A JOINT SYMPOSIUM OF

9TH US-KOREA WORKSHOP ON NANOSTRUCTURED MATERIALS

&

7TH US-KOREA WORKSHOP ON NANOELECTRONICS

10-12 Aug. 2010
Hyatt Regency Bellevue
City of Bellevue, Seattle, WA

(Affiliated with UKC-2010:
The 2010 US-Korea Conference on
Science, Technology & Entrepreneurship)

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U. S. Air Force Office of Scientific Research
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Program Overview

	Tuesday 10 August	Wednesday 11 August	Thursday 12 August
07:00- 08:00		Registration & *Continental Breakfast* (Juniper)	*Continental Breakfast* (Larch)
08:00-09:50		Plenary Session & Joint Session I (Juniper)	Joint Session V (Spruce)
09:50-10:10		*Mid-Morning Break*	*Mid-Morning Break*
10:10-12:05	Arrival	Joint Session II (Juniper)	Joint Session VI (Spruce)
12:05-13:30		*Lunch* (Juniper)	*Lunch* (Cedar Ballroom)
13:30-15:20		Joint Session III (Juniper)	Joint Session VII (Spruce)
15:20-15:40		*Mid-Afternoon Break*	*Mid-Afternoon Break*
15:40-17:20		Joint Session IV (Juniper)	Joint Session VIII (Spruce)
17:20-18:30	Registration	*Evening Break*	*Evening Break*
18:30-20:30	*Welcome Dinner* 18:00-20:30 (Juniper)	*Networking Dinner* (Larch)	*Farewell Dinner* (Larch)

Co-Chairs for 9th US-Korea Workshop on Nanostructured Materials:

Dr. Hugh DeLong *(Air Force Office of Scientific Research)*
Dr. Sang-Hee Suh *(Center for Nanostructured Materials Technology)*

Co-Chairs for 7th US-Korea Workshop on Nanoelectronics:

Dr. Harold Weinstock *(Air Force Office of Scientific Research)*
Dr. Jo-Won Lee *(Nat'l Program for Tera-level Nanodevices)*

Joint Organizing Committee:

LtCol John Seo *(Asian Office of Aerospace R&D)*, ***Co-Chair***
Dr. Sang-Hee Suh *(Center for Nanostructured Materials Technology)*, ***Co-Chair***
Prof. Wonbong Choi *(Florida International Univ.)*
Dr. Hugh DeLong *(Air Force Office of Scientific Research)*
Prof. Soon-Hyung Hong *(Korea Advanced Inst. of Science & Technology)*
Dr. Jo-Won Lee *(Nat'l Program for Tera-level Nanodevices)*
Dr. Misoon Mah *(Air Force Office of Scientific Research)*
Dr. Harold Weinstock *(Air Force Office of Scientific Research)*

Joint Advisory Committee:

Dr. Byung-Lip ("Les") Lee *(Air Force Office of Scientific Research)*, ***Co-Chair***
Dr. H. Thomas Hahn *(Korea Inst. of Science & Technology - KIST)*, ***Co-Chair***
Dr. Ken Goretta *(Asian Office of Aerospace R&D)*
Prof. Ki-Bum Kim *(Seoul National Univ.)*
Dean Haiwon Lee *(Hanyang Univ.)*
Prof. Kun-Hong Lee *(Pohang Univ. of Science & Technology)*
Prof. Cheol Park *(National Inst. of Aerospace)*
Prof. Duck-Joo Yang *(Univ. of Texas at Dallas)*

Invited Speakers:

Plenary Speakers -

Dr. Patrick Carrick *(Director for Physics, Air Force Office of Scientific Research)*
Dr. Mark Maurice *(Director for Int'l Office, Air Force Office of Scientific Research)*
Dr. H. Thomas Hahn *(Korea Inst. of Science & Technology - KIST)*
Dr. Jong-Deok Kim *(Head, Global Network Development Team, National Research Foundation of Korea - NRF)*
Dr. Eul-Son Kang *(Korea Agency for Defense Development)*

Overview Presentations -

Dr. Jo-Won Lee *(Nat'l Program for Tera-level Nanodevices)*
Dr. Sang-Hee Suh *(Center for Nanostructured Materials Technology)*
Dr. Charles Lee *(Air Force Office of Scientific Research)*
Dr. Gail Brown *(Air Force Research Lab)*
Dr. Benjamin Leever *(Air Force Research Lab)*
Dr. Tia BellsonTolle *(Air Force Research Lab)*

Presentations on Workshop Theme "New Trends of Graphene and Carbon Nanotube Research" -

Prof. Charles Ahn *(Yale Univ.)*
Prof. Ray Baughman *(Univ. of Texas at Dallas*)
Prof. Wonbong Choi *(Florida Int'l Univ.)*
Prof. Chang-Beom Eom *(Univ. of Wisconsin)*
Prof. Donhee Ham *(Harvard Univ.)*
Prof. Philip Kim *(Columbia Univ.)*
Prof. Nicholas Kotov *(Univ. of Michigan)*
Dr. William Mitchel *(Air Force Research Lab)*
Prof. Jiwoong Park *(Cornell Univ.)*
Prof. Duck-Joo Yang *(Univ. of Texas at Dallas)*

Prof. Soon-Hyung Hong *(Korea Advanced Inst. of Science & Technology)*
Prof. Haiwon Lee *(Hanyang Univ.)*
Prof. Soon-Il Lee *(Ajou Univ.)*

Presentations on "NBIT: Nano-Bio-Information Technology Symbiosis" Phase I Program Review *(Sponsored by U. S. Air Force Office of Scientific Research and Ministry of Education, Science and Technology of Korea)* **-**

Dr. Adam Braunsweig *(Northwestern Univ.) for Chad Mirkin PI:* SH Hong
Dr. Leon Chen *(Univ. of California, San Diego) for Sungho Jin PI:* KB Kim
Prof. H. Thomas Hahn *(Univ. of California, Los Angeles) PI:* KH Lee
Dr. Young-Wook Jun *(Univ. of California, Berkeley) for Paul Alivisatos PI:* JW Cheon
Prof. Moon J. Kim *(Univ. of Texas Dallas) PI:* YH Lee
Prof. Julie Kornfield *(California Inst. of Technology) PI:* SY Park
Prof. Hongkun Park *(Harvard Univ.) PI:* MH Jo
Prof. Andrew Steckl *(Univ. of Cincinnati) PI:* DH Choi
Prof. Jimmy Xu *(Brown Univ.) PI:* HJ Shin
Prof. Minhee Yun *(Univ. of Pittsburgh) PI:* YH Lee

Prof. Jinwoo Cheon *(Yonsei Univ.) Co-PI:* Alivisatos
Prof. Dong-Hoon Choi *(Korea Univ.) Co-PI:* Steckl
Prof. Seunghun Hong *(Seoul Nat'l Univ.) Co-PI:* Mirkin
Prof. Moon-Ho Jo *(Pohang Univ. of Sci. & Technology) Co-PI:* H Park
Prof. Ki-Bum Kim *(Seoul Nat'l Univ.) Co-PI:* Jin
Prof. Kun-Hong Lee *(Pohang Univ. of Sci. & Technology) Co-PI:* Hahn
Prof. Sang-Gi Lee *(Ehwa Womans Univ.) Co-PI:* Hahn
Prof. Young-Hee Lee *(Sungkyunkwan Univ.) Co-PI:* M Kim
Prof. Soo-Young Park *(Kyungpook Nat'l Univ.) Co-PI:* Kornfield
Prof. Hyunjung Shin *(Kookmin Univ.) Co-PI:* Xu

AGENDA

10 Aug 2010 (Tuesday): Hyatt Regency Bellevue

REGISTRATION (16:30 –18:00)

WELCOME DINNER (18:00 – 21:00): Juniper
Moderator: TBD

18:00 ***WELCOME REMARKS:***
Dr. Jae H. Kim (UKC 2010 General Chair, Boeing Company)
Dr. Mark Maurice (Director for Int'l Office, Air Force Office of Scientific Research)

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11 Aug 2010 (Wednesday): Hyatt Regency Bellevue

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07:00 Breakfast: Larch

REGISTRATION (07:00 – 08:00) in front of Juniper

PLENARY SESSION (08:00 – 08:30): Juniper

08:00 ***OPENING & WELCOME REMARKS:***
Lt Col John Seo *(Asian Office of Aerospace R&D),* ***Presiding***

Dr. Patrick Carrick (Director for Physics, Air Force Office of Scientific Research)
Dr. JongDeok Kim (Head, Global Network Development Team, Nat'l Research Foundation)
Dr. H. Thomas Hahn (President, Korea Inst. of Science & Technology)
Dr. Eul-Son Kang (Director for Materials, Korea Agency for Defense Development)

08:20 ***INTRODUCING CHAIRS, MODERATORS & COMMITTEE MEMBERS:***
Dr. Sang-Hee Suh *(Center for Nanostructured Materials Technology) – Korea side*
Dr. Harold Weinstock *(Air Force Office of Scientific Research) – US side*

NANOMATERIALS/NANOELECTRONICS JOINT SESSION I (08:30 – 09:50): Juniper
Moderator: Dr. Jong-Deok Kim *(Nat'l Research Foundation of Korea)*

08:30 Dr. Sang-Hee Suh (Center for Nanostructured Materials Technology)
"National Program for Nanostructured Materials Technology: An Overview"

08:50 Dr. Tia BensonTolle (Air Force Research Lab)
"ADD-AFRL Collaborative Research in Nanotailored Materials and Devices"

09:10 Prof. H. Thomas Hahn (Univ. of California, Los Angeles, KIST)
NBIT: *"Hierarchical Carbon Fiber Composites (Part 1 of 2)"*

Abstract: Hierarchical composite laminates with carbon fiber/epoxy and multi-walled carbon nanotubes (MWCNTs) were processed and characterized for the mechanical and electrical properties. MWCNTs were directly grown onto AS4 carbon plain-weave fabric and processed into laminates by using a vacuum assisted resin transfer molding (VARTM) or a wet-lay-up method followed by autoclave curing. The tensile tests show that CVD process to grow MWCNTs onto the carbon fabric did not deteriorate the tensile strength of the carbon fibers. The samples with MWCNTs processed by the wet-lay-up method show increased fracture toughness (mode 1) by 20% over the control samples

without MWCNTs. The electrical conductivity tests show more promising results. The out-of-plane electrical conductivity of samples with MWCNTs was increased by 59 times over the control samples. The deposited MWCNTs decrease the electrical contact resistance between the sample and the electrodes attached thereto and increase the sensitivity of crack detection capability, which was shown by resistance change measurement during double-cantilever beam (DCB) tests. Scanning electron micrography was used to delineate the failure modes of the fracture-toughness samples.

09:30 Prof. Kun-Hong Lee (Pohang Univ. of Science & Technology)
& Prof. Sang-Gi Lee (Ehwa Womans Univ.)
NBIT: *"Hierarchical Carbon Fiber Composites (Part 2 of 2)"*

Abstract: See Prof Thomas Hahn's Abstract Above.

09:50 Break

NANOMATERIALS/NANOELECTRONICS JOINT SESSION II (10:10 – 12:05): Juniper
Moderator: Dr. Sang-Hee Suh *(Center for Nanostructured Materials Technology)*

10:10 Prof. Ray Baughman (Univ. of Texas at Dallas)
"Multifunctional Nanostructured Yarns and Fabrics for Energy and Other Applications"

Abstract: Though yarn spinning has prehistoric origins and remains vital today, a host of important materials cannot be made into yarns by previously known methods. Generically applicable methods are demonstrated for producing continuous yarns comprising up to 99 wt% of otherwise unspinnable nano-powders or nanofibers that remain highly functional. These methods utilize the strength and electronic connectivity of sometimes minute amounts of carbon nanotube sheets that are helically scrolled in the yarns. Scrolled 50 nm thick nanotube sheet or sheet stacks can confine nanopowders, micropowders, or nanofibers in the corridors of often irregular scroll sacks, whose observed complex structures are related to twist-dependent extension of Archimedean or Fermat spirals or spiral pairs into scrolls. This new technology is used to make yarns of graphene ribbons, superconductors, high performance battery materials, catalytic oxygen electrodes for fuel cells, TiO_2 for release of active oxygen, and strong sutures containing biomedical agents. The observed mechanical properties enable yarn knotting and the weaving and sewing of biscrolled multifunctional yarns into textiles.

10:35 Prof. Haiwon Lee (Hanyang Univ.)
"Fabrication of CNT Channels on Three-Dimensional Building Blocks and Their Applications"

Abstract: Carbon nanotubes (CNTs) are an ideal electrode material because of their good conductivity, high aspect ratio with nano-sized diameters, and strong chemical and physical hardness. Therefore, CNTs can be used for efficient nano-electrodes in sensors, photo-electronic devices, and alternative sources of energy including solar-cell and fuel-cell applications. It is expected that the high-density single-walled CNTs–3 dimensional networks (SWNT-3DNs) assure the maximum effective density of SWNTs in the confined area of the template. By adjusting both the 3D structure of the template and the SWNTs growth conditions, the density of and the distance between the bundles of SWNTs can be controlled. The distance between the bundles of SWNTs is more important when the CNT surfaces are modified with functional materials for multi-functional applications. We have focused on fabricating uniform SWNT-3DNs on various pillar substrates including Si, sapphire and quartz. The density of SWNT bundles and the gap between the SWNT channels were controlled. Based on the SWNT-3DNs fabricated on a Si pillar substrate, several applications such as solar-cell, strain sensor, and filter for microfluidics were carried out.

11:00 Dr. Leon Chen (Univ. of California, San Diego) for Prof. Sung-Ho Jin
NBIT: *"High-Resolution, Large-Area, Nano Imprint Lithography using Electro Lattice Image & Electron-emitting Nanoprobes (Part 1 of 2)"*

Abstract: For successful technology transfer of nano materials and device innovations to industrially viable manufacturing levels, high-throughput nanofabrication is essential. While significant advances have been made in the field of nano materials and devices, the progress toward large scale integration into useful electronic devices and system arrays has been rather slow, largely due to the lack of industrially viable and efficient nanofabrication techniques, especially with two major bottleneck issues on how to precisely place nanomaterials/devices in high enough densities, and how to provide convenient high-throughput nanomanufacturing.
In this presentation, some research progress toward such high-throughput nano-manufacturing will be discussed. AFM based or nano-manipulator based, massively parallel nanopattern writing using multi-tip probes can be combined with nano-imprint lithography and associated processes for efficient nanomanufacturing. Advancement of such techniques could lead to a wide use of nano materials and devices for practical applications.

11:20 Prof. Ki-Bum Kim (Seoul National Univ.)
NBIT: *"High-Resolution, Large-Area, Nano Imprint Lithography using Electro Lattice Image & Electron-emitting Nanoprobes (Part 2 of 2)"*

Abstract: See Dr Leon Chen's Abstract above.

11:40 Dr. William Mitchel (Air Force Research Lab)
"Graphene Growth by Carbon Source MBE"

Abstract: We demonstrate the direct deposition of graphene from solid source carbon to obtain large-area epitaxial graphene. Molecular carbon beams were obtained by the evaporation of C_{60} in a conventional effusion cell and from a heated graphite filament. Substrate temperatures varied from 1200 to 1400°C. Both carbon sources resulted in high quality and continuous epitaxial graphene compared with conventional, Si sublimation grown material, however, we also demonstrate that the physical and electronic structure depend strongly on the carbon source used. The graphene layer from C_{60} deposition has AB stacking with similar electronic structure to conventionally grown graphene on SiC (0001), while growth with the graphite filament results in non-Bernal stacked graphene layers with Dirac-like electronic structure, which is similar to conventionally grown graphene on SiC (0001). Raman spectra for conventionally grown and C_{60} grown graphene demonstrate direct deposition of graphene. AFM, Raman mapping, and electrical measurements show that the direct deposition of graphene by solid source carbon is a promising method for homogeneous large area graphene growth.

12:05 Lunch: Larch***

NANOMATERIALS/NANOELECTRONICS JOINT SESSION III (13:30 – 15:20): Juniper
Moderator: Dr. Joe Tringe *(Lawrence Livermore National Lab)*

13:30 *Dr. Benjamin Leever (*Air Force Research Lab)
"Nanomaterials for Energy Research Activities at AFRL/RX"

Abstract: Energy-related research at AFRL/RX covers a broad spectrum of applications and devices including batteries, organic/hybrid photovoltaic devices, capacitors, fuel cells, deployed energy systems, thermoelectric materials, and alternative fuels. This talk will focus on our research activities across these areas that specifically target nanostructured materials and architectures. Several projects will be highlighted including: TiO_2 nanotubes in dye-sensitized solar cells, nanostructured dielectrics for capacitors, and photocurrent mapping in organic photovoltaic devices.

13:50 Prof. Nicholas Kotov (Univ. of Michigan)
"Amazing Properties of Layered Nanocomposites from Clay Sheets and CNTs"

Abstract: Layer-by-layer assembly (LBL) is a new technique for design and manufacturing of composite materials based on sequential adsorption of nanometer scale layers of polymers and inorganic colloids. LBL is a universal method which provides unique uniformity and structural control to the resulting hybrid composites. This technique can resolve hard challenges of materials science related to mechanical, electrical, optical, and biological properties. In this presentation I will focus predominantly on mechanical property and charge transfer. Nanoscale building blocks are individually exceptionally strong. However that macroscale composites made from them are not. Assembly of a clay/polymer composite one nanoscale layer after another following the LBL technology with several very common polymers allowed us to prepare a homogeneous, optically transparent material with planar orientation of alumosilicate nanosheets. The stiffness and tensile strength of these multilayer composites are an order of magnitude greater than those for analogous nanocomposites made by traditional techniques. Stiffness and strength of such materials approach that of steel, while being made in a low-temperature process. The individual sheets were demonstrated to be consolidated in laminates. Engineering of polymers in atomic scale, LBL films in nanometer scale, and laminates in micro/mesoscale represents the multiscale hierarchical approach of composite design. Similar structural requirements of materials organization between nanoscale building blocks and matrix are also encountered in the design of electrical properties of the composites. Single walled carbon nanotubes exhibit exceptional conductivity at the level of individual tubes which is difficult to translate in the macroscopic world. Using LBL technology makes possible combining conductivity, transparency, and mechanical strength, which is critical for many key developments in electronics and energy applications today. LBL assembly with traditional polyelectrolytes resulted in coatings with electrical and optical characteristics comparable and competitive with much thicker and more brittle indium tin oxide layers traditionally used in industry. The same approach can also be used for the preparation of conductive fabrics and papers by impregnating them with carbon nanotubes in a cyclic process. The utilization of these materials as biosensors and energy storage devices will be discussed. Other applications as smart fabrics/papers, energy storage, and energy conversion will be discussed as well.

14:15 Prof. Soon-Hyung Hong (Korea Advanced Inst. of Science & Technology)
"Fabrication Processes and Applications of CNT Nanocomposites"

Abstract: Carbon nanotubes (CNTs) have been received a great interest as excellent reinforcement for composite materials due to their exceptionally high strength, modulus and thermal & electric conductivities. In this research, CNT/Metal nanocomposites, in which CNTs are homogeneously distributed in metal matrix with strong interfacial strength, are fabricated by a novel fabrication process, i.e. molecular level mixing process. Molecular level mixing process consisted of functionalization of CNTs, sonication treatment, calcination and reduction processes are followed to obtain CNT/Metal nanocomposite powders. CNT/Cu and CNT/Ni nanocomposites show high yield strengths and moduli, which are 2-3 times and 1.2-1.7 times higher than those of matrices, respectively. The critical issues on fabrication of CNT nanocomposites are homogeneous dispersion of CNTs and strong interfacial bonding between CNT and matrix. CNT/Metal nanocomposites, fabricated by the molecular-level mixing process, showed highly enhanced mechanical properties due to synergistic strengthening mechanism of homogeneously dispersed CNTs and grain-size refinement of matrix. For the functional application of carbon nanotube nanocomposites, the CNT/Co nanocomposite field emitter, fabricated by screen printing and sintering, shows reduced turn-on voltage with enhanced electric conductivity for field emission display application. CNT/Carbon nanocomposite having nanoporous microstructure shows increased specific capacity and good cyclic performance suitable for application of secondary battery electrode material. It is expected that the CNT nanocomposites, are emerging multi-functional materials with versatile properties and application areas.

14:40 Dr. Young-Wook Jun (Univ. of California, Berkeley) for Prof Paul Alivisatos
NBIT: *"Nanoparticle Plasmon Rulers for Single Molecule Imaging (Part 1 of 2)"*

Abstract: The intensity and spectral signature of light scattering from plasmonic nanocrystals depends strongly upon their separation. This phenomenon can be used to construct a spectroscopic ruler for monitoring the assembly and deformations of macromolecular complexes. In live cells, the ruler can report dynamic assembly of proteases and membrane receptors such as caspases and receptor tyrosin kinases (RTKs). The biomolecular assembly changes the distance between the particles resulting in a change in the light scattering. Here, we present plasmon rulers to study various cell signaling processes including apoptosis, cancer development, and angiogenesis at the single molecule lever. Specifically, in collaboration with Cheon group, we discuss about plasmon ruler detection of magnetically stimulated signal activation.

15:00 Prof. Jinwoo Cheon (Yonsei Univ.)
NBIT: *"Nanoparticle Plasmon Rulers for Single Molecule Imaging (Part 2 of 2)"*

Abstract: See Dr. Jun's Abstract above.

15:20 Break

NANOMATERIALS/NANOELECTRONICS JOINT SESSION IV (15:40 – 17:25): Juniper
Moderator: Dr. Jo-Won Lee (*Nat'l Program for Tera-Level Nanodevices*)

15:40 Dr. Adam Braunsweig (Northwestern Univ.) for Prof. Chad Mirkin
NBIT: *"Template-directed Assembly Strategies (Part 1 of 2)"*

Abstract: We have developed an arsenal of strategies based on scanning probe molecular printing methods developed in our group, namely dip-pen nanolithography (DPN) and polymer pen lithography (PPL), to form arbitrary patterns of molecular and biological species with nanometer-to-micrometer feature size control. These tools have been used to explore the concept of directed assembly, which has been employed to assemble a variety of devices, including biosensors and molecular tunnel junctions that use nanowires prepared by On-Wire Lithography (OWL). We anticipate that these strategies will result in a suite of new device architectures and methods to organize matter on the nanoscale.

16:00 Prof. Seunghun Hong (Seoul Nat'l Univ.)
NBIT: *"Template-directed Assembly Strategies (Part 2 of 2)"*

Abstract: See Dr. Adam Braunsweig's Abstract above.

16:20 Prof. Andrew Steckl (Univ. of Cincinnati)
NBIT: *"Electronic, Photonic and Magnetic Properties of Modified DNAs Complexed with Heavy Metal Ion (Part 1 of 2)"*

Abstract: This project involves an investigation of DNA for multiple device applications[1]. The Cincinnati portion of this research project investigates the use of natural (salmon sperm) DNA primarily for photonic applications[2], including biopolymer based organic light emitting diodes (BiOLEDs)[3] and lasers. For these solid state devices, thin films of DNA are required with properties which enable their incorporation into complex multi-layer structures. DNA thin films have been produced using both solution (spin-coating) and evaporation (molecular beam deposition[4]) techniques. To facilitate the device fabrication process, the DNA is modified by combination with the surfactant cetyltrimethylammonium chloride (CTAC). The interactions among DNA, CTAC, and the laser dye sulforhodamine (SRh) have been investigated through the use of optical spectroscopy, electrophoresis[5],

[1] Y. W. Kwon, C. H. Lee, D. H. Choi, and J. I. Jin, J. Mater. Chem. **19,** 1353 (2009).
[2] A. J. Steckl, Nature Photonics **1,** 3 (2007).
[3] J. A. Hagen, W. X. Li, A. J. Steckl, and J. Grote, Appl. Phys. Lett. **88,** 171109 (2006).
[4] J. A. Hagen, W. X. Li, H. Spaeth, J. G. Grote, and A. J. Steckl, Nano Lett. **7,** 133 (2007).
[5] H. You, H. Spaeth, V. N. L. Linhard, and A. J. Steckl, Langmuir **25,** 11698 (2009).

and circular dichroism (CD) spectroscopy[6]. Lasing with low threshold has been obtained[7] from SRh incorporated in a DNA/CTMA thin film fabricated with a grating that provided distributed feedback gain. BiOLEDs incorporating DNA as an electron-blocking layer have demonstrated significant increases in brightness, efficiency, and lifetime. Fine line structures have been fabricated [8] in DNA thin films by direct-write electron-beam lithography.

16:40 Prof. Dong-Hoon Choi (Korea Univ.)
NBIT: *"Electronic, Photonic and Magnetic Properties of Modified DNAs Complexed with Heavy Metal Ion (Part 2 of 2)"*

Abstract: Organic-soluble deoxyribonucleic acids (DNAs) bearing chalcone moieties in their side chains were synthesized by using purified natural sodium DNA. In addition to the chalcone-containing DNA homopolymer (CcDNA), a copolymer (CTMADNA-co-CcDNA) was synthesized. Two kinds of photoreactive DNA were employed as gate insulators for fabricating organic thin-film transistors (OTFTs). An organic semiconductor (5,5′-(9,10–bis((4-hexylphenyl)ethynyl) anthracene-2,6-yl-diyl) bis(ethyne -2,1-diyl) bis(2-hexylthiophene; HB-ant-THT) was deposited on the photocrosslinked DNA-based gate insulators via a solution process. The measured dielectric constant (k) of the photocrosslinked DNAs was 5.4–6.2 at 0.5 MHz. Interestingly, the resulting TFT devices had extremely high field-effect mobilities, and their corresponding transfer curves indicated low hysteresis. The carrier mobility of the device with HB-ant-THT deposited on the CTMADNA-co-CcDNA gate insulator was the best, i.e., 0.31 $cm^2 V^{-1} s^{-1}$ (I_{on}/I_{off} = 1.0 × 10^4).

17:00 Dr. Charles Lee (Air Force Office of Scientific Research)
"Nanomaterials Chemistry: AFOSR Perspective"

17:20 Adjourn

WORKSHOP BANQUET (18:30 – 21:00): Larch***
Moderator: Prof. Duck-Joo Yang *(Univ. of Texas at Dallas)*

[6] A. J. Steckl, H. Spaeth, K. Singh, J. Grote, and R. Naik, Appl. Phys. Lett. **93,** 193903 (2008).
[7] Z. Yu, W. Li, J. Hagen, Y. Zhou, D. Klotzkin, J. G. Grote, and A. J. Steckl, Applied Optics **46,** (2007)
[8] R. A. Jones, W. X. Li, H. Spaeth, and A. J. Steckl, J. Vac. Sci. Technol. B **26,** 2567 (2008).

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***12 Aug 2010 (Thursday)*: Hyatt Regency Bellevue**

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07:00 Breakfast: Larch

***NANOMATERIALS*/*NANOELECTRONICS* JOINT SESSION V (08:00 – 09:50): Spruce**
Moderator: Dr. Hugh DeLong *(Air Force Office of Scientific Research)*

08:00 Dr. Jowon Lee (*Nat'l Program for Tera-Level Nanodevices*)
"National Program for Tera-Level Nanodevices: An Overview "

08:20 Prof. Philip Kim (*Columbia Univ.*)
"Toward Graphene Quantum Electronics"

Abstract: Graphene has been provided us opportunities to explore exotic transport effect in low-energy condensed matter systems and the potential of carbon based novel device applications. In this presentation I will discuss the exotic quantum transport behavior discovered in graphene nanostructures in the relation to the device applications beyond CMOS operation. In particular, I will present quantum carrier collimation both of which appear even at room temperature employing graphene lateral heterojunction. In addition, I will discuss the enhanced device performance of suspended graphene devices and graphene with a novel substrate.

08:45 Prof. Jiwoong Park (Cornell Univ.)
"Accurate Carbon Nanostructures"

Abstract: Carbon based nanostructures, including carbon nanotubes and graphene, have played a central role in nanoscale science and technology in the past decade. Even though many promising devices (electronic, optoelectronic, and sensing) have been demonstrated using individual carbon nanostructures, applying them for larger scale devices has been difficult due to the enormous challenges that are unique to nanostructures. In this talk, I will present some of the recent advances made by my group, including accurate optical characterization of individual carbon nanotubes and the batch-synthesis and TEM characterization of single layer graphene devices and membranes.

09:10 Prof. HyunJung Shin (Kookmin Univ.)
NBIT: *"Synthesis of Bismuth Nanowires with Diameter and Length Control – An Approach for Forming Band-Gap Engineered Homojunction (Part 1 of 2)"*

Abstract: Synthesis of crystalline bismuth nanowires with controlled variation of diameters and higher aspect ratio (>100) has been achieved by electrochemical deposition in anodic aluminum oxide membrane (AAO) template. This project demonstrated that diameter variation can be achieved over a range as broad as 86 nm to 26 nm with the use of the AAO template. For bismuth this range of size variation is known to correspond to that for semimetal to semiconductor transition. The length of the nanowires (~10 μm) is also controllably variable, as it is predetermined by the thickness of the AAO. Step-variation of the diameter along the length of the Bi nanowires has also been achieved using AAO template with Y-shaped pores. These nanowires resemble high-necked bottles with the diameters in the thicker and the narrow regions being ~70 nm and ~35 nm, respectively. Functionally, a change in bandgap is expected to accompany to the change in diameter, thereby forming an electronic homojunction. X-ray diffraction pattern and transmission electron microscopy show that all the nanowires are single crystalline having rhombohedral structure and are preferentially oriented along (012). UV-VIS-NIR reflectance spectra indicate that the Bi nanowires with narrow diameters (50 nm and 38 nm) are semiconducting and those with diameter ~65 nm are

metallic. This new system is well poised to enter the next phase of explorations - electronic, IR, and thermoelectric applications.

09:30 Prof. Jimmy Xu (Brown Univ.)
NBIT: *"Synthesis of Bismuth Nanowires with Diameter and Length Control – An Approach for Forming Band-Gap Engineered Homojunction (Part 2 of 2)"*

Abstract: See Prof Hyunjung Shin's Abstract above.

09:50 Break

NANOMATERIALS/NANOELECTRONICS JOINT SESSION VI (10:10 – 12:05): Spruce
Moderator: Dr. Harold Weinstock *(Air Force Office of Scientific Research)*

10:10 Prof. Donhee Ham (Harvard Univ.)
"GHz-THz Circuits Using One-Dimensional Nanoscale Devices"

Abstract: While plasmonic resonance has been beyond the normal reach of electronics, we envision that it is possible to obtain plasmonic resonance at GHz~THz frequencies using one-dimensional (1D) nanoscale systems such as carbon nanotubes and quantum wires. I will present our research aimed at experimentally observing the GHz~THz plasmonic resonance in carbon nanotubes and GaAs/AlGaAs quantum wires. The study can potentially suggest a way of building resonators and transistors for THz speed operation, a bolometric way of performing multispectral THz wave detection, and a frequency-domain means of studying the electron behaviors in one dimension, which has an element of fundamental importance from the point of view of condensed matter physics.

10:35 Prof. Soon-Il Lee (Ajou Univ.)
"Transparent Conducting CNT Electrodes for Optoelectronic Applications"

Abstract: Transparent conducting films of entangled carbon nanotubes (CNTs), in particular single-walled CNTs (SWCNTs), have attracted a great deal of attention as a promising electrode material that can replace fragile indium-tin oxide (ITO) films which overwhelmingly dominate the current optoelectronics applications. The necessity for flexible transparent electrodes has been triggered by the ever-increasing interest for transparent optoelectronic devices with both aesthetic and practical appeal to users. As the result of many vigorous studies, the fabrication of SWCNT films with a sheet resistance below 100 Ω/sq. and better than 80% transmission of visible light has become feasible. However, there have not been many reports of successful fabrication of optoelectronic devices based on CNT transparent conducting electrodes. The few fabricated devices have typically shown inferior operation characteristics compared to those of devices with conventional ITO electrodes because of the complications intrinsic to SWCNT films. In this presentation, the issues related to the fabrication of organic optoelectronic devices on SWCNT electrodes will be discussed. Moreover, we will present a number of examples for the fabrication of optoelectronic devices with a transparent SWCNT electrode.

11:00 Prof. Chang-Beom Eom (Univ. of Wisconsin-Madison)
"Making Multifunctional Oxide Heterostructures Atom by Atom"

Abstract: Complex oxide materials possess an enormous range of electrical, optical, and magnetic properties. For instance, insulators, high quality metals, dielectrics, ferroelectrics, semiconductors, ferromagnetics, colossal magnetoresistance materials, superconductors, and nonlinear optic materials have all been produced using oxide materials. A major challenge is the atomic layer controlled heteroepitaxial growth of various complex oxide materials so that these properties can be fully utilized in novel devices. This talk will describe the synthesis of ferroelectric, ferromagnetic, 2-dimensional electron gas oxide heterointerfaces and multiferroic perovskite oxides whose structures

are engineered using epitaxy. These oxide heterostructures were grown by pulsed laser deposition with in situ high pressure RHEED on an atomic-layer level. Numerous examples of the controlled epitaxial growth of perovskite oxides (e.g., $SrRuO_3$, $BaTiO_3$, $BiFeO_3$, Giant Piezoelectric oxide), including superlattices and metastable phases by strain and domain engineering will be described.

11:25 Prof. Moon J. Kim (Univ. of Texas at Dallas) & Prof. MinHee Yun (Univ. of Pittsburgh)
NBIT: *"Extremely low noise carbon nanotube for device applications (Part 1 of 2)"*

Abstract: We have investigated extremely low noise carbon nanotubes for various device applications. Hence, it is desirable and important to develop robust low-resistance electrical contact between CNTs and metal electrodes in order to explore potential applications of CNT technologies. In this regard, we report a performance analysis on carbon nanotube (CNT) Schottky diodes using source-drain current anisotropy. An analytical model is derived based on thermionic field emission and used to correlate experimental data from Pd-Hf, Ti-Hf, Cr-Hf, Ti-Cr, and Pd-Au mixed metal devices fabricated on one single 6 mm-long CNT. Our report also includes a surface-inversion channel model based on low temperature and electrical measurements of a distinct single-walled semiconducting CNT contacted by Hf, Cr, Ti and Pd electrodes. Anomalous barrier heights and metal-contact dependent band-to-band tunneling phenomena are utilized to show that dependent upon contact work function and gate field, transport occurs either directly between the metal and CNT channel or indirectly via injection of carriers from the metal-covered CNT region to the CNT channel. The model is consistent with previously contradictory experimental results, and the methodology is simple enough to apply in other contact-dominant systems.

11:45 Prof. YoungHee Lee (SungKyungKwan Univ.)
NBIT: *"Extremely low noise carbon nanotube for device applications (Part 2 of 2)"*

Abstract: See Prof Moon Kim's Abstract above.

12:05 Lunch: Cedar Ballroom

NANOMATERIALS/NANOELECTRONICS JOINT SESSION VII (13:30 – 15:20): Spruce
Moderator: Prof. Haiwon Lee *(Hanyang Univ.)*

13:30 Dr. Gail Brown (Air Force Research Lab)
"Nanoscience Research for Electronic and Optical Materials in AFRL/RX"

13:50 Prof. Charles Ahn (Yale Univ.)
"Nanostructured Complex Oxide Materials"

Abstract: Complex oxide materials exhibit a broad diversity of behavior encompassing a range of functional properties, such as magnetism, ferroelectricity, and superconductivity. Recently, there has been interest in examining these materials for post-CMOS applications, in particular through the use of various control parameters, such as magnetic fields, strain, and electric fields, to control the ground states of these materials. These efforts have resulted in the observation of novel effects, such as a giant planar Hall effect in magnetic oxides. In addition, the drive to develop materials with new multifunctional capabilities has led to interest in multiferroic oxides, which are systems that exhibit the presence of and coupling between magnetic and electric order parameters. In this work, we demonstrate a large magnetoelectric coupling in doped lanthanum lanthanum manganite/ferroelectric composite structures, allowing one to control magnetism via charge carrier density. This carrier-mediated coupling opens new pathways for the development of magnetoelectric devices with a large coupling between magnetic and electric degrees of freedom.

14:15 Prof. Wongbong Choi (Florida International Univ.)
"Graphene for Printed Electronics"

Abstract: We present the fabrication and electrical characterization of large graphene structure on polyethylene terephthalate (PET) flexible substrate. Graphene film was grown on Cu foil by thermal chemical vapor deposition and transferred to various substrates including PET, glass and silicon by using hot press lamination and etching process. The graphene/PET film shows high quality, flexible transparent conductive structure with unique electrical-mechanical properties; ~88.80% light transmittance and ~ 800 Ω/sq sheet resistance. We demonstrate application of graphene/PET film as flexible and transparent electrode for solar cell and field emission displays. The graphene film exhibits excellent structural integrity and uniform electrical properties with large variation of bending radius. We also report the synthesis and characterization of a self-organized graphene-carbon nanotube hybrid film consisting of multilayer graphene (MLG) connected to the apex of vertically oriented multiwall carbon nanotube (MWNT). This MLG-CNT is synthesized by thermal CVD and transferred to flexible substrates where the hybrid structure exhibits a multilayered graphene film at bottom connecting vertically aligned MWNT as a top layer. Finally, we will discuss the applications of graphene film as flexible and transparent electrode in nanoelectronics and energy devices.

14:40 Prof. Moon-Ho Jo (Pohang Univ. of Science & Technology)
NBIT: *"SiGe Alloy Nanowire Photonics (Part 1 of 2)"*

Abstract: Photocarrier dynamics in semiconductor nanocrystals (NCs), such as colloidal quantum dots (QDs) and nanowires (NWs), are often modified to produce substantially high responsivity with its spectral modulations due to their unique geometries at the nanometer scale. For example, light absorption can be spectrally tuned by the enhanced optical field resonance in semiconductor NWs, as well as the quantum confinements in semiconductor QDs, and also the photoconductive gain can be significantly amplified due to the temporal charge separation at highly populated surface and interface states. Thereby, the bottom-up NW can serve as a model platform to investigate the integrated photonic and electronic processes in a strong light-matter coupling regime, since the low-dimensional potential variations can be easily built within individual NWs during the syntheses. Here, we demonstrated an on-NW energy-band graded photodetection within an axially graded $Si_{1-x}Ge_x$ ($0 \leq x \leq 1$) NW in an individually addressable manner. Specifically we find that the amplitudes of the photocurrent and photoconductive gain under the visible light are demultiflxed into the multiple output signals within individual $Si_{1-x}Ge_x$ NWs, different each other by up to two orders of magnitude, over the continuously varying energy band-gap and surface trap-state density. Our on-NW band modulated photodetectors suggest general implications for the heteroepitaxial integration of the broadband Si nanophotonic components.

15:00 Prof. HongKun Park (Harvard Univ.)
NBIT: *"SiGe Alloy Nanowire Photonics (Part 2 of 2)",*
"Optoplasmonic Engineering of Light-Matter Interactions."

Abstract: Manipulating light-matter interactions at the nanoscale has broad implications for many research areas, ranging from spectroscopy and sensing to communications and quantum information processing. In this presentation, I will discuss our research efforts to develop a general strategy for engineering light-matter interaction using nanoscale plasmonic and optoelectronic interfaces. Topics that will be discussed include (1) a cavity-free, broadband approach for engineering photon-emitter interactions via sub-wavelength plasmon confinement in metallic nanowires, (2) the realization of "dark" optoplasmonic circuit elements that are based on near-field electrical generation and detection of optical plasmons, and (3) the deterministic coupling between quantum emitters and photonic and plasmonic crystal cavities.

15:20 Break

NANOMATERIALS/NANOELECTRONICS JOINT SESSION VIII (15:40 – 17:20): Spruce
Moderator: Dr. Misoon Mah *(Air Force Office of Scientific Research)*

15:40 Prof. Soo-Young Park (Kyungpook Nat'l Univ.)
NBIT: *"Self-Assembled Liquid Crystalline Block Copolymer (Part 1 of 2)"*

Abstract: Fast, reversible, and durable switching between homeotropic and planar anchoring at the aqueous/LC interface in response to environmental stimuli is mediated by an appropriately designed diblock copolymer. The switching time between homeotropic and planar anchoring appeared to be mass-transfer limited (changing as quickly as the buffer could be exchanged, within ~2 seconds). Reversible, and repeatable switching was sustained for as many cycles as were tested (~20 cycles). The homeotropic orientation at pH =12 remained unchanged for 6 days, indicating that the LCP block secures the self-assembled layer on the LC interface and maintains its conformation over time. What distinguishes the present approach from previous responsive aqueous/LC interfaces is the orientational coupling between the backbone and the mesogenic side groups of the SGLCP block. Thus, the change in conformation of the polylectrolyte "responsive" block exerts its influence through a single covalent connection to the SGLCP "transducer" block, rather than through the local density of the hydrophobes in the 5CB. Using an SGLCP as the "transducer" block opens the way to systematic optimization by choice of the mesogen, the mode of attachment (side-on vs. end-on) and the spacer. The SGLCP can be connected to a wide variety of "responsive" blocks, such as single-stranded DNA, aptamer-binding RNA, peptides or proteins.

16:00 Prof. Julia Kornfield (California Int. of Technology)
NBIT: *"Self-Assembled Liquid Crystalline Block Copolymer (Part 2 of 2)"*

Abstract: See Prof Park's abstract above.

16:20 Prof. Duck-Joo Yang (Univ. of Texas at Dallas)

A) "New Carbon Nanomaterials"
Abstract: The carbon nanoparticles newly synthesized were found to give intense photoluminescence (PL) in the visible region, 400-550nm, when excited at 250-375 nm wavelength range. TEM image shows that the particle size of the new carbon nanoparticles is approximately 50nm. Not only PL property but also other characterization work will be presented.
B) "Novel Process for Composite Fiber Preparation"
Abstract: A novel and versatile fabrication process based on delamination concept is discovered for the preparation of various composite fibers. This novel process can be used for the preparation of various fibers & yarns not only from single-walled nanotubes (SWNTs), double-walled nanotubes (DWNTs), or multi-walled nanotubes (MWNTs) but also from the mixtures thereof. The detailed process and preliminary mechanical properties of the samples prepared will be presented.

16:45 Lt Col John Seo (Asian Office of Aerospace Research & Development)
"US-Korea NBIT Phase I and Phase II Summary"

Dr. Byung-Lip ("Les") Lee *(Air Force Office of Scientific Research)*
"A Joint Symposium of 10th US-Korea Workshop on Nanostructured Materials and 8th US-Korea Workshop on Nanoelectronics"

17:20 Adjourn

FAREWELL DINNER (18:30 – 21:00): Larch***
Moderator: Dr. Thomas Hahn *(Korea Inst. of Science & Technology)*

US-Korea Nano-Bio-Information Technology (NBIT) Symbiosis Program:
(Co-Sponsored by US Air Force Office of Scientific Research and)
Ministry of Education, Science & Technology of Korea)

Phase I (2007-2010)

1. "Nanoscaling Laws of Magnetic Nanoparticles and Their Biomedical Applications"
Prof. Jinwoo Cheon *(Yonsei Univ.)*
Prof. Paul Alivisatos *(Univ. of Calif., Berkeley)*

2. "Electronic, Photonic and Magnetic Properties of Natural and Modified DNAs"
Prof. Dong-Hoon Choi *(Korea Univ.)*
Prof. Andrew Steckl *(Univ. of Cincinnati)*

3. "Template-directed Assembly Strategies"
Prof. Seunghun Hong *(Seoul Nat'l Univ.)*
Prof. Chad A. Mirkin *(Northwestern Univ.)*

4. "Si-Ge Alloy Nanowire Photonics"
Prof. Moon-Ho Jo *(Pohang Univ. of Sci. & Technology - POSTECH)*
Prof. Miyoung Kim *(Seoul Nat'l Univ*.) and Prof. Hongkun Park *(Harvard Univ.)*

5. "High Resolution, Large Area, Nanoprint Lithography using Electron Lattice Images and Electron-emitting Nanoprobes"
Prof. Ki-Bum Kim *(Seoul Nat'l Univ.)*
Prof. Sungho Jin *(Univ. of Calif., San Diego)*

6. "Hierarchical Carbon Fiber Composites"
Prof. Kun-Hong Lee *(Pohang Univ. of Sci. & Technology - POSTECH)*
Prof. Sang-Gi Lee *(Ehwa Univ.)*
Prof. H. Thomas Hahn *(Univ. of Calif., Los Angeles)*

7. "Extremely Low Noise Carbon Nanotubes for Peltier and Photo-detector Device Applications"
Prof. Young-Hee Lee *(Sungkyunkwan Univ.)*
Prof. Moon J. Kim *(Univ. of Texas Dallas)* and Prof. Minhee Yun *(Univ. of Pittsburgh)*

8. "Self-Assembled Liquid-Crystalline Gels: from Nanostructure to Function"
Prof. Soo-Young Park *(Kyungpook Nat'l Univ.)*
Prof. Julie Kornfield *(Calif. Inst. of Technology)*

9. "1-D Semimetal-semiconductor Homo-junction Nanowires for Uncooled IR Detection & Microelectronic Coolers"
Prof. Hyunjung Shin *(Kookmin Univ.)*
Prof. Jimmy Xu *(Brown Univ.)*

10. "Low Noise Carbon Nanotubes for Peltier and Photo-Detector Device Applications"
Prof. Young-Hee Lee (SungKyunKwan Univ.)
Prof. Moon J Kim (Univ. of Texas Dallas)

Phase II (2010-2013)

1. "Massively Parallel Nanostructure Assembly Strategies for Sensing and Information Technologies"
Prof. Seunghun Hong *(Seoul Nat'l Univ.)*
Prof. Chad A. Mirkin *(Northwestern Univ.)*

2. "Integrated Nano Optoplasmonics"
Prof. Moon-Ho Jo *(Pohang Univ. of Sci. & Technology - POSTECH)*
Prof. Hongkun Park *(Harvard Univ.)*

3. "Large Area Graphene Synthesis and Its Applications"
Prof. Young-Hee Lee *(Sungkyunkwan Univ.)*
Prof. Moon J. Kim *(Univ. of Texas Dallas)*
Prof. Minhee Yun *(Univ. of Pittsburgh)*

4. "Multifunctional Yarns and Fabrics for Energy Applications"
Prof. Seong-Jeong Kim *(Hanyang Univ.)*
Prof. Ray Baughman *(Univ. of Texas Dallas)*

5. "Nano-Engineered Materials for Controlled Thermal Transport and Harvesting"
Prof. Ki-Bum Kim *(Seoul Nat'l Univ.)*
Prof. Jimmy Xu *(Brown Univ.)*

6. "Meso size effect (MSE) from Self-Assembled carbon structures and their device applications"
Prof. Hee-Cheul Choi *(Pohang Univ. of Sci. & Technology - POSTECH)*
Prof. Ji-Woong Park *(Cornell Univ.)*

7. "Metal-free and Oxygen-free Graphene as Oxygen Reduction Catalysts for Highly Efficient Fuel Cells"
Prof. Jong-Beom Baek *(Ulsan National Institute of Sci. & Technology - UNIST)*
Prof. Liming Dai *(Case Western Reserve Univ.)*

8. "Large-Scale Energy Harvesting Based on Piezoelectric Nanogenerators"
Prof. Sang-Woo Kim *(Sungkyunkwan Univ.)*
Prof. Zhong-Lin Wang *(Georgia Institute of Technology)*

9. "Tunable PhoXonic Band Gap Materials from Self-Assembly of Block Copolymers"
Prof. Young-Jong Kang *(Hanyang Univ.)*
Prof. Ed Thomas *(Massachusetts Institute of Technology)*

BACKGROUND

Both the US and Korea have had a substantial investment in nanotechnology over the past several years, and the same trend is expected to continue into the near future. In order to provide an opportunity for scientists and engineers in both countries to exchange the information especially in the areas of "nanostructured materials" and "nanoelectronics," the *US Air Force Office of Scientific Research* (AFOSR) and its overseas arm, *US Asian Office of Aerospace R&D* (AOARD), have been sponsoring a series of US-Korea Workshops since 2002. For this year, a joint symposium of the ***9th*** *US-Korean Workshop on Nanomaterials* and the *7th US-Korea Workshop on Nanoelectronics* will be held on 10-12 August at Hyatt Regency Bellevue, Seattle, WA. This 2 day event is open to public and will highlight the progress of new collaborative research programs between US and Korean universities.

The *1st US-Korea Workshop on Nanostructured Materials* was organized as a part of the *US-Korea Symposium on Nanotechnology,* which was held at the Korean Federation of Science and Technology Societies (KOFST) and Hanyang Univ. in Seoul, Korea, on 9-11 July 2002. The Symposium was co-chaired by Dean Sung-Goon Kang at Hanyang Univ. and Dr. Byung-Lip Lee at AFOSR. The Workshop Panel Co-Chairs were Dr. Jo-Won Lee, in charge of the Nat'l Program on Tera-Level Nanodevices in Korea, and Prof. H. Thomas Hahn at the Univ. California at Los Angeles (UCLA). As a result of overwhelmingly positive feedback, it was decided to continue the Workshop part of panel discussion as an annual event in two countries alternately. The follow-up Workshops were held at Caltech in Pasadena, CA (2003), Hanyang Univ. (2004), the Korea Inst. of Science & Technology in Seoul, Korea (2005), UCLA (2006), Seoul Nat'l Univ. (2007) and NanoMaterials for Defense Conference, Arlington, VA (2008) and Hanyang Univ. (2009). Starting in 2004, the *US-Korea Workshop on Nanoelectronics* has been held concurrently to expand the scope of technical information exchange.

Following the 2004 meeting, 17 exploratory research grants were awarded to a number of universities in Korea under the *AFOSR Nanoscience Initiative* organized by Dr. Jack Agee at AFOSR. Among them, 4 research grants were initiated with full matching support from the Center for Nanostructured Materials Technology (CNMT), directed by Dr. Sang-Hee Suh and funded by the *21st Century Frontier R&D Program* of the Ministry of Science & Technology (MOST) in Korea. In 2007, a new initiative for research collaboration was proposed by Dr. Misoon Mah at AOARD, Dr. Byung-Lip Lee at AFOSR and Dr. Sang-Hee Suh at CNMT. Strong support from Dr. Jae-Yong Hur at MOST and Dr. Brendan Godfrey at AFOSR led to the inauguration of a new *Initiative for Nano-Bio-Information Technology Symbiosis (NBIT)* with 1:1 matching support from MOST (now renamed as Ministry of Education, Science & Technology) and AFOSR. As a result, a total of 10 research projects were established involving premier research universities in the US and Korea for Phase I (2007-2010). Three of the Phase I projects are to be continued along with six new ones for a total of nine NBIT research projects in Phase II (2010-2013) of our international collaborative research program.

Chronology

1st US-Korea Workshop on Nanostructured Materials
(US-Korea Symposium on Nanotechnology: Session NANO-6)
Dr. Jo-Won Lee (Nat'l Program on Tera-Level Nanodevices), *Co-Chair*
Prof. H. Thomas Hahn (Univ. of California at Los Angeles - UCLA), *Co-Chair*
Hanyang Univ., Seoul, Korea, 11 July 2002

2nd US-Korea Workshop on Nanostructured Materials
Dr. Byung-Lip Lee (Air Force Office of Scientific Research - AFOSR), *Co-Chair*
Dr. Jo-Won Lee (Nat'l Program on Tera-Level Nanodevices), *Co-Chair*
California Inst. of Technology, Pasadena, California, USA, 9 August 2003

3rd US-Korea Workshop on Nanostructured Materials
Dr. Sang-Hee Suh (Center for Nanostructured Materials Technology), *Co-Chair*
Prof. H. Thomas Hahn (UCLA), *Co-Chair*
1st US-Korea Workshop on Nanoelectronics
Dr. Jo-Won Lee (Nat'l Program on Tera-Level Nanodevices), *Co-Chair*
LtCol Todd Steiner (AFOSR), *Co-Chair*
Hanyang Univ., Seoul, Korea, 10-11 May 2004

A joint session of:
4th US-Korea Workshop on Nanostructured Materials
2nd US-Korea Workshop on Nanoelectronics
Dr. Sang-Hee Suh (Center for Nanostructured Materials Technology), *Co-Chair*
Prof. Wonbong Choi (Florida Int'l Univ.), *Co-Chair*
Korea Institute of Science & Technology, Seoul, Korea, 25-26 April 2005

A joint session of:
5th US-Korea Workshop on Nanostructured Materials
3rd US-Korea Workshop on Nanoelectronics
Prof. H. Thomas Hahn (UCLA), *Co-Chair*
Dr. Sang-Hee Suh (Center for Nanostructured Materials Technology), *Co-Chair*
Univ. of California at Los Angeles, Los Angeles, California, USA, 8-9 August 2006

A joint symposium of:
Dr. Sang-Hee Suh (Center for Nanostructured Materials Technology), *Symposium Co-Chair*
Dr. Byung-Lip Lee (AFOSR), *Symposium Co-Chair*
6th US-Korea Workshop on Nanostructured Materials
Prof. Kun-Hong Lee (Pohang Univ. of Science & Technol.), *Co-Chair*
Dr. Hugh DeLong (AFOSR), *Co-Chair*
4th US-Korea Workshop on Nanoelectronics
Prof. Jong-Chun Woo (Seoul Nat'l Univ.), *Co-Chair*
Dr. Misoon Mah (Asian Office of Aerospace R&D), *Co-Chair*
Seoul Nat'l Univ., Seoul, Korea, 4-5 June 2007

A joint session of:
7th US-Korea Workshop on Nanostructured Materials
Dr. Hugh DeLong (AFOSR), *Co-Chair*
Dean Haiwon Lee (Hanyang Univ.), *Co-Chair*
5th US-Korea Workshop on Nanoelectronics
Dr. Donald Silversmith (AFOSR), *Co-Chair*
Prof. Ki-Bum Kim (Seoul Nat'l Univ.), *Co-Chair*
Hyatt Regency Crystal City, Arlington, Virginia, USA, 24-25 April 2008

A joint symposium of:
8th US-Korea Workshop on Nanostructured Materials
Dr. Sang-Hee Suh (Center for Nanostructured Materials Technology), *Co-Chair*

Dr. Hugh DeLong (AFOSR), *Co-Chair*
6th US-Korea Workshop on Nanoelectronics
Dr. Jo-Won Lee (Nat'l Program on Tera-Level Nanodevices), *Co-Chair*
Dr. Donald Silversmith (AFOSR), *Co-Chair*
Hanyang Univ., Seoul, Korea, 19-20 May 2009

A joint symposium of:
9th US-Korea Workshop on Nanostructured Materials
Dr. Sang-Hee Suh (Center for Nanostructured Materials Technology), *Co-Chair*
Dr. Hugh DeLong (AFOSR), *Co-Chair*
7th US-Korea Workshop on Nanoelectronics
Dr. Jo-Won Lee (Nat'l Program on Tera-Level Nanodevices), *Co-Chair*
Dr. Harold Weinstock (AFOSR), *Co-Chair*
Hyatt Regency Bellevue, Seattle, WA, 10-12 Aug 2010

A joint symposium of:
10th US-Korea Workshop on Nanostructured Materials
Dr. Sang-Hee Suh (Center for Nanostructured Materials Technology), *Co-Chair*
Dr. Byung-Lip Lee (AFOSR), *Co-Chair*
8th US-Korea Workshop on Nanoelectronics
Dr. Jo-Won Lee (Nat'l Program on Tera-Level Nanodevices), *Co-Chair*
Dr. Harold Weinstock (AFOSR), *Co-Chair*
Korea Institute of Science and Technology, Seoul, Korea, 16-18 May 2011

Meeting Schedule:

- **2010/08/11 (Wed) 8 AM ~ 2010/08/12 (Thu) 6 PM:**
  2009 US-Korea Workshops on Nanomaterials & Nanoelectronics (Hyatt Regency Bellevue, Seattle, WA)
  Anyone who registered at the UKC 2010 can attend the US-Korea Workshop.

- **2010/08/13 (Fri) 8 AM ~ 2010/08/14 (Sat) 6 PM:**
  UKC-2010: 2010 US-Korea Conference on Science, Technology & Entrpreneurship (Hyatt Regency Bellevue, Seattle, WA)
  Anyone who registered at the US-Korea Workshop can attend the UKC 2010.

Banquets:

- **2010/08/10 (Tue) 6 PM: (Invitation Only)**
  Welcoming Dinner (Juniper, Hyatt Regency Bellevue)

- **2010/08/11 (Wed) 6 PM: (Invitation Only)** (***)
  Banquet (Larch, Hyatt Regency Bellevue)

- **2010/08/12 (Thu) 6 PM: (Invitation Only)** (***)
  Farewell Dinner (Larch, Hyatt Regency Bellevue)

Registration

- Online Registration is now open (http://www.ukc.org/)
- Online Registration deadline: **July 11th, 2010**
- Registration Fees:
  - ✓ **All speakers: Complimentary**; UKC 2010 technical sessions are also complimentary. However, ***all meals should be purchased for August 13th and 14th.***
  - ✓ Non-speakers: The Workshop sessions are open to all UKC 2010 participants.

Workshop Lunch and Dinner (***)

- To join the workshop lunch and dinner, please email Lt Col John Seo (john.seo@aoard.af.mil) with your intention to attend by 15 July 2010 with your lunch and dinner meal choices (meat, fish, vegetarian) for August 11th and 12th. The discounted meal tickets can be purchased onsite.

Abstract Submission

- Abstract Submission Deadline: **July 15th, 2010**
- Template Download:

** Please send your abstract to Lt Col John Seo (john.seo@aoard.af.mil)*

For More Information, Please Contact:

Lt Col John Seo: +81-3-5410-4409 ext 3516, john.seo@aoard.af.mil

Dr. Jae H. Kim: (425) 681-4253, jae.h.kim@boeing.com; (425) 301-4547, jkim1@ieee.org (UKC 2010 General Chair)

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