and technology development, currently strong emphasis on the fusion between IT and Nanotechnology (NT). The Korean Nanotechnology program has also a strong emphasis on interdisciplinary research and education. The majority of its Nanotech funding has been allocated in the areas of nano-electronics (IT) & nano-materials where the industries are already quite competitive. The R &D and industry in nanobio area is comparatively weak and the funding is nanobiotech area is very small. The funding from the Ministry of Health and Welfare (MOHW) in Nanotechnology (focusing on diagnostics) is about between USD1-2 M since 2002. Other funding for Nanobio and medicine comes from the Ministry of Education and Human Resources (MOEH, Brain-Korea 21 program), Ministry of Science and Technology (MOST), and Korean Science and Engineering Foundation (KOSEF). Note that Korea nanotech investment per capita is the 2<sup>nd</sup> highest next to Japan among all Asian Pacific economies.

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Taiwan launched its National Nanotechnology Program in 2002 and the budget is about USD 630M between 2003-2008 over 6 year contributed by all the funding agencies in Taiwan including National Science Council (NSC), Ministry of Economic Affairs (MOEA), Ministry of Education (MOE), Ministry of Health (MOH), Atomic Energy Council (AEC), and Environmental Protection Administration (EPA). 13.8% of the total budget is dedicated to the Academic Excellence Program (AEP) funded by NSC and 1.6% of government program funded by Ministry of Health total of USD10M focusing on Nanobio and nanomedicine. Taiwan has a clear focus on the interdisciplinary research. Nanobiotechnology is one of the 6 research areas under the AEP and about 23% of the AEP projects are in the area of Nanobiotechnology area. These projects total of 19 include

1. Nanoscale Bio-detectors and biochips
2. Interactions between bio-cells and nanomaterials
3. Self-assembly and manipulation of biomolecule
4. Manipulation, Detection and Measurement
5. Application and nanoparticles for drug delivery
6. Microsensors
7. Microfluidics

Nano Chinese medicine is also popular in Taiwan, especially among industries.

In Japan, in addition to advancing manufacturing technologies for Japanese industries, another main targeted application of Nanotechnology is to contribute in building safe and secure society as well as improving healthcare for mankind. Nanobio has become a priority in Japanese S & T policy. The government started a serious coordinated effort in 2003 following a survey conducted by the Ministry of Economy, Trade and Industry (METI) on Nano-bio Technology Trends and Industry Application. METI immediately launched a number of Nano-bio projects under the Focused 21 Program led by Japanese industries such as Olympus, Toray, NEC, Shimazu, and others. The projects are summarized in the following Table 1 (note we use 100yen to a USD):

Table1

Project Name	Period	Funding for 2005 (USD)
Bio & IT Fusion Machines/Devices Development	2003-2006	17.1
Advanced NanoBio Devices	2003-2006	3.6
Screening Using Nano, Micro-particles	2003-2006	2.9
NanoBio Chips Through Protein Interaction Analysis	2003-2006	3.8
Manufacturing of Nano-capsule for Artificial Oxygen Carriers	2003-2006	3.8
Tissuing Manufacturing Technology Development Using Microprocessing Technologies	2003-2006	4.1
Nano Medical Device Development	2004-2007	1.4

To further promote NanoBio industries in Japan, METI established the NanoBio Working Group and Industry Committee to investigate the status of NanoBio industry in Japan and overseas and to formulate the Roadmap in collaboration with Japanese industries, universities and national institutions as well as think-tank organizations such as Mitsubishi Research Institute.

The Ministry of Education, Sports, Culture, Science and Technology (MEXT) also places a priority on NanoBio in its S & T policy. NanoBio projects are funded under various schemes including Science and Research Grant Assistance, 21 Century Center of Excellence (COE), Science and Technology Promotion Funds and etc. In particular the 21 Century COE program is a 5 year program with budget between 1-5 Million USD per year per project. The following Table 2 summarizes some of the key projects.

Table 2

Category	Project Name	Period	Host Organization
<b>Medical</b>	Regenerative Medicine Research Center	2003-	Tokyo Women Medical University Medical Research)
<b>Interdisciplinary and New Areas</b>	Fusion of New Function Microbiology and Nanotechnology	2003-	Todai Univ. (Bio Nano Electronics Research Center)
	Medical Photonics	2003-	Hamamatsu Medical University (Medical Research Dept)
<b>Life Science</b>	Bio and Nano Fusion New Life Science	2002-	Hokaido Univ. (Faculty of Science)
	Bio Nanotechnology Basic and Future Medical Engineering	2002-	Tohoku Univ. (Engineering Research Dept)
	Bio Engineering Frontier System	2002-	TIT (Bio Science and Engineering Dept)
	Cell and Tissue Manipulation and Control and Integration	2004-	Osaka University (Medical Research Dept)

Most recently additional Nano Bio effort came from the METI Bio Industry Division who released the Biotechnology Policy Consortium Report (June 2005) where it emphasizes the development of new “manufacturing biotechnology” that utilizes Japan’s strengths through integrating biotechnology and nanotechnology.