

Nanotechnology Activities in Korea

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- National Programs**
- Industry**
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II. Summaries



Korean environments and the characteristics of nanotechnology force Korea to follow a different approach than other countries .

Characteristics of Nanotechnology

- a Wide Range of Impact
- Expected Long-term for Commercialization
- Resource-intensive
 - High Priced Facilities
- Skilled Engineers

Environments of Korea

- Follower's Position in Nano
- Scarce Skilled Engineers
 - 1/10 of Japan
 - Engineering Careers Become Unpopular
- Lack of Nano-scale Facilities Needed
- Slowed Economic Growth
- Small Population and Territory

Korean Approach to Nanotechnology

- Strong Commitment of Government
 - Increased R&D Budgets(US\$ 166M, 2002)
- Close Collaboration between Gover., Academia, and Industry
 - e.g. NTRA (Nano Technology Research Association)
- Efficient Use of Resources
 - e.g. The National Nano Fab Centers

Korean government's commitments to nanotechnology focus on the initiation of R&D programs and the development of infra structures.

R&D Program

The major R&D programs related to NT are :

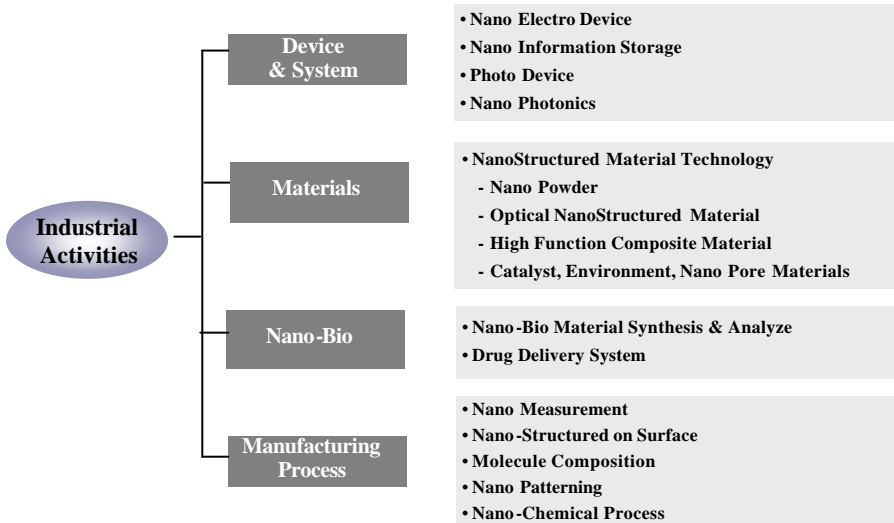
Frontier 21 R&D Program	Other major programs
<ul style="list-style-type: none"> • Tera Level Nano Device Program • Nano Mechatronics Program • Nano Materials Program • Intelligent Microsystem Program <ul style="list-style-type: none"> - Endoscopic Microcapsule - Wrist-type Micro PDA 	<ul style="list-style-type: none"> • IT-NT Fusion Technology • Nano Health Technology • Next Generation Core Environment • Nano Technology Development in field of the national defense • Core 10 R&D Domains for Next Growth Engines

Infra Structures

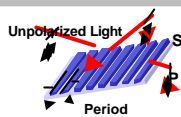
Three types of fabrication centers are at the core of infrastructures :

- I. The National Nano FabCenter : Silicon based application(Tae-Jeon)
- II. Application-specific Nano FabCenters : Non silicon based application(Su-Won)
- III. Nano Cluster : Collaboration between R&D-Manufacturing-Marketing(2 sites planned)

Activities of Korean industry can be classified into four categories ; device & system, materials, nano-bio, and manufacturing process .



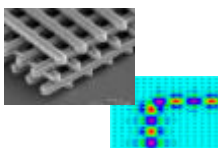
Device & System



Polarizer

- Development of Polarizer with period less than 150nm
- Aimed at enhancing the extinction ratio up to 1000 fold at 450nm

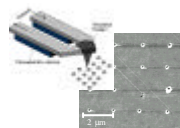
Company: LG



Photonic Crystal Device

- E-beam Lithography & Si-based micro processing
- Core technologies for Photonic Integrated Circuit
- Wave guide, Cavity, Splitter by Photonic band-gap material (Virtually no loss of information)

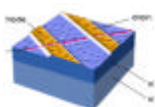
Company : LG



Nano Data Storage System (Scanning Probe Microscope)

- Atom Force Microscope Cantilever Type Data Storage System.
- Thermo Piezoelectric Substrate for the storage medium
- Density up to 300Gb/in²

Companies : LG, Samsung

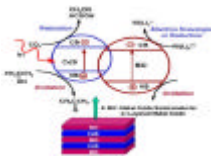
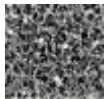
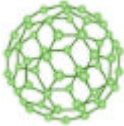
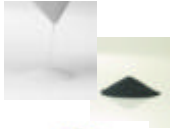


Tera Bit Level Flash Memory Device

- 30nm line width
- SONOS Memory (Silicon-Oxide-Nitride-Oxide-Silicon)

Company : Samsung,

Structured Materials



Nano Powders

- Oxide Powder, Carbonate Powders for MLCC Additives
- Powder for CNT
- Companies : Sukkyung A.T, ILjin Nanotech, Nanonix

Fullerene (C₆₀) Application

- Engine Lubricant, Wear-resistant metal coating.
- Company : Newman Nanotech

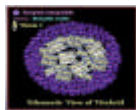
Nano Porous Membrane

- Usage for Energy Transformation, Storage
- Company : Nano pore materials Co.Ltd

Photo Catalyst

- TiO₂ Nano Sized Particle Coating
- Air Conditioner Heat Exchanger Coatings etc.
- Company : Tioz

Nano-Bio



Nano Capsule Cosmetics

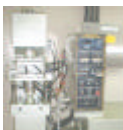
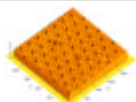
- New Functional Cosmetics with Nano-sized Encapsulated Vitamin C

Drug Delivery System

- Improved Reliability of Antibiotics 'M' by Encapsulating into the Inorganic Substances.
- Long lasted Effect of more than 1 Week per Medication

Company : Nanohybrid

Nano Process



Fast Scan AFM for Fab

- Nano Enabler : Nano Positioning with a High Repeatability and Flatness of Traverse.

Company : PSIA, SNU Precision

Nano Imprint Lithography

- Facilitates Cheap and Fast Nano Patterning.

Company : LG

Responding to government's strong commitments, major universities participate in various research areas of nanotechnology.

**Korea Advance Institute
of Science & Technology**

Nano Materials for Li 2nd Battery
Nano-Bio Materials
Photonic Crystal Assembly
Vertical-cavity Surface-emitting Laser
Carbon Nanotube Composition for Field Emitter

**Pohang university of
Science & Technology**

Nano Device & Circuit design

Nano Level Si Device & Photonic Device
E-Beam & EUV Exposure Technology

Nano Process

CNT Synthesis
Analysis of Nano scale domain structure for Ferroelectric film

BioNanotech

Nano-Bio Chip, Bio MEMS; Nanosystems for Drug Delivery
Single-Bimolecular Manipulation and Engineering

Seoul National University

Nano Materials

Anodic Aluminum Oxide(AAO) Template
Atomic Force Microscope(AFM)
Surface enhanced Raman Scattering(SERS)

**SungKyunKwan
University**

Nano Physics Lab.

Surface: Metal on Semiconductor System Molecule adsorbed on Semiconductor Surface
CNT Growth by using Equipments (PECVD,MPECVD...)
Fabrication and Application of the Anodic Aluminum Oxide

Carbon Nanotube Research Lab.

Transport Properties, Optoelectronics Properties
Nanoprobe Fabrication and Nanomanipulation
Electron devices: Field Emission Displays, Gravimetric Methods, Fuel Cell

Hanyang University

Nanotube Research Lab.

Synthesis of CNT by CVD
Synthesis of Single-walled, Double-walled and Multi-walled CNT

Nano particulate Materials Technology Lab.

Diffusion Kinetics in Nanocrystalline Metals
Hyperfine Nano Metal Powder Feedstock

Development of Nano-SOI² Process

Nano-cleavage, Nano-surface Treatment
Low-temperature Nano-epi Si growth

I. Background & Purpose of Foundation

NTRA (Nano Technology Research Association) of Korea was founded in 2002 to coordinate industrial needs related to the development of nanotechnology.

Founding Background

- Increased World-wide Investments on Nanotechnology
- Large -scale Investments on Nano by Korean Government
- Korean Industry's Need to Respond to the Governmental Initiatives
- Required Industrial Coordination to Take Advantages of Governmental Initiatives.

Founding Purpose

- Information Gathering and Sharing
- Joint Project Proposal for the Government Funds
- Joint Project Promotion between Membership Companies.

At Its Infancy

- A Young Organization - Founded in 2002
- A Small Organization - 6 Full-time Employees

II. Funding scheme & Membership Companies

NTRA is currently a small association with 48 membership organizations, and its budget comes from 2 sources

Sources of Funds

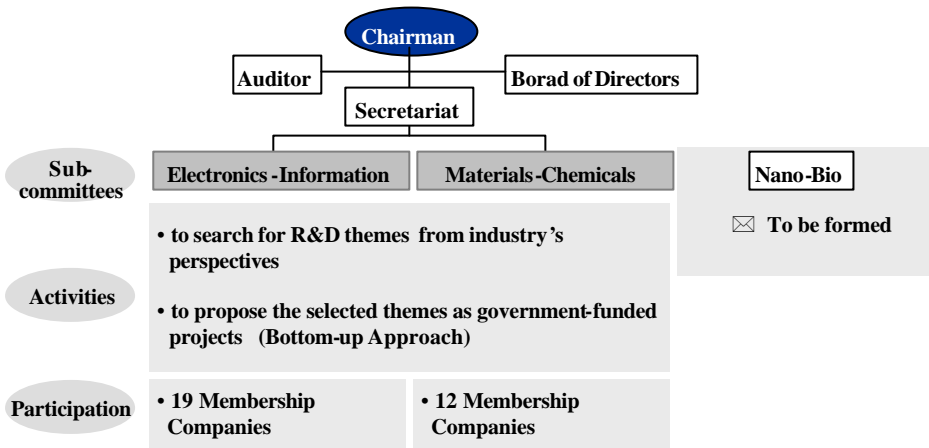
- Contract Fee of Government Projects
- Membership Fee

Membership organizations

- Executive corporate members : 8 companies
- Corporate members : 32 companies
- Laboratory & University members : 8 organizations

III. Sub-committees

Because of Nanotechnology's broad areas of impact, NTRA has formed two sub-committees to focus their efforts on specific areas of interests.



IV. Activities

Major activities of NTRA are :

☐ Government funded R&D project execution

- Core technology development based on nanotechnology for next generation businesses(2001~)
- EUV lithography core technology development for the nano Scale semiconductors(2002~)
- Development of the high efficacy new light source using carbon nano tube“(2003~)
- Development of the functional carbon nano thin film material and equipment(2003~)

☐ Nano-Korea 2003 (8.27 ~ 8.30)

- Companies participated : 49 (78 Booths)
- Visitors & Attendees : 6,000 (Exhibition), 723 (Symposium)
- A plan of Nano Korea 2004 (Expected 2004.10.27 ~ 10.30)

☐ The task of planning & reporting about the establishment of :

- Application Specific Nano Fab. Center (MOST)(2002.7~2002.12)
- Nanotechnology cluster (MOCIE)(2003.5~2003.10)
- Survey of the activities on nano industrial technology in Korea

- ✓ **The USA and Japan leads the development of nanotechnology.**
- ✓ **Korea is allocating “not small” budget for the nanotechnology.**
 - Comparing to the USA or Japan, this budget is still very small.
- ✓ **Korea’s approach should be different from those of the States and Japan ;**
 - Government strongly commits to initiate NT development programs.
 - Efficient use of resources is emphasized.
 - Careful choice of R&D themes and concentration is required.
 - A broad area of nanotechnology is currently being explored.
 - Nano should help Korea’s some industries keep their leading edges :
 - e.g., Display, Memory, TFT-LCD, Optical Storage, Appliances
- ✓ **NTRA is playing a major role in Korea to coordinate activities between Gover., Academia, and Industry, and planning to actively establish the relationships with potential overseas partners**