2007 Micro/Nano 25 Winners

Non-reflective Coating – Rensselaer Polytechnic Institute

www.rpi.edu

Three titanium dioxide nanorod layers and two silicon dioxide nanorod layers placed via oblique-angle deposition on the surface of a transparent sheet of aluminum nitride result in a coated material that reflects virtually no light. The thin films are progressively layered more densely such that the boundary layers are more gradual, reducing the reflection of light.

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Engineered Carbon Nanotube (CNT) and Nanofiber Buckypapers–Florida State Univ.

www.fsu.edu

These materials are macroscopic or continuous thin films or membranes comprised of randomly oriented and magnetically aligned CNTs and nanofibers. These buckypapers combine the advantages of large dimensions, superior electrical conductivity, nanotube alignment, and continuous production.

Enhanced Deformable Mirror (DM)–Boston Micromachines Corp.

www.bostonmicromachines.com

These devices are used for ultra-high resolution retinal imaging, which is necessary for the early detection of ocular diseases. An enhancement of the Multi-DM, this new mirror delivers increased stroke while maintaining high resolution. The mirror's 3 kHz frequency capability allows for high-speed real-time imaging with a 6-mm aperture perfectly suited for a dilated pupil.

Functionalized Nanoporous Thin Film (FNTF)–Pacific Northwest National Laboratory

www.pnl.gov

FNTF is a customized coating that preconcentrates heavy metals in water, creating samples that increase the detection sensitivity of x-ray fluorescence (XRF) spectroscopy by up to 1,000x. FNTF-coated XRF sampling disks can preconcentrate selected heavy metals from liquid samples, which then presents a solid sample to the XRF instrument.

GLAD, Glancing Angle Deposition–Micralyne, Inc.

www.micralyne.com

GLAD is a proprietary physical vapor deposition (PVD) technology used to fabricate porous thin films composed of engineered nanostructures. GLAD combines a collimated vapor stream, low adatom mobility, and computer-controlled substrate motion to form columnar thin films that can be sculpted into a variety of nanostructures, including vertically aligned nanorods, helices, and chevrons.

Hybrid Nano-CMOS Chips–Hewlett-Packard Laboratories

www.hp.com

Field programmable nanowire interconnects (FPNI) consisting of 15-nm wide crossbar wires combined with 45-nm CMOS have been demonstrated. They improve upon the FPGA architecture by lifting the configuration bit and associated components out of the semiconductor plane and replacing them in the interconnect with nonvolatile switches. This decreases the area and the power consumption of the circuit.

Invisicon Carbon Nanotube (CNT) Transparent Conductors–Eikos, Inc.

www.eikos.com

Invisicon is a flexible transparent conductive coating based on single-wall CNTs that can be applied to any surface using traditional wet atmospheric coating processes. The coating is formed from dispersions of highly purified CNTs in a fugitive fluid. The resulting coating is more transparent than competitive systems, more flexible, has better abrasion resistance, and is stable to UV moisture and heat.

LithoParticles–Univ. of California at Los Angeles

www.ucla.edu

LithoParticles are micro- or nanoscale fluorescent particles made from solid polymeric materials and dispersed in a liquid solution. The microparticles can be manufactured in any shape displaying "exquisite fidelity of the shapes." The researchers also claim to have the ability to make functional devices in solution.

Metal Infusion Surface Treatment (MIST)–C-3 International, LLC

www.cccintl.com

MIST is an advanced, low-cost infused coating technology. The process takes any of 58 desired periodic table elements, or combinations thereof, into a formulation, which is then applied to non-organic materials. With a simple spray or dip and low heat treatment, the various elements and their unique properties are diffused into surfaces, along with a 0.1- to 0.5-µm infusion coating. The result is a uniform, durable nano-thin film treatment that delivers quantum physical improvements.

Metal Rubber Textiles–NanoSonic, Inc.

www.nanosonic.com

These materials are novel, ultralow-weight, nearly transparent, electrically conductive, flexible textiles. They are made using an environmentally friendly, modified electrostatic self-assembly process. The materials are nanocomposites that contain flexible polymers and electrically conductive metal nanoclusters. Included in the mixture are noble metals, metal oxides, and metal alloy nanoclusters, along with cage-structured molecules such as carbon nanotubes, buckyballs, and biomolecules.

Microcontact Insertion Printing–Pennsylvania State Univ.

www.psu.edu

Microcontact insertion printing is a process for creating patterns of individual molecules on a surface that combines controlling self-assembling monolayers (SAMs) and soft lithography. The method builds surfaces that have molecules with specific functions inserted at known intervals on the surface.

Molecular Vapor Deposition (MVD)–Applied MicroStructures, Inc.

www.appliedmst.com

MVD is a surface engineering technology whose primary benefit is that specific characteristics can be imparted onto a substrate without altering the bulk material traits. MVD is based on organic and metal-organic vapors in a low-temperature process which ensures compatibility with any material. MVD is suited for emerging applications where functional coatings act as surface lubricants in MEMS-based sensors and structures, as release layers for lithography, or to create reactive surface sites in bio-chips.

Nanocomposites via Epitaxial, 3-D Self-Assembly of Nanodots of One Complex Material within Another–Oak Ridge National Laboratory

www.ornl.gov

Nanocomposites consisting of ordered 3-D arrays of nanodots of one complex ceramic material coherently embedded in another ceramic matrix comprise a novel class of materials for wide-ranging applications. Such materials are expected to exhibit novel physical properties tunable by adjusting the overall composition, concentration, feature size, and spatial ordering of the nanodots.

Nano eNabler System–BioForce Nanosciences, Inc.

www.bioforcenano.com

The Nano eNabler system is a benchtop molecular printer for dispensing attoliter to

femtoliter volumes of various molecules for functionalizing biosensors and creating patterned surfaces. It is the first device designed specifically to print user-defined patterns of 1- to 30-µm spots and lines onto a variety of surfaces with nanometer precision.

Nanogenerators–Georgia Institute of Technology
www.gatech.edu
These nanometer-scale generators produce continuous direct-current electricity by harvesting mechanical energy from such environmental sources as ultrasonic waves, mechanical vibration, or blood flow. The devices are based on arrays of vertically aligned zinc-oxide nanowires that move inside a novel zig-zag plate electrode. They take advantage of the unique coupled piezoelectric and semiconducting properties of the zinc-oxide nanostructures.

Nano Imprint Lithography (NIL) Equipment, NPS300–SUSS MicroTec Lithography GmbH
www.suss.com
NIL exists in two methods—UV-NIL and hot embossing. Both methods consist of printing a mold/stamp with nm-features onto a polymer, thus transferring the stamp pattern into that material. Curing of the polymer is then performed with either UV light or temperature. The uniqueness of the NPS300 equipment is in the fact that it can handle both technologies without any tradeoffs or shortened changeover capabilities.

Nano Indenter G200–MTS Systems Corp.
www.mtsnano.com
Nano Indenter G200 is a next generation nanomechanical testing system. While typically used to perform nano-indentation tests, the system also is capable of quantitative nanomechanical microscopy (3-D topography), scratch and adhesion testing, microhardness testing, and mechanical testing of MEMS devices and structures. The system employs electromagnetic actuation as the core technology.

nano-TA–Anasys Instruments
www.anasysinstruments.com
nano-TA is the first ever product that enables quantitative local thermal analysis at the sub-100-nm size scales. The nano-TA module allows any atomic force microscope to perform these local thermal analyses. The device functions as a normal imaging AFM with a resolution of better than 30 nm, and, upon choosing a region of interest, the user can reposition the probe tip and subject the region to a thermal ramp.

nanoTensile 5000 Automated Test Instrument–Hysitron, Inc.
www.hysitron.com
The nanoTensile 5000 is an automated, 3-D sensing, nanometer-scale precision tensile instrument for the testing of small-scale material specimens and miniaturized devices. This instrument provides a 3-axis load measurement and is isolated from external force and acoustic and thermal disturbances. Its displacement resolution is five times better than the next best system.

Nerve Graft Materials–Univ. of California at Berkeley
www.berkeley.edu
Nerve graft materials composed of aligned, nanoscale polymer fibers that act as physical guides for regenerating nerve fibers have been developed. These nanofibers become bioactive by attaching various biochemicals directly onto the surface of the nanofibers. The technology has been licensed to NanoNerve, Inc.

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NS Gold Oxidation Catalyst Technology–Nanostellar, Inc.
www.nanostellar.com
NS Gold is used as a coating in automotive catalytic converter systems to reduce noxious emissions by 40% more than traditional pure platinum catalyst materials at an equal cost. To develop the gold-platinum-palladium-based NS Gold, the performance of nanoscale materials in diesel emission control applications was targeted and refined using a combination of computational modeling and a rapid synthesis-analysis cycle.

PRINT Technology for Engineered Drug Therapies–Liquidia Technologies, Inc.
www.liquidia.com
PRINT is a nanoparticle fabrication technique that allows for the precise control over particle size, shape, composition, modulus, and particle surface properties. PRINT nanoparticles have been manufactured containing biological, small molecular, and imaging agents. By expressly engineering the surfaces for cell and tissue recognition, the nanoparticles can target certain cell and tissue types.

RainMaker Humidification System (RHS)–RASIRC
www.rasirc.com
This is the first and only system to generate and deliver precise amounts of ultra-pure water vapor purified for both ionic contaminants and dissolved gases. Utilizing a non-porous membrane that excludes particles, micro-droplets, volatile gases, and other opposite-charged species, the RHS adds controlled amounts of ultra pure water vapor directly into any carrier gas stream.

Self-Assembling Process for Fabricating Tailored Thin Films–Sandia National Laboratories
www.sandia.gov
This simple, economical nanotechnology coating process enables the development of nanoparticle thin films with architectures and properties unattainable by any other processing method. This nanoparticle surface chemistry enables dispersal in readily available commercial solvents, allowing easy and rapid production of films through spin, dip, or spray coating under ambient conditions.

Super CNT Fibers–Los Alamos National Laboratory
www.lanl.gov
Spun from 1-mm-long, double-wall carbon nanotubes (CNTs), Super CNT Fibers have 10% of the density, and four to five times the specific strength and specific stiffness of the best carbon fibers now used to make structural composites. CNT yarns have been directly spun from CNT arrays, providing good alignment and high CNT volume fractions.