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NANOSHEL
Creating Miracles in Black

Product Catalogue

New Era of Nano Applications....!

Future is Nanoshel

Nanoshel Catalogue has a straightforward aim—to acquaint you with the whole idea of Nano science and nanotechnology. This comprises the fabrication and understanding of matter at the ultimate scale at which nature designs: the molecular scale. Nano science occurs at the intersection of traditional science and engineering, quantum mechanics, and the most basic processes of life itself. Nanotechnology encompasses how we harness our knowledge of Nano science to create materials, machines, and devices that will fundamentally change the way we live and work.

Big Things Come in Nano-Sized Packages

Nanoshel LLC is a Wilmington, Delaware based nanotechnology company specializing in the commercialization of wide range of Nanoparticles and Innovative materials of 21st century. Nanoshel is revolutionizing nanomaterials where traditional materials fall short.

Since 2005, Nanoshel has been exploring markets, developing innovative technologies, and providing breakthrough solutions using our Nanomaterial expertise.

What's interesting about materials on the Nano scale — contrary to popular belief is that size really does matter. That's because when familiar materials are reduced to Nano proportions, they begin to develop odd properties. For example, plastics can conduct electricity, gold particles can appear red or green and solids can turn into liquids almost spontaneously at room temperature. While not all matter is subject to change, the manipulation of such Nano change is a cornerstone of nanotechnology research.

At the Nano scale, substances may behave differently or better compared to the same substances at macro sizes. For instance, Gold can change Colour, Carbon can conduct heat and electricity better Silver has improved antimicrobial properties.

Other changes that occur to substances at the Nano scale can include: Becoming super-elastic, Becoming more chemically reactive, Getting physically stronger or weaker, Being able to cope with massive changes in temperature and pressure.

It's because of these unique properties that nanotechnology could be used in such a huge range of products.

This catalogue discuss nanotechnology and its impact on almost every industry, including computers, semiconductors, pharmaceuticals, defense, health care, communications, transportation, energy, environmental sciences, entertainment, chemicals, and manufacturing. This merging of different fields will result in developments that are not simply evolutionary; they will be revolutionary

If you want to buy nanomaterial's or discuss nanotechnology applications, you can also visit our Web site at www.nanoshel.com.

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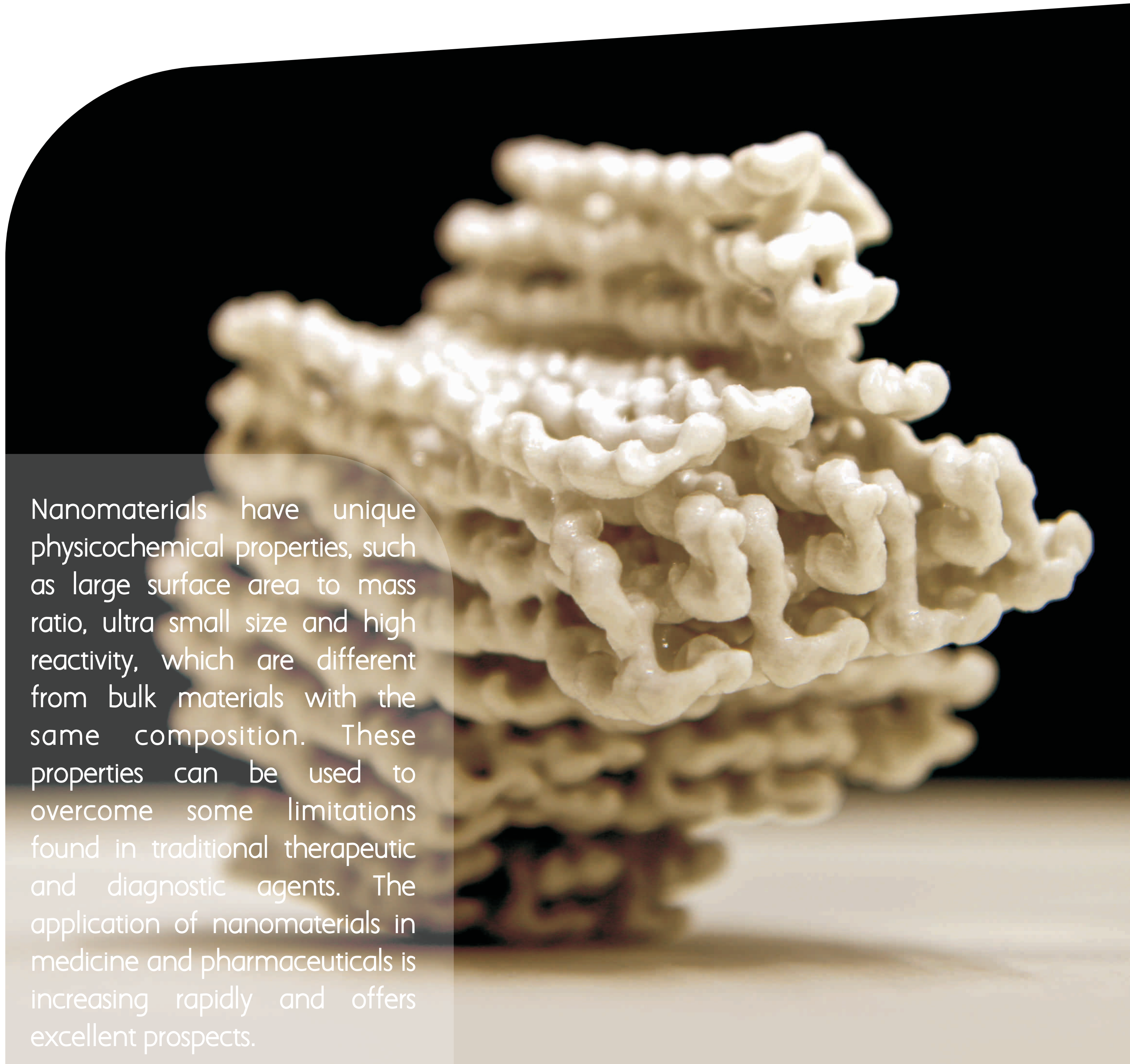
Targeted Drug Delivery | Tissue Engineering & Regenerative Medicine

Nanobased Medical Treatment

Intelligent nano materials for medicine



Nanomaterials have unique physicochemical properties, such as large surface area to mass ratio, ultra small size and high reactivity, which are different from bulk materials with the same composition. These properties can be used to overcome some limitations found in traditional therapeutic and diagnostic agents. The application of nanomaterials in medicine and pharmaceuticals is increasing rapidly and offers excellent prospects.

Nanomaterials have unusual mechanical, optical, electrical and chemical behaviors, they have been widely used in medicine and pharmaceuticals for the sensitive detection of key biological molecules, more precise and safer imaging of diseased tissues and novel forms of therapeutics etc. In the last two decades, a number of nanoparticle-based therapeutic and diagnostic agents have been developed for the treatment of cancer, diabetes, pain, asthma, allergy, infections, and so on.

Nano-Gold Conjugation

Nano GOLD products are 'conjugation friendly' nanoparticles with a proprietary surface coat that greatly enhances colloidal stability and permits easy covalent attachment of a variety of molecules, including antibodies, analytes and other biomolecules.

In the case of immuno-gold conjugates, the antibody can be attached irreversibly without the need for extensive trials at different values of pH and/or salt concentration, as is typical of traditional 'passive' binding methods.

In the case of analyte-gold conjugates, the multipoint attachment of the polymer to the gold surface ensures that the analyte is firmly anchored. By contrast, direct attachment of analytes to gold surfaces by self-assembly techniques is far less stable and unwanted desorption is a significant problem.
Nano GOLD nanoparticles can be provided in a variety of formats (e.g. 10 OD liquid or as lyophilized nanoparticles) formulated to allow a one-step reaction with antibodies.

The kits available are designed for research use and for the development of diagnostic products, specifically for the screening of potential antibodies or small scale 'proof of principle' studies. Please contact us if you require any additional information and to discuss your bulk or custom conjugation requirements.

Features

- Proprietary surface coat
- Ultra-stable
- Covalently link antibodies and analytes
- Simple conjugation processes
- Different surface chemistries
- Custom labeling service available

Benefits

- Antibody-GOLD conjugates in just 15 minutes
- Enhanced assay sensitivity
- Protective coat prevents metal-antibody interactions
- Rapid screening of multiple antibodies for assay development
- No pH titrations
- Fully scalable - from R&D to Production
- Custom Nano labeling services

Nano Medicine
Diagnostics

A major emphasis in bioengineering and medical technology has improved diagnostic techniques to screen for disease. Such screening is required to identify illnesses, assess risk of disease onset, or determine progression or improvement of disease state such as cancer, stroke, Alzheimer's, or cardiac disease. Nanotechnology may improve the sensitivity, selectivity, speed, cost, and convenience of diagnosis. Individual biomolecular interactions can be detected by the deflection of a microcantilever, the red-shifted emission of a gold nanoparticle, or the altered conductance of a nanowire. Nanoscale labeling agents, such as quantum dots, have numerous advantages to intracellular labeling and visualization. Nanotechnology has opened up the possibility of other screening strategies as well.

Faster,less expensive medical diagnostics through nanotechnology

Stock Number	Product Description	Application
NS6130-01-108	Gold Nanopowder (Au, 99+%, 50-100nm)	Biomolecular Interactions
NS6130-01-109	Gold Nanopowder (Au, 99+%, <80nm)	Biomolecular Interactions
NS6130-02-253	Cadmium Sulphide (CdS, 99+%, 5-10nm)	DNA Targets
NS6130-02-288	Zinc Sulphide (ZnS, 99+%, 5-10nm)	Optical Detection & Visualization
NS6130-03-311	Copper Oxide (CuO, 99+%, 80nm)	Optical Detection & Visualization
NS6130-02-240	Lead Sulphide (PbS, 99+%, 80nm)	Optical Detection & Visualization
NS6130-06-601	Carbon Nanotubes (SWCNT, 99+%, OD: 2-3nm)	Electrical Detection

Nanotechnology-on-a-chip is one more dimension of lab-on-a-chip technology. Magnetic nanoparticles, bound to a suitable antibody, are used to label specific molecules, structures or microorganisms. Gold nanoparticles tagged with short segments of DNA can be used for detection of genetic sequence in a sample. Multicolor optical coding for biological assays has been achieved by embedding different-sized quantum dots into polymeric microbeads. Nanopore technology for analysis of nucleic acids converts strings of nucleotides directly into electronic signatures.

Nano Medicine
Targeted Drug Delivery

Nanoparticles, which have diameters under 100nm, or one-thousandth of a millimeter, are thought to be the most promising drug carriers. It's hard for a white blood cell to understand, it has a nanoparticle next to it. Those same tiny dimensions allow them to slip through the cracks between cells and infiltrate cell membranes, where they can go to work administering medicine.

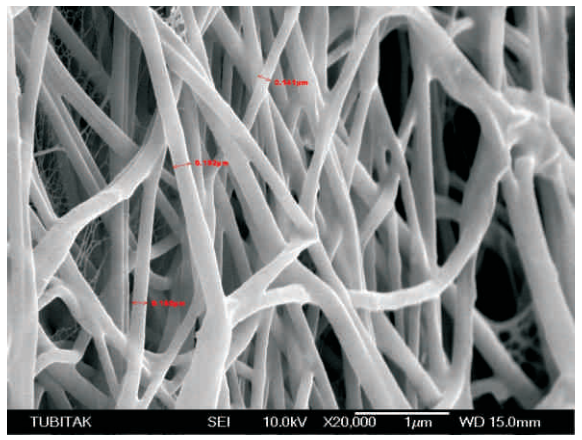
Drug delivery & potential applications
- -Polymeric nanoparticles (PNPs)
- -Polyketal nanoparticles
- -Nanoparticle-aptamer conjugates
- -Colloidal Gold nanoparticles
- -Dendrimers
- -Hyperbranched polymers
- -Dendritic polymer-drug conjugates
- -Nanocrystals
- -Quantum dots
- -Nanoliposomes (nanosomes)
- -Fullerenes and carbon nanotubes
- -Carbon nanohorns
- -Chitosan and lecithin nanoparticles
- -Nanodiamonds
- -Smart' Bio-nanotubes
- -Implantable drug-carrying nanofilms
- -Multifunctional particles and systems
- -Theranostic approaches

Stock Number	Product Description	Application
NS6130-03-320	Iron Oxide Nanopowder (Fe_2O_3, gamma, 99%, <40nm)	Cell Imaging
NS6130-03-321	Iron Oxide Nanopowder (Fe_3O_4, high purity, 99.5%, 80nm)	Cell Imaging
NS6130-01-108	Gold Nanopowder (Au, 99+%, 50-100nm)	Therapeutic Applications
NS6130-01-109	Gold Nanopowder (Au, 99+%, <80nm)	Target Drug Delivery
NS6130-01-104	Silver Nanopowder(Ag 99%, 20nm, metal basis)	Biosensing

Nano Medicine

Tissue Engineering & Regenerative Medicine

Nanotechnology can help reproduce or repair damaged tissue. "Tissue engineering" makes use of artificially stimulated cell proliferation by using suitable nanomaterial-based scaffolds and growth factors. For example, bones can be regrown on carbon nanotube scaffolds. Tissue engineering might replace today's conventional treatments like organ transplants or artificial implants. Advanced forms of tissue engineering may lead to life



Nanomaterials can also compensate for limitations in the scaffold. Embedding nanoparticles in biomaterials can enhance their mechanical and electrical conductive properties, for example. Nanomaterials can also increase cell viability, promote adhesion, control the release of growth factors and cytokines, and even physically shape biomaterials and cells to create a desired tissue structure.

Ultimately, smart controllable nanorobots could potentially go to work for us — circulating inside the body, finding diseased tissues and repairing them by destroying defected cells and molecules or by encouraging cells to regain their function. We believe that these tiny nanostructures could redefine medicine in the future. It's a future and we should look forward to being a part of.

Nanoshel Carbon nanotubes/nanofibers (CNTs/CNFs) are good scaffold candidates for bone tissue engineering applications due to their superior cytocompatible, mechanical and electrical properties. It was seen that a 60nm diameter CNFs stimulated osseointegration by significantly increasing osteoblast adhesion and decreasing competitive cell adhesion. Nanoshel CNT/CNF reinforced polymer nanocomposites have demonstrated excellent electrical conductivity for tissue regeneration. An 80%/20% polylactic acid (PLA)/CNT composite exhibited ideal electrical conductivity for bone growth in comparison to PLA which acted as an insulator. Thus CNTs/CNFs can act as osteogenic scaffolds with superior properties to effectively enhance bone regeneration.

Stock Number	Product Description	Application
NS6130-09-919	Hydroxyapatite Nano Powder (99%, 50nm)	Bone Tissue Engineering
NS6130-09-924	Hydroxyapatite silver coated (99%, 200nm)	Bone Forming (Osteoblast) Cells
NS6130-09-918	Chitosan Nanofibers (99%, 100nm)	Bone Tissue Engineering
NS6130-09-925	Gelatin Nano Powder (99%, 100nm)	Encapsulating Stem Cells
NS6130-09-926	Collagen Nano Powder (99%, 80nm)	Bone Tissue Engineering

Nano Environment

Water Filteration | Polution Detection | Water Treatment Technologies

Nanobased Treatment Technologies

Nano Environment
Filtration

In terms of wastewater treatment, nanotechnology is applicable in detection and removal of various pollutants. Heavy metal pollution poses as a serious threat to environment because it is toxic to living organisms, including humans, and not biodegradable. Various methods such as Photocatalysis, Nanofiltration, Adsorption, and Electrochemical oxidation involve the use of $TiO2$, ZnO, ceramic membranes, nanowire membranes, polymer membranes, carbon nanotubes, submicron nanopowder, metal (oxides), magnetic nanoparticles, nanostructured boron doped diamond are used to resolve or greatly diminish problems involving water quality in natural environment.

Most environmental applications of nanotechnology fall into three categories: (i) environmentally-benign and/or sustainable products (e.g. green chemistry or pollution prevention), (ii) remediation of materials contaminated with hazardous substances, and (iii) sensors for environmental agents. In particular, nanotechnologies play a large role in current efforts to develop better methods for detection and decontamination of harmful biological agents, which are in many respects environmental issues.

Stock Number	Product Description	Application
NS6130-03-350	Titanium Oxide Nanopowder (TiO_2, anatase, 99+%, 10-25 nm)	Water Purification
NS6130-03-362	Zinc Oxide Nanopowder (ZnO, 99+%, 10-30 nm)	Degradation of Contaminants
NS6130-03-306	Cerium Oxide Nanopowder (CeO_2, 99%, <80nm)	Water Purification
NS6130-01-115	Diamond Nanopowder (C, 55-60%, 3-10 nm)	Remove Contaminants
NS6130-03-321	Iron Oxide Nanopowder (Fe_3O_4, high purity, 99.5+%, 80nm)	Decontamination
NS6130-09-918	Chitosan Nanofibers (99%, 100nm)	Adsorbent of Contaminants
NS6130-01-103	Silver Nanopowder(Ag 99%, 30-50nm, metal basis)	Antibacterial Activity

NANOSHEL Creating Miracles in Black

Nano Environment
Polution Detection & Sensing

Nanostructure material	Function
Silver nanoparticle array membranes	Water quality monitoring
Carbon nanotubes (CNTs)	Electrochemical sensors
CNTs as a building block	Exposure to gases such as NO2, NH3 or O, the electrical resistance of CNTs changes dramatically, induced by charge transfer with the gas molecules or due to physical adsorption
CNTs with enzymes	Establish a fast electron transfer from the active site of the enzyme through the CNT to an electrode, in many cases enhancing the electrochemical activity of the biomolecules
CNTs sensors	Developed for glucose, ethanon, sulphide and sequence specific DNA analysis
Magnetic nanoparticles coated with antibodies	Useful for the rapid dection of bacteria in complex matrix

Air pollution can be remediated using nanotechnology in several ways. One is through the use of nano-catalysts with increased surface area for gaseous reactions. Catalysts work by speeding up chemical reactions that transform harmful vapors from cars and industrial plants into harmless gases. Catalysts currently in use include a nanofiber catalyst made of manganese oxide that removes volatile organic compounds from industrial smokestacks. Other methods are still in development.

Nano Sensors

The characterization of environmental sensors is based primarily on the physics involved and their operating mechanisms. For example, chromatography relies on the separation of complex mixtures by percolation through a selectively adsorbing medium with subsequent detection of compounds of interest. Electrochemical sensors include sensors that detect signal changes (e.g. resistance) caused by an electric current being passed through electrodes that interact with chemicals. Mass sensors rely on disturbances and changes to the mass of the surface of the sensors during interaction with chemicals. Optical sensors dectet changes in visible light or other electromagenetic waves during interactions with chemicals. Within each of these categories, some sensors may exhibit characteristic that overlap with those of other categories. For example, some mass sensors may rely on electrical excitation or optical settings.

Types of sensors: Biosensors, Electrochemical Sensors, Mass Sensors, Optical Sensors, Gas Sensors

Stock Number	Product Description	Application
NS6130-03-350	Titanium Oxide Nanopowder (TiO_2, anatase, 99+%, 10-25 nm)	Oxidative Transformation
NS6130-03-362	Zinc Oxide Nanopowder (ZnO, 99+%, 10-30 nm)	Photocatalysis Oxidation
NS6130-01-133	Iron Nanopowder (Fe, 99+%, 60-80 nm)	Destroying Contaminants
NS6130-06-601	Carbon Nanotubes (SWCNT, 99+%, OD: 2-3nm)	Destroying Contaminants

Nano Environment
Water Treatment Technologies

Carbon Nanotube Based Technologies
Carbon nanotubes can be uniformly aligned to form membranes with nanoscale pores that are able to filter out contaminants. Their nanoscale pores make these filters more selective than other filtration technologies. The carbon nanotubes also have high surface areas, high permeability, and good mechanical and thermal stability.120 Though several other methods have been used, carbon nanotube membranes can be made by coating a silicon wafer with a metal nanoparticle catalyst that causes carbon nanotubes to grow vertically aligned and tightly packed. The spaces between the carbon nanotubes can then be filled with a ceramic material to add stability to the membrane.

Amount of Water Treated
Although their pores are significantly smaller, carbon nanotube membranes have been shown to have the same or faster flow rates as much large pores, possibly because of the smooth interior of the nanotubes.

Contaminant Removal
Laboratory studies report that carbon nanotube membranes can remove almost all kinds of water contaminants, including turbidity, bacteria, viruses, and organic contaminants. These membranes have also been identified as promising for desalination and as an alternative to reverse osmosis membranes.

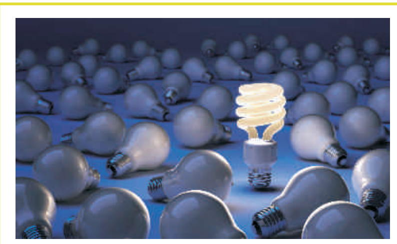
Other Nanofiltration Approaches
- Nanofiltration Membranes and Device
- Nanofibrous Alumina Filters
- Nanofiber Gravity Flow Devices
- Nanoporous Ceramics, Clays and Other Adsorbents
- Nanoporous Ceramic Bio Media Filtration
- Nanoporous Ceramic Membrane Filter
- Cyclodextrin Nanoporous Polymer
- Polypyrrole Carbon Nanotube Nanocomposite

Nano Zeolites
Natural, Synthetic, Coal Fly Ash, and Compound Zeolites

Nano Energy

Reduction in Energy Consumption | Increasing the Efficiency of Energy Production

Energy Storage Through Graphene | Effect of Nanotechnology on CO_2 Emission | Graphene



Nanobased Increased Energy Efficiency

Nano Energy
Reduction in Energy Consumption

New nanotechnology applications are underway in the energy sector. Better energy production, storage, transmission and usage are possible with nanotechnology.

Nanotechnology refers to any technology that includes components that are smaller than 100 nanometers. A nanometer is one billionth of a meter. A single virus measures approximately 100 nanometers. Science and engineering are working to develop new nanomaterials in the energy sector that may improve energy efficiency, storage, conversion, consumption, and better renewable energy sources

Batteries

Currently, the large number of used batteries and accumulators represent an environmental problem. Nanomaterials could help develop batteries with higher energy capacities or rechargeable batteries and accumulators, which will help with the disposal issue of batteries. For example, Researchers at Stanford University have found a way to use silicon-based nanowires to increase significantly the capacity of rechargeable lithium-ion batteries that currently power-up electronic devices such as laptops, video cameras, cell phones, and many others. In fact, the new technology, known as Li-ion, can increase 10 times the capacity of traditional Lithium batteries. Also, Silicon Nanopowder can reduce the possibility of batteries catching fire by providing less flammable electrode materials.

Stock Number	Product Description	Application
NS6130-02-269	Lithium Iron phospate Nanopowder (LIP, 99%, <40nm)	Energy Storage
NS6130-03-640	Carbon Nanotubes (MWCNT, OD: 20-30nm, 99%)	Increases Rate of Energy Trf
NS6130-03-350	Titanium Oxide Nanopowder (TiO2, anatase, 99+%, 10-25 nm)	Synthesis Properties
NS6130-01-141	Silicon Nanopowder (Si, 99+%, <100 nm, Monocrystalline)	Energy Transfer

Nanomaterials Application

Fe-Ni Alloy Nanopowder	High-Power Magnets
Carbon Nanotubes	High-Sensitivity Sensors
Silicon Nanopowder	Next-Generation Computer Chips
Graphene	Better Insulation Materials
Phosphors Nanopowder	Phosphors for High-Definition TV
Nano Based LED's	Low-Cost Flat-Panel Displays
Diamond Nanopowder	Tougher and Harder Cutting Tools
LiFePo4 Nanopowder	High Energy Density Batteries

Nano Energy
Increasing the Efficiency of Energy Production

Energy generation and storage are perhaps two of the most imperative, on-going, and challenging issues facing the world to date. Rapidly growing global energy demands place increasingly greater burdens on the incumbent fossil fuel-based infrastructure. This has resulted in a switch toward both the exploration of new and clean energy sources and the development of highly efficient energy storage devices. Nanomaterials and nanodevices are expected to play a key role in this paradigm shift. However, breakthroughs are needed in our abilities to synthesize nanomaterials and atomistic assembly, to study energy transduction at nanoscale, and to understand the underlying chemical and physical mechanism involved in high-efficient energy conversion and storage. This Energy Section focuses on the science and engineering of nanomaterials and nanodevices used in all forms of energy harvesting, conversion, storage, and utilization.

Potential topics include, but are not limited to

- Nanomaterials for batteries - Lithium Ion Phosphate Nanopowder
- Nanomaterials for hydrogen generation and storage - Carbon Nanotubes
- Nanomaterials for high-performance LED - Quantum Dots
- Optoelectronic nanomaterials for efficient energy usage - Graphene Nanopowder
- Photovoltaic cells based on hybrid nanostructures - Gold Nanopowder
- Piezoelectric or triboelectric nanogenerators - TiO2 Nanopowder
- Supercapacitors - Graphene Nanopowder (Single Layer)

Reduction of Energy Consumption

Reduction of energy consumption is an active area in nanotechnology. Energy reduction using nanotechnology targets the development of more efficient lighting, better combustion systems, use of lighter and stronger materials in the transportation sector. Light-emitting diodes (LEDs) or quantum caged atoms (QCAs) are interesting applications for energy consumption reduction.

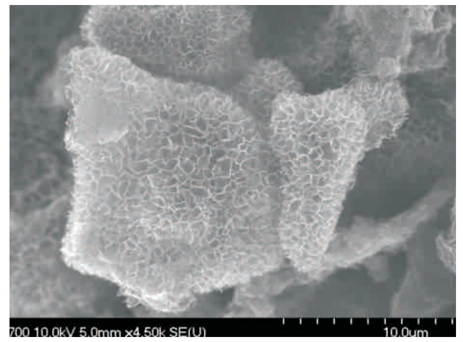
Energy Storage Through Graphene

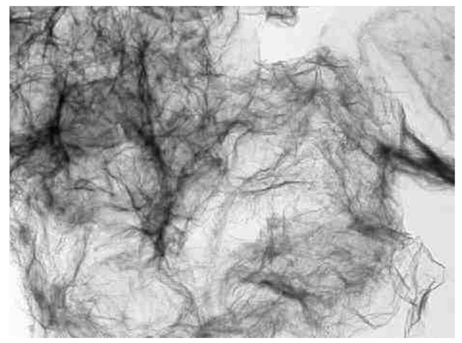
An entirely new strategy for engineering graphene-based supercapacitors has been developed by researchers potentially leading the way to powerful next-generation renewable energy storage systems. The new strategy also opens up the possibility of using graphene-based supercapacitors in electric vehicles and consumer electronics.

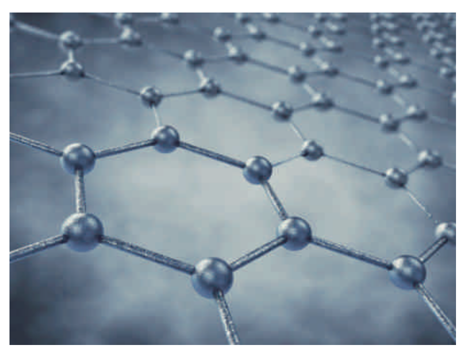
Supercapacitors which are typically composed of highly porous carbon that is impregnated with a liquid electrolyte are known for possessing an almost indefinite lifespan and the impressive ability to recharge extremely rapidly, in seconds even. But existing versions also possess a very low energy-storage-to-volume ratio in other words, a low energy density. Because of this low energy density 5-8 Watt-hours per liter in most supercapacitors they're not practical for most purposes. They would either need to be extremely large or be recharged very, very often for most uses.

The world's largest producer of nano graphene platelets (NGPs), Nanoshel single layer graphene has exhibited high electrical properties including exceptional in-plane electrical conductivity (up to ~ 20,000 S/cm) when compared to other nanomaterials including carbon nanotubes (CNTs) and carbon nano-fibers (CNFs). Products targeted include a wide range of consumer electronics including smart phones and other portable electronics, computer peripherals, touchpad's, POS kiosks, and industrial controls.

NANOSHEL offers a variety of graphene materials in sizes ranging from nano to micron in the x, y, and z axis. These advanced materials are collectively referred to as nano graphene platelets (NGPs). NGPs offer improved material performance and superior mechanical, thermal, barrier, and electrical conductivity properties. As a result, Nanoshel is able to work with companies to functionalize graphene for specific applications that include batteries, fuel cells, supercapacitors, light weight structural components as well as electromagnetic interference (EMI), radio frequency interference (RFI), electrostatic discharge (ESD), lightning strike, and other functional and structural composite applications.

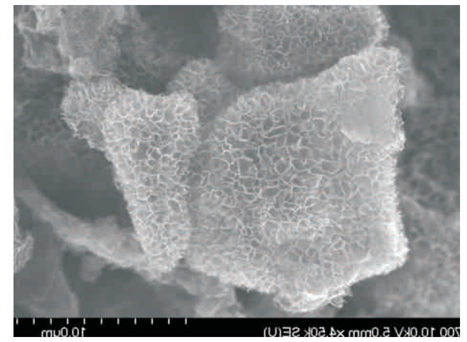


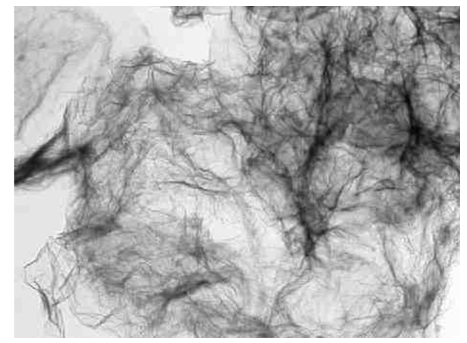


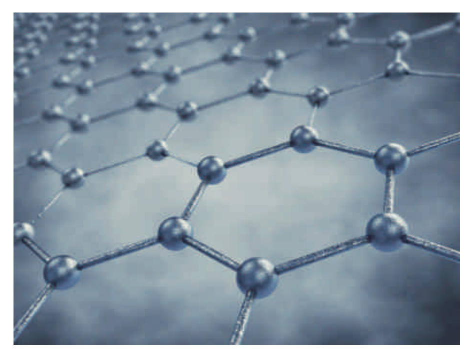


Stock Number	Product Description	Application
NS6130-03-364	Graphene Nanopowder (C,99%,Single Layer)	Super Capacitor
NS6130-03-365	Graphene Nanopowder (C,99%, 4-6 Layer)	Super Capacitor Battery
NS6130-03-371	Graphene Nanopowder (C,99%, Single Layer-Modified)	Transistors/ Electrodes

Effect of Nanotechnology on CO_2 Emission







From an analysis of the impact of nanotechnologies on Co2 emissions, it is clear that nanotechnologies provide a piece of the solution, but not the entire one. Currently available technologies have the potential to directly reduce carbon emissions by almost 200,000 tons by 2020, chiefly through weight savings and improved combustion in transport applications and through improvements in building insulation.

Impact of nanotechnologies in emission reductions

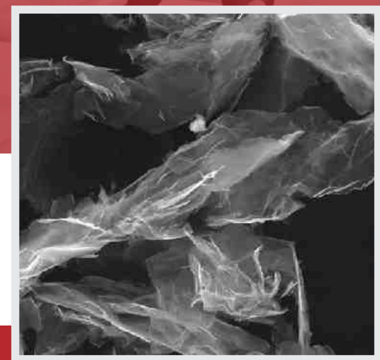
a) The reduction of emissions from transportation through weight reductionand improved drive train efficiency. The traditional automotive industry rule of thumb is that a 10% reduction in weight gives a 5% increase in fuel efficiency, but the adoption of Nanocomposites across the vehicle, from engine parts to body panels has increased this savings.

b) The use of improved insulation in residential and commercial buildings Nanomaterials are already being used to reduce the energy required for heating and cooling, and from manufactures estimates these materials are some 30% more efficient that current technologies (without taking into account lighter weight, the ability of materials such as aerogels to trap sunlight etc).

c) The generation of renewable photovoltaic energy. Thin film solar panels using flexible substrates will open up new application areas, but silicon based solar technologies, previously hampered by a shortage of silicon, a situation forecast to ease in 2008, are now promising far higher conversion efficiencies.

d) Nanoshel is working with technology companies in US and Europe in reduction of Co2 emmission with use of various nanomaterial nanotechnologies.

Stock Number	Product Description	Application
NS6130-01-101	Silver Nanopowder (Ag, 99%, 50-80 nm, metal basis)	Carbon Reduction
NS6130-03-353	Titanium Oxide Nanopowder (TiO_2, rutile, 96+%, 30nm coated with silicon)	Improve Insulation
NS6130-03-360	Zinc Oxide Nanopowder (ZnO, 99.9 +%,80-200nm)	Weight Reduction
NS6130-01-141	Silicon Nanopowder (Si, 99+%, <100 nm, Monocrystalline)	Improve Insulation


Electronic Property

One of the hottest areas of graphene research focuses on the intrinsic electronic properties; how electrons flow through a sheet – only one atom thick – while under the influence of various external forces.

Thermal and thermoelectric properties

Its thermal conductivity was measured recently at room temperature and it is much higher than the value observed in all the other carbon structures as carbon nanotubes, graphite and diamond (> 5000 W/m/K).

Mechanical properties

It was found that graphene is harder than diamond and about 300 times harder than steel. To put this into context, it will take the weight of an elephant balanced on a needle-point in order to break this one atom thick fabric! The tensile strength of graphene exceeds 1 Tpa.

Optical properties

Graphene, despite being the thinnest material ever made, is still visible to the naked eye. Due to its unique electronic properties, it absorbs a high 2.3% of light that passes through it, which is enough that you can see it in air (if you could manage to hold it up!).

Chemical Properties

Other than weakly attached adsobates, graphene can be functionalized by several chemical groups (for instances OH-, F-) forming graphene oxide and fluorinated graphene. It has also been revealed that single-layer graphene is much more reactive than 2, 3 or higher numbers or layers.

Stock Number	Product Description	Properties
NS6130-03-364	Graphene Nanopowder (Single Layer Flakes > 50%)	Unique Electronic Property
NS6130-03-365	Graphene Nanopowder (4 to 6 Layer Flakes > 80%)	300 Times Harder than Steel
NS6130-03-366	Graphene Nanopowder (Polymer Composite Material)	Functionalized by Several Chem. Group
NS6130-03-367	Graphene Nanopowder (Electrically Conductive Composites)	Intrinsic Electronic Property

NANOSHEL
Creating Miracles in Black

Nano Information & Communication

Transparent Conductive Displays | Conductive Carbon Nanotube Ink
Novel Semiconductor Devices | Novel Optoelectronic Devices | Memory Storage

Nanobased Sensing Technology

Transparent Conductive Displays

DISPLAYS

Innovating the world of nano materials to enable tomorrow's high-tech electronic designs

Transparent Conductive Films (TCFs) are used in most high-tech displays and touchscreens. Currently, the electronics industry relies primarily on Indium Tin Oxide (ITO) to make electro-conductive films for displays.

ITO / SWCNT in Transparent Conductive Display :

It is brittle, making it unsuitable for touchscreens and flexible displays The cost of processing ITO is very high. Single-walled carbon nanotubes (SWNT) are an ideal alternative, resolving the above challenges while offering exceptional electrical and mechanical properties. Up until now, however, their use was limited as a result of technical barriers. Nanoshel Nanomaterials has developed an innovative SWNT technology that overcome these barriers, enabling best-in-class transparent conductive thin films suited to a wide application spectrum including solar cells, touchscreens, displays, electrochromic windows and thin-film transistors.

A closer look SWNTs must be solubilised before they can be turned into TCFs. The sonication methods typically used to achieve this have the downside of limited scalability and damage to the SWNT structure. Nanoshel Nanomaterials has overcome these issues by eliminating the need for sonication, ultra centrifugation and functionalisation. Nanoshel innovative, scalable reductive dissolution technology uses liquid ammonia to produce solubilised carbon nanotubes in the form of inks, which can then be deposited as films. The negative charge on the SWNTs within the ink allows for further functionalisation, extending the field of potential applications to composites, sensors and biology.

Stock Number	Product Description	Application
NS6130-06-601	Carbon Nanotubes (SWCNT, 99+%, OD: 2-3nm)	Conductive Display
NS6130-02-226	Indium Tin Oxide Nanopowder (ITO, In_2O_3:SnO_2 90:10)	Conductive Display
NS6130-04-437	Graphene Dispersion Single Layer (C,20 wt%,Laitral Size:20nm)	Conductive Display

Conductive Carbon Nanotube Ink

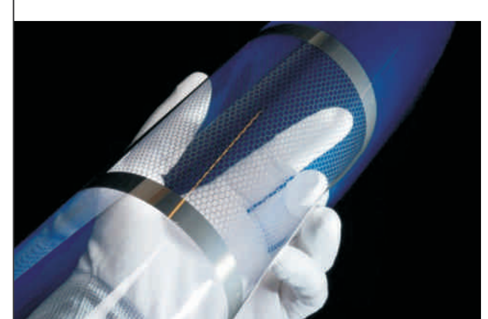
Carbon nanotubes are cylindrical nanostructured allotropes of carbon with unique properties. These carbon molecules have been extensively exploited for a variety of applications owing to their exceptional mechanical robustness, thermal conductivity, electronic transport and optical photoluminescence properties. One of its versatile applications is in the form of carbon nanotube ink, where carbon nanotubes are used in ink to print on paper and plastic surfaces. However, carbon nanotubes are difficult to manipulate and, have a propensity to aggregate and resist dispersion. Therefore, there is need for an easily dispersible carbon nanotube ink.

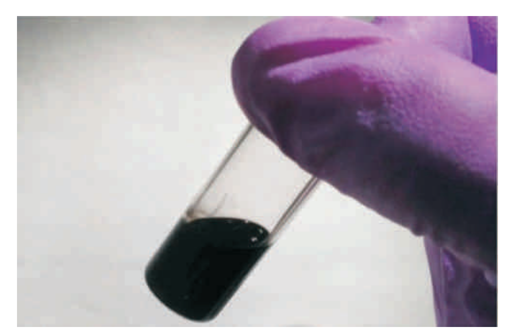
Advantages

1. Aqueous solutions of individually-dispersed (MWCNT Purity: 99% OD: 10-20nm, Length: 3-8um High Purity) have been prepared using the novel additive as a co-dispersant to concentration in the g.L range. The highest achieved concentration is 3.35 g/L, but much higher concentrations are possible.
2. This novel ink product is prepared in high enough concentrations to achieve the highest contrast ratio possible compared to other inks on the same substrate.

Applications

1. Ultra-high contrast ink: Using carbon nanotube ink prepared in high enough concentrations with the above method will allow for highest contrast ratio possible compared to other inks.
2. Conductive Inks: This novel ink has high concentrations of carbon nanotube (MWCNT Purity: 99% OD: 10-20nm, Length: 3-8um High Purity) solutions, some of which have high electrical conductivity, which is ideal for the conductive coatings that are important for the upcoming flexible electronics industry.
3. Transitive Inks (for Thin Film Transistors or TFTs): Certain species of carbon nanotubes (SWCNT, Purity: >98 wt%, OD: 1-2nm, Avg Length: 3-8um High Purity) are semiconductors. However, their properties are not discernable when they are generated along with a mixture of other carbon nanotube species. This novel ink allows the carbon nanotubes to be individually dispersed and retain their semiconductor properties when the ink is dry.
4. Document Security: The optical properties of nanotubes are intact due to their individually dispersed states. The unique photoluminescence properties in the near infra-red (NIR) spectral region can be used as document signatures or authentication marks. These features could be pre-built into the paper as a watermark or printed on the paper as an ink.





Nano Information & Communication
Novel Semiconductor Devices

When the size of semiconductor materials reduces to nanoscale, their physical and chemical properties change dramatically, resulting in unique properties due to their large surface area or quantum size effect. Currently, semiconductor nanomaterials and devices are still in research stages, but they are promising for applications in many fields, such as solar cells, nanoscale electronic devices, light-emitting nano devices, laser technology, waveguide, chemical and biosensors, and catalysts. Further development of nanotechnology will certainly lead to significant breakthrough in semiconductor industry. Recently, strong attentions have been drawn in the research of silicon based nanostructures including silicon quantum dots and silicon nanowires. This field has become one of the most active research areas of semiconductor nanotechnology.

The targeted materials include: silicon nanowires (SiNWs) array, carbon nanotubes (CNTs) array, silicon quantum dots (SiQDs), carbon quantum dots (CQDs), organic/inorganic hybrid nanomaterials, heterojunction structures, and functional nanomaterials with nonlinear optic, humidity sensitive, thermal sensitive, gas sensitive, and magnetic properties.

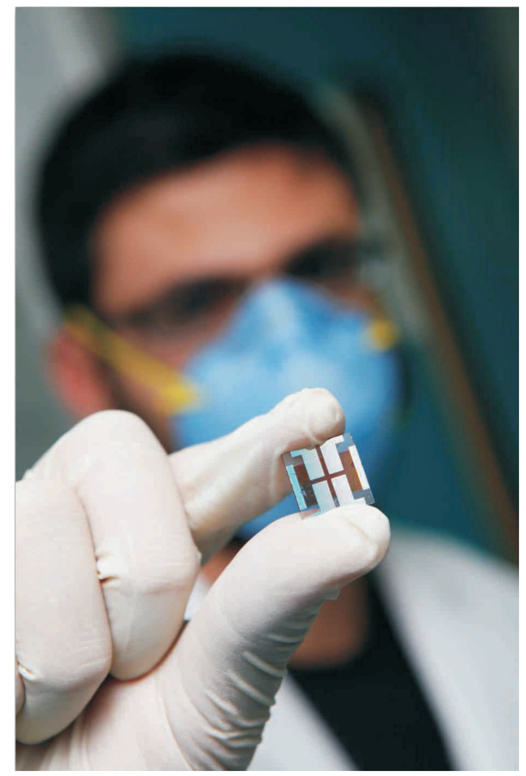
Nano Particles Advantages for Polishing Slurries

Al_2O_3 Nano	:	Faster rate of surface removal reduces operating costs
CeO_2 Nano	:	Less material required due to small size of particles

Stock Number	Product Description	Application
NS6130-01-141	Silicon Nanopowder (Si, 99+%, <100 nm, Monocrystalline)	Semiconductor
NS6130-01-142	Silicon Nanopowder (Si, 99+%, <80 nm, Monocrystalline)	Semiconductor
NS6130-06-601	SWCNT, >98 wt%, OD: 1-2nm, Avg Length: 3-8um High Purity	Wafer Polishing
NS6130-06-635	SWCNT NH_2 , 90-95wt% OD: 1-2nm, L: 15-30um, NH_2: 2-3Wt%	Wafer Polishing

NANOSHEL Creating Miracles in Black

Nano Information & Communication
Novel Optoelectronic Devices



Single-crystal compound semiconductor nanowires can be grown on variety of substrates including Silicon nanopowder. Direct bandgap and higher mobility make them attractive for applications such as chip-to-chip optical interconnects, head-mount displays, sensors, and flexible electronics. They are also excellent vehicles for understanding how reduced dimensions affect electrical and optical properties.

Carbon nanotubes are rolled up sheets of graphene, a one atom thick layer of sp2 bonded carbon. Both nanotubes and graphene have unique and technologically attractive qualities, including high carrier mobility (2×105/V·sec), high sustained current density (109 A/cm2 vs. 106 A/cm2 for Cu), and no surface dangling bonds, so many high-k dielectrics can be readily used as gate oxides.

Graphene sheets can be produced by attaching a graphite microcrystal to an AFM tip (in inovation Material) and scratching it over a Si wafer. Although sufficient for basic research this method is not readily adapted to large scale device fabrication. Research Laboratory are making Graphene layers by heating SiC to ~1200oC, while monitoring this process using Low Energy Electron Microscopy

Nanoimprint lithography (NIL) is a quick way to nano-pattern a surface, well suited for large area repeating geometries such as lines and dots, as well as stand alone nanostructures such as nanogap electrodes. A 2D plasmonic grating is formed by imprinting nanoholes into PMMA and evaporating a thin metal layer over the pattern. By making this pattern on a thin actuator, we demonstrated an optical switch. A grating pattern of 200 nm pitch was used to make Si 'nanowire' with <70 nm diameter and 100 cm length, which served as excellent chemical sensors.

Stock Number	Product Description	Application
NS6130-03-364	Graphene Nanopowder (C,99%,Single Layer)	High Carrier Mobility
NS6130-06-601	Carbon Nanotubes (SWCNT, 99+%, OD: 2-3nm)	High Current Density
NS6130-01-143	Silicon Nanopowder (Si, 98+%, <50 nm,)	Device Fabrication
NS6130-07-713	Si-AL Nanopowder, >99% <80nm	Chemical Sensors

Nano Information & Communication

Memory Storage

Current memory technologies fall into three separate groups: dynamic random access memory (DRAM), which is the cheapest method; static random access memory (SRAM), which is the fastest memory but both DRAM and SRAM require an external power supply to retain data; and flash memory, which is non-volatile it does not need a power supply to retain data, but has slower read-write cycles than DRAM.

Carbon nanotubes tubes made from rolled graphite sheets just one carbon atom thick could provide the answer. If one nanotube sits inside another slightly larger one, the inner tube will 'float' within the outer, responding to electrostatic, van der Waals and capillary forces. Passing power through the nanotubes allows the inner tube to be pushed in and out of the outer tube. This telescoping action can either connect or disconnect the inner tube to an electrode, creating the 'zero' or 'one' states required to store information using binary code. When the power source is switched off, van der Waals force which governs attraction between molecules keeps the Inner tube in contact with the electrode. This makes the memory storage non-volatile, like Flash memory.

Stock Number	Product Description	Application
NS6130-01-108	Gold Nanopowder (Au, 99+%, 50-100nm)	Enhancing Charge
NS6130-01-143	Silicon Nanopowder (Si, 98+%, <50nm)	High Refractive Index
NS6130-01-151	Platinum Nanopowder (Purity: >99.9%, APS: <80nm)	Charge Storage Layers
NS6130-07-713	Si-AL Nanopowder, >99% <80nm	Energy Storage
NS6130-09-906	Fe-Ni Alloy Nanopowder, >99%, <80nm, Fe:Ni/5:5	Magnetic Data Storage
NS6130-06-639	SWCNT COOH Elec , Electrical-grade SWCNTs, >99%, OD: 2-3nm,	Magnetic Data Storage
NS6130-06-698	SWCNT Fluoronated (High Purity, 99%, Dia: <5nm, L: 20-30um)	Magnetic Data Storage
NS6130-03-365	Graphene Multi Layered (4-6 Layer Flakes, >80%, 1um-10um)	Magnetic Data Storage

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Nano Heavy Industry

Aerospace
Nano Structured Coatings
Nano Catalysis

Nano in Smart Structures
Concrete
Coatings
Steel Structure Composite
Fire Protection & Detection

Automobiles
Nanotechnology in Automobiles
Nanotechnology Drive of the future

Nanobased Industrial Technology