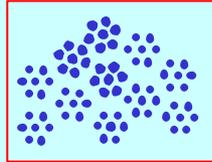




Development of Nanostructured Materials Technologies for Structural Applications by CNMT



Sang-Hee Suh

Center for Nanostructured Materials Technology

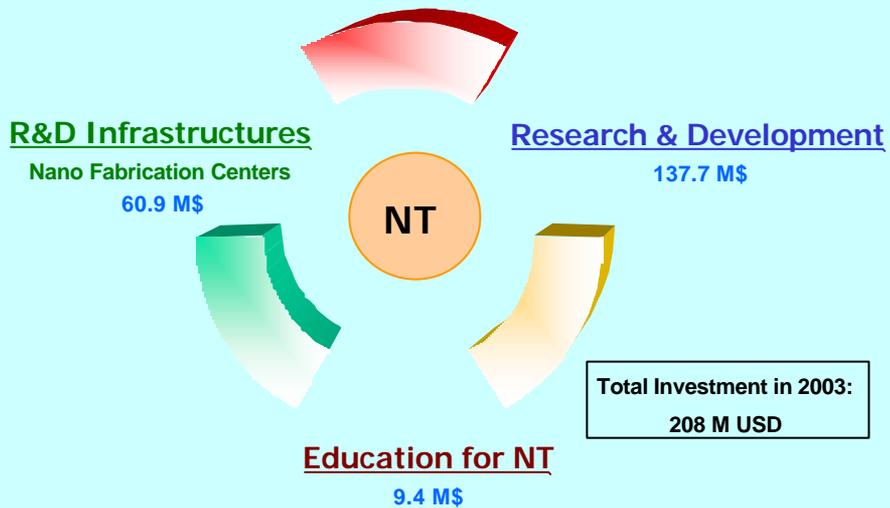
<http://cnmt.kist.re.kr/>

Outlines

- R&D investment for NT by Korean Government
- R&D programs for NT in Korea
- R&D program by the CNMT
 - ✦ R&D program for structural applications by the CNMT



Investment for NT by Korean Government



21C Frontier R&D Program

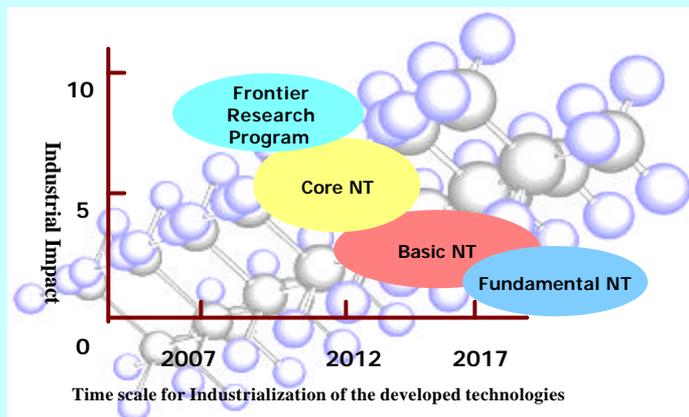
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3

R&D Programs for Nanotechnologies in Korea

R&D Programs for Nanotechnologies by the Ministry of Science and Technology of Korea



21C Frontier R&D Program

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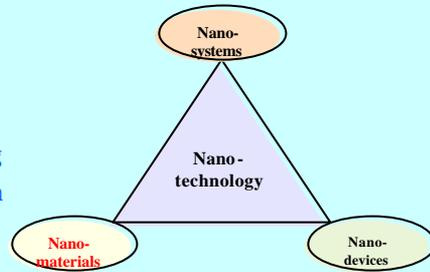
Frontier Research Programs for Nanotechnologies

Frontier Research Centers for Nanotechnology

- Center for Nanostructured Materials Technology
- Center for Nanoscale Mechatronics & Manufacturing
- Tera-level Nanodevice Program

Budget

- About 10 M US Dollars every year for 10 years for each Center



Overview of the R&D Program by the CNMT

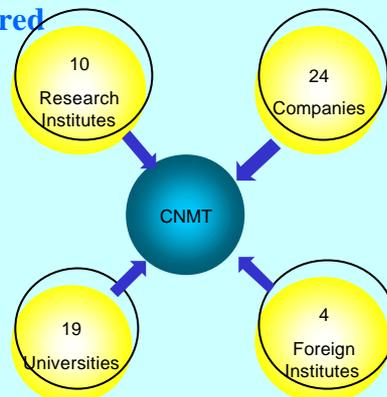
Three Areas with 30 Projects

- High strength nanostructured materials
- Environmental and energy storage materials
- Optical materials for information technology

2002. 7. – 2012. 3.

55 Institutions

550 Researchers



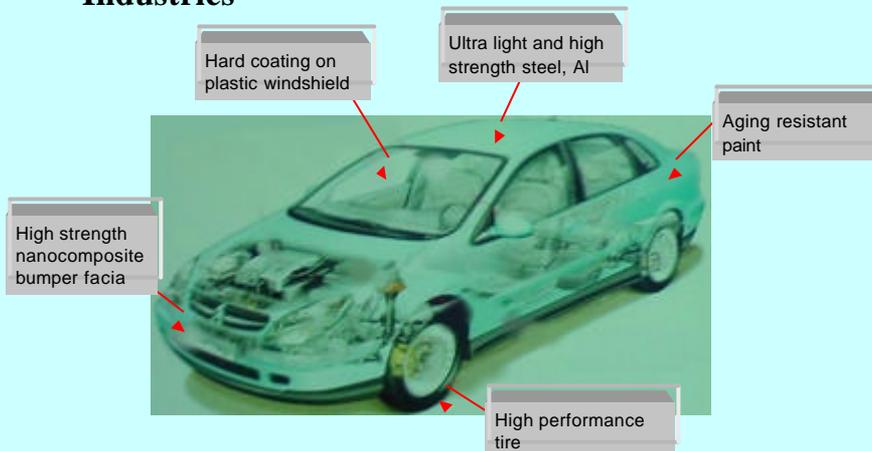
Nanostructured Materials under Development by the CNMT

- **High strength nanostructured materials**
 - Nanostructured bulk materials
 - Nanostructured composite materials
 - Hard coating materials
- **Environmental and energy storage materials**
 - Catalysts for environment applications
 - Active materials for rechargeable batteries
- **Optical materials for information technology**
 - Nanostructured materials and devices for broad band optical communication
 - Nanostructured materials and devices for display applications



Structural Applications of Nanostructured Materials

- **Nanostructured Structural Materials for Car Industries**

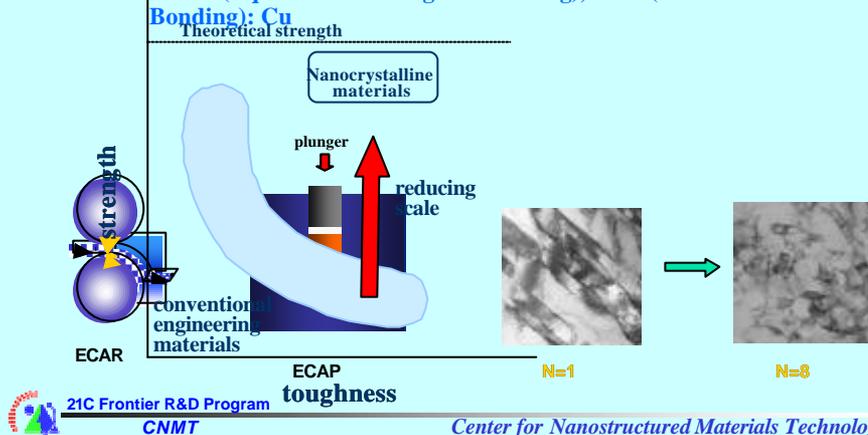


Nanocrystalline Materials by Severe Plastic Deformation by J.W. Park of KIST, D.H. Shin of Hanyang Univ. and C.Y. Lim of KIMM

- To increase the strength of Al and Cu alloys 2 to 3 times and obtain superplastic behavior at the processing temperatures by reducing the crystal grain size down to 100-200 nm.

- ECAR (Equal Channel Angular Rolling) : Al alloys

- ECAP (Equal Channel Angular Pressing), ARB (Accumulative Roll Bonding): Cu



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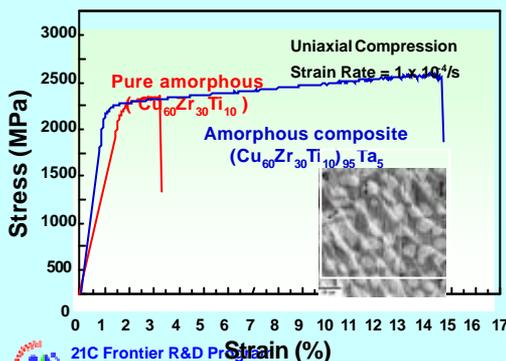
9

Amorphous Composite Materials by J.C. Lee of KIST, S.Y. Shin of KITECH and S.H. Lee of POSTECH

- To develop amorphous composite materials and their processes with UTS of 2-3 Gpa and elongation of 4-6%.

- Formation of soft crystals in bulk metallic glass during rapid solidification or heat treatment

- Powder sintering to form a composite structure of soft crystals in bulk metallic glass



21C Frontier R&D Program

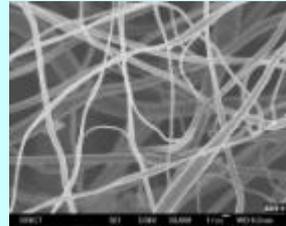
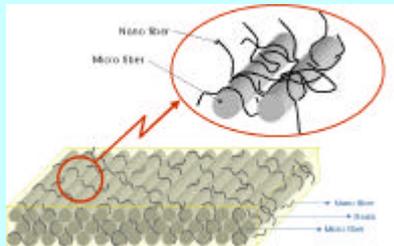
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10

Polymeric Nanocomposite by T.W. Kim of KIMM and J.R. Lee of KRICT

- Polymer matrix composite reinforced with both micron- and nano-carbon fibers

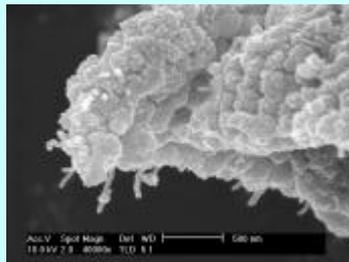


Carbon nanofibers made by electrospinning

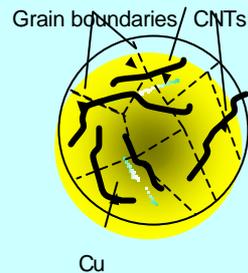


Metallic Nanocomposite by S.K. Lee of KIMM and S.H. Hong of KAIST

- Cu matrix composite reinforced with CNF or CNT
- Target strength: 1 Gpa



Cu powder embedded with CNTs



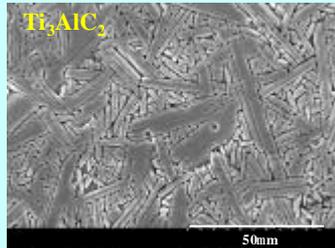
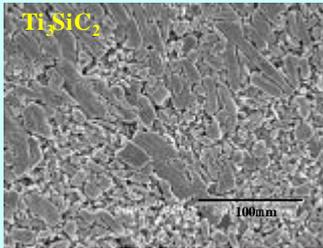
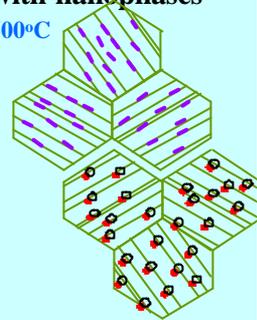
Ceramic Nanocomposite by S.H. Park of KIST

Laminated Ceramics

- ✦ Ti_3SiC_2 , Ti_3AlC_2
- ✦ Machinable and low friction coefficient (< 0.1)
- ✦ High oxidation resistance
- ✦ Low fracture strength < 600 Mpa

Reinforced with nanophases

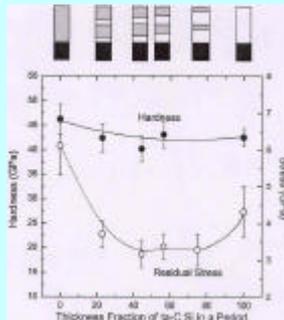
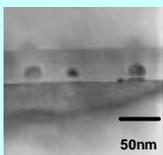
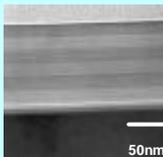
- ✦ 1.5 Gpa, 1500°C



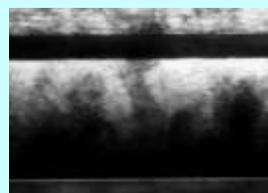
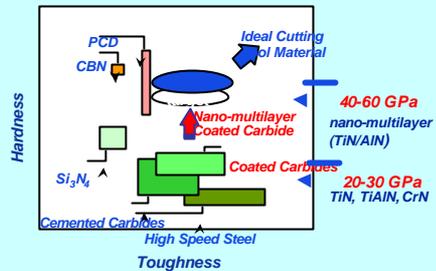
Nanostructured Multilayer Hard Coating by K.R. Lee and Y.J. Paik of KIST

Carbon based nanoscale multilayers and nano-composite films for precision dies

- ✦ Tetrahedral amorphous carbon coating



Nanomultilayersuperlattice materials for cutting tools

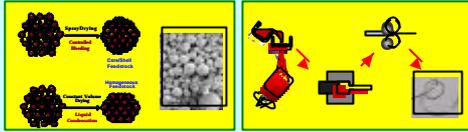


TiN/VN multilayers

Nanostructured Thermal spray coating by S.H. Hwang of RIST and H.K. Suk of KIST

Development of Feedstock Materials

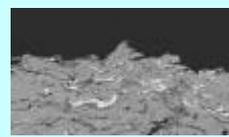
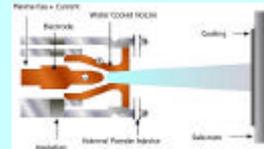
- ✦ Powder feedstock from nanoparticles by spray drying or liquid condensation
- ✦ Hard metallic wire by spray forming and downstream mechanical processing



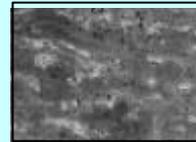
Development of Thermal Spray Processes

- ✦ Plasma spraying, High velocity oxyfuel spraying, Cold spraying, Electric arc spraying
 - ▶ WC/Co cermet coating for high wear resistance and durability
 - ▶ Multi-component coating for low friction coefficient
 - ▶ Hard metallic coating for corrosion and erosion resistance

Plasma spraying



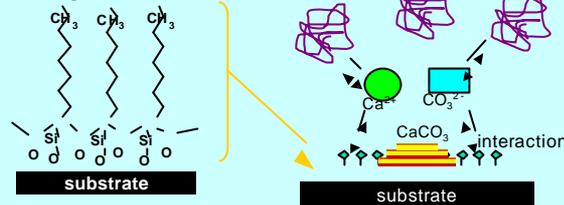
Multi-component solid lubricant coating



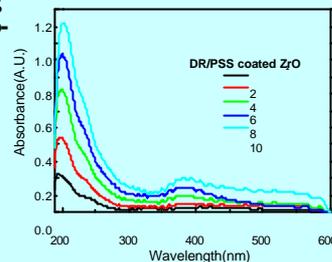
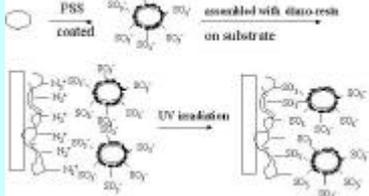
WC/Co cermet coating

Organic / Inorganic Hybrid Nanocomposite Coating for Plastic Materials by Kilwon Cho of Postech

- ✦ Organic / organic nanocomposite coating through the control of crystallization of inorganic materials on the various organic templates

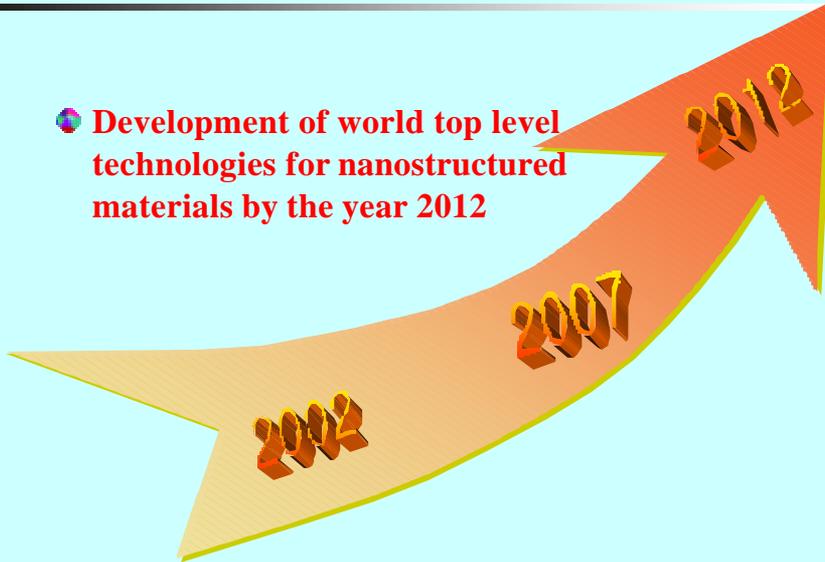


- ✦ Multilayered organic/inorganic nanocomposite thin film by using dip-coating or spin coating with polyelectrolyte and nanoparticles.



Vision of the Frontier Research Program for Nanostructured Materials Technology

- **Development of world top level technologies for nanostructured materials by the year 2012**



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BIO.INFO.NANO The Convergence of 21st-Century Technologies

Monday

October 20, 2003

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- **The Convergence of 21st-Century Technologies**
Thomas Kalil, Special Assistant to the Chancellor for Science and Technology
- **Bio-Info-Nano in Service of Society**
S. Shankar Sastry, Chairman of the Department of EECS
- **Bridging the Nano-Bio Interface**
Paul Alivisatos, Chancellor's Professor of Chemistry and Materials Science
- **Integration of Novel Nanostructures with CMOS**
Jeffrey Bokor, Professor of EECS
- **Integrated BioPOEMS with Nanophotonic Probes**
Luke P. Lee, Assistant Professor of Bioengineering

