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Nanotechnology Initiatives and Research Funding in Malaysia

By: Gary Wong

The definition of a nanometre is exactly one-billionth of a metre, or 10^{-9}m. According to Thomas Kenny of Stanford University, nano is *"almost as wide as a DNA molecule and 10 times the diameter of a hydrogen atom."* **[1]** To better visualise nanoscale in all its miniscule glory, the graphic to the right (Figure 1) sums up the intricate complexities of objects, both natural and man-made.

By the same token, nanoscience is the study of how nanoscale *"things work, using commonly accepted experimental and theoretical techniques."***[2]** Nanotechnology is the application of nanoscience knowledge to a particular industry or marketplace. While many readers would equate nanotechnology with the field of electronics and miniaturisation, it also has a profound impact on many other branches of R&D. Breakthroughs in biomedical, bio-nanotechnology, materials science, manufacturing, self-assembly, nano-materials and other fields.

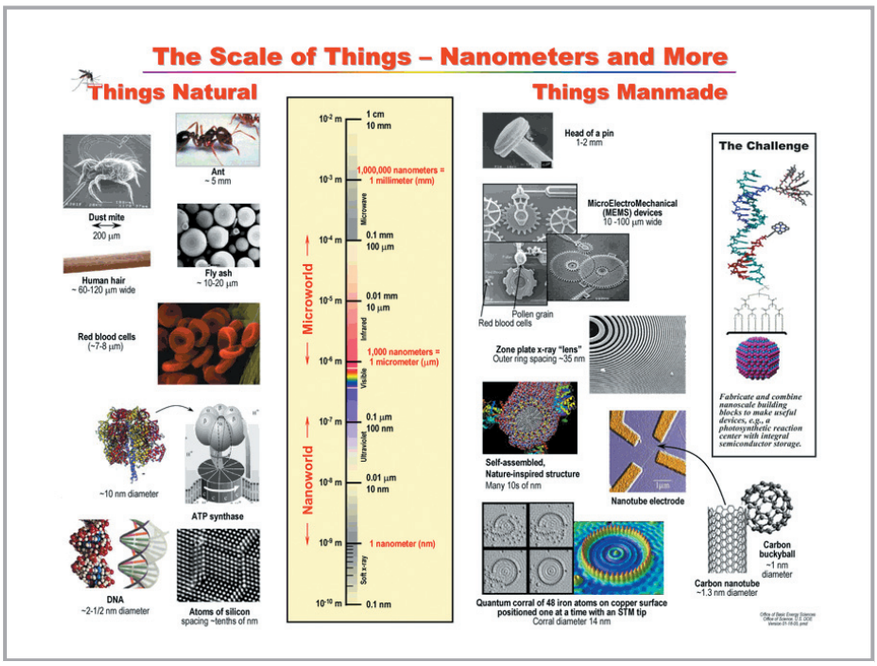

Figure 1: The Scale of Things – a comparison of natural and man-made objects in terms of size and scale. Printed with permission by the Office of Basic Energy Sciences of the Department of Energy, USA.

The development of nanotechnology research and policy-making in the Asia Pacific region has been fueled by the creation of the NNI (National Nanotechnology Initiative) in the United States of America. The NNI is a federal initiative created during the Clinton Administration in 2001 to replace the obsolete Interagency Working Group on Nanotechnology (IWGN) **[3]** and it pushes nanoscale science and technology to the fore as a research area of paramount importance to the future of technology.

The Importance of Nanotechnology as a Research Area

Government agencies, non-profit organisations, private corporations and institutions have been working to increase the awareness of nanotechnology and to fund public and private R&D of nanotechnology. In Malaysia, Nano-technology and Precision Engineering has been identified in the Eighth Malaysia Plan (2001–2005) as a key research area, and classified under the Strategic Research (SR) portion (which includes Design and Software Technology, Specialty Fine Chemical Technology and Optical Technology) of the Intensification of Research and Development in Priority Areas (IRPA) programme. **[4]**

The First Asia Nanotech Forum (ANF) Summit 2004 was held in Phuket, Thailand on 10 May 2004, where eleven economies from the Asia Pacific region participated in a regional nanotechnology forum to exchange views on the status of R&D in nanotechnology. These include Australia, China, Hong Kong, India, Korea, Japan, Malaysia, Singapore, Taiwan, Thailand and Vietnam.

Ir. Prof. Dr Mohd. Ali bin Hashim, the former Director of Science and Technology at the Ministry of Science, Technology and Innovation (MOSTI) spoke at the Phuket forum on government initiatives in support of nanotechnology in Malaysia, noting the allocation of research grants amounting to approximately RM 1.2 billion. Grant schemes that funds nanotechnology R&D are: the IRPA grant scheme (allocation for

Table 1: Malaysian R&D Grants [5]

R&D Grant Allocation in Past and Current Malaysia Plans				
	IRPA	IGS	MGS	DAGS
5th Malaysia Plan	RM 400 Million			
6th Malaysia Plan	RM 600 Million			
7th Malaysia Plan	RM 708 Million	RM 100 Million	RM 65 Million	RM 30 Million
8th Malaysia Plan	RM 833 Million	RM 230 Million	RM 100 Million	RM 90 Million

public research institutions, public and private institutes of higher learning, collaborative industries), the MSC Research and Development Grant Scheme (MGS), the Industry Research and Development Grant Scheme (IGS) and the Demonstrator Application Grant Scheme (DAGS).

Approximately 35% of IRPA research funds would be allocated to Strategic Research, which includes Nano-technology and Precision Engineering. The nanoscience research areas include nanophotonics, nanobiosystems, nano-electronics, nanostructured materials and nanometrology. As of Q2 2004, MOSTI has approved 3 nanotechnology programs and 17 nanotechnology projects amounting to RM 142,707,118 in research funds, falling just short of the RM 153,455,044 in research requests. **[5]**

Local Research

Many local (both public and private) institutions has had a boost in nanotechnology research based on government initiatives to bring nanotechnology to the forefront.

One of the main contributors to the research and development of nanoscience is the Ibnu Sina Institute for Fundamental Science Studies (IIS) at Universiti Teknologi Malaysia (UTM).

Established in 1997 with the goal of becoming a research university by 2010, the IIS seeks to advance the knowledge of frontier science research through the application of fundamental science and state-of-the-art facilities **[6]**. Apart from encouraging the application of basic knowledge in physics, chemistry, biology and mathematics in the pursuit of its lofty goals, the institute also seeks collaborative and inter-disciplinary research among scientists and researchers in Malaysia.

The institute's Director, Prof. Dr Halimaton Hamdan (who was also a keynote speaker at the ANF Summit 2004) is a leading researcher in Zeolite and Porous Material, a specialised research area of nanotechnology.

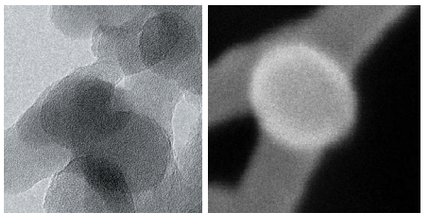

Figure 3: Transmission Electron Microsope (TEM) and Scanning Electron Microsope (SEM) view of Maerogel. Images reproduced with permission from www.zeolite.fs.utm.my.

Under the Eighth Malaysia Plan IRPA, IIS was awarded RM 11,291,100 in research grant towards the development of zeolites and derivatives as catalysts in the synthesis of specialty fine chemicals**.** Remnants of the long-term grant from the Seventh Malaysia Plan also covers production of zeolite from rice husks, heterogenous catalytic conversion of latex mesoporous MCM-41 zeolites and many other ongoing or completed projects **[7]**.

Porous materials such as zeolite (which are hydrated alumino-silicate materials with an open structure) have extremely small (0.3 – 10 nm) windows, channels and cavity architectures. These materials have applications in molecular electronics, quantum dots or chains, zeolite electrodes, batteries, nonlinear optical materials, enzyme mimics, chemical sensors, molecular wires and nanodevices.

Nanotechnology research at the IIS has led to many zeolite and porous breakthroughs, such as the synthesis and production of amorphus silica, synthetic zeolite (such as the mesomorphous MCM-41 – Figure 2) from rice husks as well as silica aerogel from rice husks, which is termed Maerogel (Figure 3).

IIS is currently aligning to practice three distinct nanotechnologies; "Wet" nanotechnology – a study of biological systems that exists primarily in water or organic environments, "Dry" nano-technology – the focus on fabricating structures in carbon, silicon and inorganic materials through the use of metals and semiconductors (inorganic); and computational nanotechnology – the modeling and simulation of complex nanoscale structures using computational resources to impact "wet" and "dry" nanotechnology **[8]**.

All Things Great and Small

In the effort to promote and bring attention to this branch of specialised research, the government has launched many initiatives to bring nanotechnology into the limelight. The afore-mentioned Asian Nanotechno-logy Forum summit brings together policy makers and researchers from 13 countries to discuss the educational, social, environmental and economic benefits for fostering an international network and collaboration of nanotechnology research. The Asian Pacific Confederation of Chemical Engineering is also organising the 11th APCChE Congress on 27 - 30 August 2006 with the theme "Innovation Sustaining Future Business" at the Kuala Lumpur Convention Centre, Malaysia (*Website: www.apcche2006.org*) to promote nanotechnology (among other things) in sustainable future technologies, with keynote speeches and technical workshops. ■

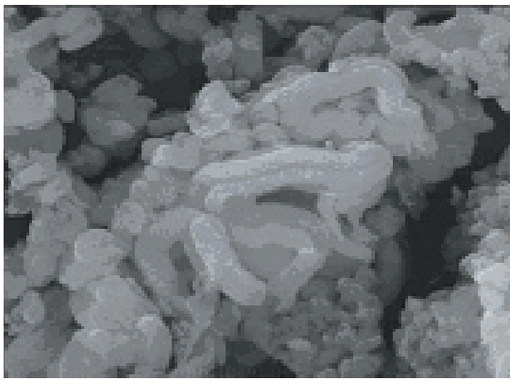

Figure 2: Worm-type MCM-41 synthesised from rice husk. Image reproduced with permission from www.zeolite.fs.utm.my.

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