

Summary of Science Talk (Nanotechnology & Material Science)

1. Importance of research in Nanotechnology & Material Science.

Material science has provided the basis for the development of numerous technologies in this century, especially in the area of nanotechnology. The growth of scientific research in the East Asia region has significantly contributed to the field of material science, and it is the interest of the region to transform these scientific endeavors into products which can have direct or indirect impact on the social and economic developments in the region. The e-Asia Joint Research Forum has identified the need to strengthen existing research collaborations and to pursue new research collaborations with the aim of consolidating knowledge and human resources to make the East Asia region as leader in materials science research.

2. Necessity for research cooperation in the East Asian region and synergistic effect.

To initiate interests and discussions for collaborative research the following topics were presented by Japanese researchers as potential candidate areas for cooperation.

◆ *Nano-biosensor for Health (Dr. Miki)*

This proposal combines nanobio- and nanoelectronics- technologies. The aim of the research is to develop the highly sensitive detection systems for diseases commonly found in Southeast Asia, such as influenza (human and bird flu) and common cancers, especially cervical cancer.

◆ *Monitoring Technology for Materials Corrosion (Dr. Shinohara)*

This proposal aims at enhancing the existing cooperation with Asian countries, it also seek to establish a network for long term materials corrosion measurements.

◆ *High Temperature Oxidation and Corrosion Resistant Coating Technology (Dr. Murakami)*

This proposal aims at the understanding of the deterioration mechanism of components exposed at high temperatures, under various conditions. Standardization of oxidation and hot corrosion properties is also in the scope of this proposal.

◆ *High Quality Crystal Growth Technology (Dr. Ohashi)*

This proposal is capable of producing high quality crystals, which are applicable to a wide range of high tech applications such as LEDs, sensors, radiation detectors.

Participants from Thailand, and the Philippines also presented the priority research areas in material science.

The topics presented by the Japanese researchers were of interests to participants from other participating countries of the science talk. For examples, Prof. Liem from IMS (Institute of Materials Science) of Vietnam expressed intention to participate in joint research projects on all of four topics. Prof. Songsivilai from NANOTEC/NSTDA and Dr. Sirisoonthorn from MTEC/NSTDA of Thailand showed similar interest in presented topics.

In addition, Dr. Suchiva from MTEC/NSTDA of Thailand proposed collaboration in the area of biomaterial, especially in tissue regeneration materials.

Dr. Guevara from PCIEERD-DOST of the Philippines presented the priority research areas of the Philippines. They were nano-structures for solar energy applicable to devices and storage, nano-based materials for environmental applications like waste water purification. Dr. Guevara also expressed interests in collaborating on the biosensor and crystal growth research which Japanese researchers proposed.

Dr. Lim from Universiti Brunei Darussalam expressed interests to collaborate in biosensor and oxidation resistant coating.

After the discussion, the research topics were identified and the following values for collaboration were identified:

- **Nano-biosensors for Health and Food Security**

There are common problem of diseases in Southeast Asia such as influenza (human and bird flu), common cancers especially cervical cancer in female, and Malaria. One of Japan's urgent and emergent studies is to develop nano-biosensor technologies for detecting the diseases, and all participants agreed this is a very important topic to collaborate. Japanese researchers emphasized the applications to health, while the importance of applying nano-biosensor to food security is mentioned by Dr. Guevara from Philippines, Prof Liem from Vietnam and Dr. Lim from Brunei. As a result, the participants mutually agree that research in nano-biosensors is important and of interests to Japan and Southeast-Asia countries. This field of research can bring significant impact to the society and economy in the region.

- **Monitoring Technology for Materials Corrosion**

The participants concluded that the study of corrosion can improve the design, preservation and maintenance of equipment and infra-structures. The diverse environmental conditions across the East Asia and Southeast Asia regions provide opportunities for very comprehensive data to be acquired. These data can be used to set material testing standards, especially in the evaluation of materials under-going corrosion. Improvement of resistance to corrosion will increase the life cycle of materials and finally results in higher reliability of products and lower burden on the environment. Because the extent and process of corrosion differs by the environment in which materials are placed in, understanding the relations between corrosion and the environment is very important and needs collaboration among various countries in wide geographical region and thus environmental variety.

- **High Temperature and Oxidation Resistant Coating Technology**

The nature of this research benefits equipment operated at high temperatures. The outcome of this research will enhance the energy savings and cost savings capabilities of high temperature equipment, particularly turbine systems. High temperature and oxidation resistant material becomes essential for using in turbine systems like aero engine or gas turbine in power plant when we seek increase in energy efficiency and reduction in CO₂ emission as well. The coating technology for increasing the resistance to high temperature and oxidation is also considered very important and will have a boarder impact, because all the countries in East Asia are facing a common challenge to increase the efficiency of energy usage while decrease the CO₂ emission.

It is also important to understand the deterioration mechanism of components exposed to various atmospheres, such as high humidity, seashore, fugitive dust, etc. They can accelerate the

deterioration. By establishing the East-Asian standard for evaluating the components under such conditions will be expected under this collaboration.

- **High Quality Crystal Growth Technology**

The synergy of this project is the match up of high-tech high-quality crystal growing with art and craftsmanship as in gem stone cutting and polishing. In addition, the high quality crystals can be used in a wide of products, enhance having the potential to provide opportunities of high-tech cutting edge equipment such as LEDs, communication devices, sensors, radiation detectors etc. to be produced. Those products or related services have a huge market in East Asia region, such as infrastructure for information technology and less CO₂ emission. On the other hand, East Asian countries are familiar to crystal industry, because a lot of gem mines are there and lapidary has been developed there. Therefore, interaction between traditional and novel technology will induce synergy effect to increase their competitive capability in many aspects of industries.

3. Possible composition of research groups with the participation of at least three countries and their respective roles.

- Biosensor for Health or Food Security
Japan, Vietnam, Thailand, Philippine, Brunei, Laos
- Monitoring Technology for Materials Corrosion
Japan, Vietnam, Thailand, Laos
- High Temperature and Oxidation Resistant Coating Technology
Japan (Sample preparation, proposal of hot corrosion / oxidation evaluation), Vietnam (evaluation for gas turbine /steam gas turbine components), Thailand, Philippine, Brunei
- High Quality Crystal Growth Technology
Japan, Vietnam, Thailand, Laos

List of Participants:

Japan:

Dr. Johsei Nagakawa, Section Manager, External Collaboration Division, NIMS

Dr. Kazushi Miki, Group Leader, Functional Heterointerface Group, Advanced Key Technologies Division/Polymer Materials Unit, NIMS

Dr. Naoki Ohashi, Division Director, Environment and Energy Materials Division, NIMS

Dr. Hideyuki Murakami, Group Leader, Surface Kinetics Group, E&EM Div./High Temperature Materials Unit, NIMS

Dr. Tadashi Shinohara, Group Leader, Materials Corrosion Group, E&EM Div./Materials Reliability Unit, NIMS

Dr. Teruo Kishi, Program Director of SICORP, JST

Dr. Geng Tu, Manager, Department of International Affairs, JST

Laos:

Dr. Silap Boupcha, Director, IT Management and Promotion Division, National Authority for Science and Technology, Laos

Philippines:

Dr. Amelia P. Guevara, PCIEERD-DOST Executive Director, Philippines

Thailand:

Prof. Sirirung Songsivilai, Executive Director, NANOTEC, NSTDA, Thailand

Dr. Somnuk Sirisoonthorn, Senior Director, MTEC, NSTDA, Thailand

Dr. Krisda Suchiva, Deputy Director, MTEC, NSTDA, Thailand

Vietnam:

Prof. Nguyen Quang Liem, Director, IMS, VAS, Vietnam

Brunei

Dr. Chee Ming Lim, Head of Energy Research, Universiti Brunei Darussalam

Cambodia:

Dr. OM Romny, Director General, Institute of Technology of Cambodia