
**NANOSHEL LLC**
3422 Old Capitol Trial Suit 1305
Willmington DE - 19808, United States
Phone : +1 302 268 6163
Fax: +1 302 996 5818
E-mail: sales@nanoshel.com
Web : www.nanoshel.com

**Intelligent Material Pvt. Ltd.**
Plot No. 117, Industrial Area, Ph-2,
Panchkula 134109 Haryana (India)
Phone: +91 9779880077, +91 9569591212
Fax: +91 22 66459880
Email: nanoshel2@gmail.com
Web : www.nanoshel.in


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# Product Catalogue

New Era of Nano Applications....!

## Nanocatalyst: effect of size reduction

Catalytic technologies are critical to present and future energy, chemical process, and environmental industries. Conversion of crude oil, coal and natural gas to fuels and chemical feedstock, production of a variety of petrochemical and chemical products, and emission control of CO, hydrocarbons, and NO, all rely on catalytic technologies. Catalysts are also essential components of electrodes for fuel cells that use either solid oxide ionic or polymeric proton electrolyte.

## Drivers for development of advanced catalysts include

- Production of high value products with inexpensive raw materials
- Energy-efficient and environmentally-benign chemical conversion processes
- Increasingly stringent environmental regulations
- Low-cost catalysts such as with reduction or replacement of precious metals

## Introducing a catalyst increases the speed of a reaction in one of three ways

- It can lower the activation energy for the reaction
- Act as a facilitator and bring the reactive species together more effectively
- Create a higher yield of one species when two or more products are formed

In era of nanotechnology where size of every object is going to smaller and smaller with their enhanced properties; catalysts of nano size are also used in several chemical processes and beneficial for human being. In this section we are trying to collect all literature data on application of nanocatalyst reported within the last few years.

| Product Description | Application |
|---|---|
| Al2O3 NanoPowder | Water Purification |
| N-Doped TiO2 & ZrO2 | Water Purification |
| KF/CaO Nanocatalyst | Bio Diesel Production |
| Platinium Colloidal | Fuel Cells Application |
| Carbon Nanotubes | Drug Delivery |
| TiO2 NanoPowder | Photo Catalytic Activity |
| Nano Aluminium Metal Powder | Solid Rocket Propellants |
| CdS, CdTe Nanopowder | Thin Film Solar Cell |
| Nano Sized Palladium Catalysts | West Water Treatments |
| Carbon nanotubes | Fuel Cells, Molecular Sieves, Double Layer Capacitors Li-ion Secondary Batteries |








The aerospace applications for nanotechnology include high strength, low weight composites, improved electronics and displays with low power consumption, variety of physical sensors, multifunctional materials with embedded sensors, large surface area materials and novel filters and membranes for air purification, nanomaterials in tires and brakes and numerous others.

| Product Description | Application |
|---|---|
| Carbon nanotubes, nanofibers | Designer properties, programmable materials |
| Polymer clay nano composites | High strength, low weight |
| Polymer cross-linked aerogels | Physical Sensors |
| Biomimetic hybrids | Reduced life cycle costs |

# Nano Aerospace
## Nanostructured Coatings

Nanoshel nanomaterials that have a great potential in aerospace components such as: New nanoporous filters and sensors for comfort and safety, control of air quality and safety

- Noise reduction via controlled size nanopores
- New catalysts: heterogeneous catalysts use 1-50nm nanoparticles.
- Zeolites and new artificial high-surface area materials may be interesting new catalysts
- Sensors based on nanoparticles able to obtain new selectivities and increased sensibility

### NANOSTRUCTURED COATINGS

Currently under development, there are multifunctional nanocoatings for aerospace that can provide corrosion protection using environmentally safe materials; sense corrosion and mechanical damage of aircraft skin; initiate responses to sensed damage either as alarm changes in colour or real selfhealing behaviours; and improve fatigue resistance. For example, CrAlN is a multiphase coating composed of CrN nanocrystalline grains where Al is in solid solution within the grains or in the boundary region as an amorphous mixture of Al-N and Al-O.

Nanostructured SiO2, ZrO2-SiO2, Al2O3-SiO2 ceramic layers obtained both by sol-gel and electrophoretic deposition are alternative for corrosion protection on aluminum alloys. Other functionalities as abrasion resistance are nanocomposite layers composed of conductive polymers and corrosion inhibitors (CeO2, ZrO2, montmorillonite) are being deposited by chemical and electrochemical techniques for corrosion protection.

### NANOCOMPOSITES

Nanocomposites based on various metal, ceramic or plastic matrix material strengthened by metal or ceramic nanoparticles or nanoplatelets can improve the strength by 100%. But also layered silicate nanocomposites are finding applications in engine components and fuel storage tanks due to their increased lifetime, enhanced strength and elastic modulus and improved polymer barrier properties.

Polymer-silicate nanocomposites have been an attractive means of improving matrix resins in carbon-fiber-reinforced composites. Organic modification of the silicate aids dispersion into the polymer matrix and provides a strong interaction between the nanoclay and the matrix. The dispersion of the layered silicate clay improves the stability as well as the stiffness, strength and barrier properties of polymers without altering current processing techniques.

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-01-142 | Silicon Nanopowder (Si, 99+%, <80 nm, Monocrystalline) | Nanostructured Coatings |
| NS6130-03-301 | $Al_2O_3$ Nanopowder ($Al_2O_3$, alpha, 99%, <80 nm,) | Nanostructured Coatings |
| NS6130-03-363 | Zirconium Oxide Nanopowder ($ZrO_2$, 99+%, <80 nm,) | Nanocomposites |
| NS6130-01-105 | Aluminum Nanopowder (Al, 99+%, 100 nm, metal basis) | Nanocomposites |



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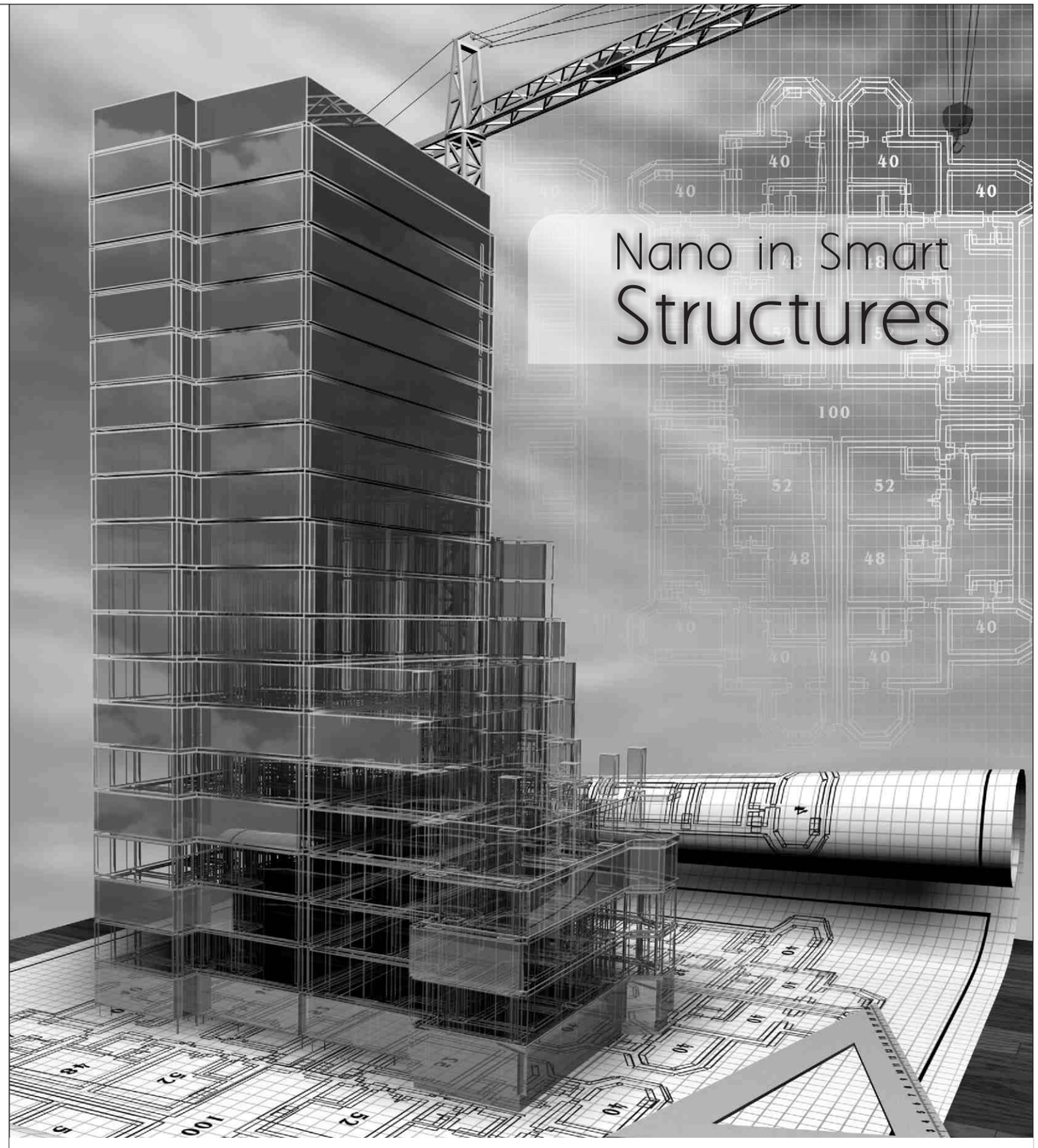


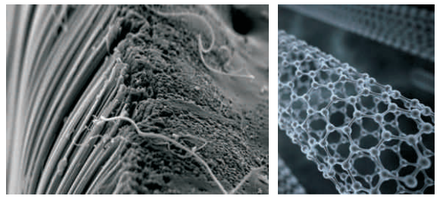



Coatings | Concrete | Fire Protection & Detection

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# Nano Smart Structure
## Coatings

### Materials Modification and Enhancement Towards Energy Efficient and Green Buildings

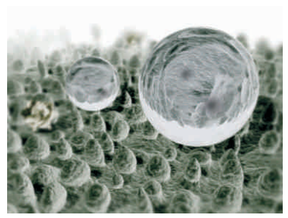
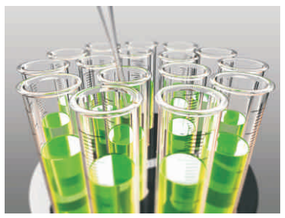
Buildings are responsible for about 90% of the total electricity consumption at end-use level, and account for over 60% of the total Green House Gas (GHG) emission. With increasing concern of the GHG emission arising from electricity consumption and the elevated energy costs, the demand for better thermal insulation in the building enclosures will accelerate.

Nanotechnology can also be used to fabricate materials to trap or re-direct light and heat to desired areas for energy conservation. For instance, nano coatings or treated surfaces can alter the thermal properties of window glasses, as specific nano particles can be used to increase or decrease infrared absorption. Porosity can also be introduced to window coating to lower the thermal conductivity to slow down heat transfer, forming energy efficient glass materials for buildings.

In another project, an inorganic thermal insulation coating material has been developed based on wave reflection theory. Since inorganic materials are used, the risk of emitting harmful organic substances to the environment over time is eliminated. The multi-layered coating material consists of a periodical two-layered structure which acts as a radiant barrier. The thermal insulation can be greatly enhanced again with air-filled glass beads in the coating material. Yet another thermal insulating coating can be formed by adding titanium dioxide (TiO2) nanoparticles into an anchoring polymer matrix with self cleaning property.

With the increasing demand for energy efficient buildings, successful completion of such projects would provide technologies that can be readily commercialized to achieve building construction with green features and good insulation.

Fire protection of structural building materials can be done through insulation schemes using fire resistant steel, fire resistant coatings using ceramic, diluting and endothermic reagents, and intumescent paints. Nano fillers can be used to reduce flammability and improve physical properties.


| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-03-344 | Silicon Oxide Nanopowder ($SiO_2$,99+%, 20-30 nm) | Lower Thermal Conductivity |
| NS6130-03-353 | Titanium Oxide Nanopowder ($TiO_2$, anatase/rutile, 99%, 20nm) | Self Cleaning Property |





# Nano In Smart Structures
## Concrete

### Areas of applying nanotechnology in construction will be mainly focused on :

- Lighter and stronger structural composites
- Low maintenance coating
- Better proper ties of cementitious materials
- Reducing the thermal transfer rate of fire retardant and insulation
- Construction related nano-sensors.

Concrete is one of the most common and widely used construction materials. Its properties have been well studied at macro or structural level without fully understanding the properties of the cementitious materials at the micro level. The rapid development of new experimental techniques makes it possible to study the properties of cementitious materials at micro/nano-scale. Research has been conducted to study the hydration process, alkali-silicate reaction (ASR), and fly ash reactivity using nanotechnology. The better understanding of the structure and behavior of concrete at micro/nano-scale could help to improve concrete properties and prevent the illness, such as ASR.

Addition of nanoscale materials into cement could improve its performance. Nano- $SiO_2$ could significantly increase the compressive for concrete, containing large volume fly ash, at early age and improve pore size distribution by filling the pores between large fly ash and cement particles at nanoscale. The dispersion/slurry of amorphous nanosilica is used to improve segregation resistance for self-compacting concrete. It is also been reported that adding small amount of carbon nanotube (1%) by weight could increase both compressive and flexural strength.

Cracking is a major concern for many structures. University of Illinois Urbana-Champaign is working on healing polymers, which include a microencapsulated healing agent and a catalytic chemical trigger (Kuennen, 2004). When the microcapsules are broken by a crack, the healing agent is released into the crack and contact with the catalyst. The polymerization happens and bond the crack faces. The self-healing polymer could be especially applicable to fix the microcracking in bridge piers and columns. But it requires costly epoxy injection at present.

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-03-344 | Silicon Oxide Nanopowder ($SiO_2$,99+%, 20-30 nm) | Increase Compressive Strength |
| NS6130-06-680 | Industrial-grade MWNTs (>80%, OD:20-40 nm) | Increase Flexural Strength |
| NS6130-09-901 | Clay Nanopowder , >99%, 80-150nm | Increase Flexural Strength |
| NS6130-09-920 | Kaolite Nano Clay, >99%, <80nm | Increase Flexural Strength |
| NS6130-09-907 | Natural Montmorilonite Modified , >99%, <80nm | Increase Flexural Strength |
| NS6130-03-394 | $TiO_2$ Degussa, P-25 ($TiO_2$, anatase/rutile, 99+%, 300-400nm) | Increase Flexural Strength |
| NS6130-03-385 | $TiO_2$ Nano Tubes (Purity:>99%, Dia:80-100nm) | Increase Flexural Strength |


# Nano Smart Structures
## Fire Protection & Detection

Firefighters work at dangerous disaster sites where their lives are put at risk. For these firefighters, protective clothing can easily be called the most important lifesaver available to them. The fabric of such clothing is very stiff due to the high heat resistance that is demanded.

This makes it uncomfortable and not very functional to wear. We have thus far measured and analyzed the heat resistance, comfort, and functionality of protective clothing, and based on the findings, have proposed standard values for the performance of such clothing in Japan.

In an attempt to raise heat resistance, comfort, and functionality performance, attempts have been made to develop protective clothing using a variety of existing materials, but progression is currently at a dead end. The development of new protective clothing promises to protect firefighters and help them perform firefighting effectively. In an effort to spark a groundbreaking evolution in protective clothing, we are pursuing research in this area using nanotechnology, for example nanomaterials and nanocoatings.

Methods and standards for evaluating the heat resistance, comfort, and functionality demanded for nanotechnology-based protective clothing, and are planning the development of a simulation program that can predict the heat resistance of protective clothing by entering the physical parameters of the fabric from which it is made.

| Product Description | Application |
|---|---|
| Carbon nanotubes | Lightweight bulletproof vests and shirts |
| Nanofibers | Colour changing property |
| Nanofibers nano composites | Waterproof and Germ proof |
| Nanowhiskers | Cleaner kids clothes |
| Conductive Nano Fiber | Wired and Ready to Wear |
| Silver Nanopowder | Antibecterial Clothes |

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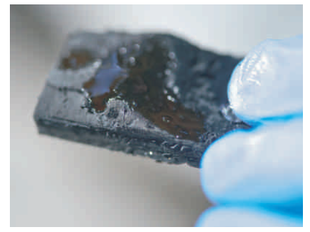
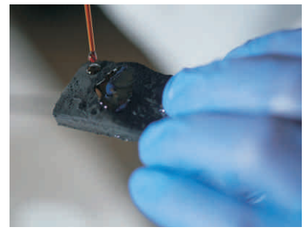
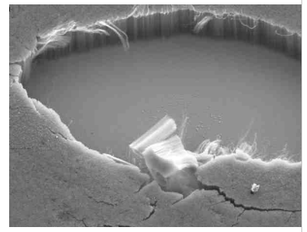
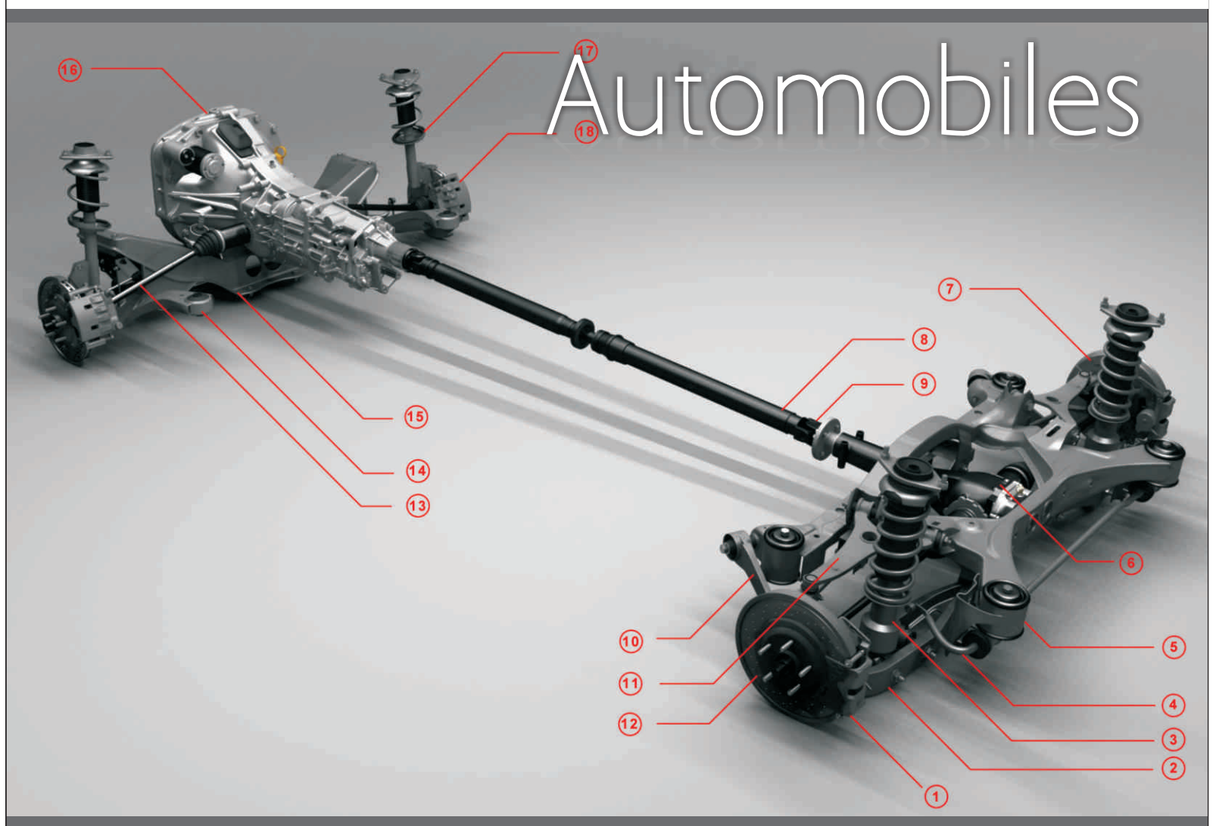
# Nano Heavy Industry









# Nano Automobiles
## Nanotechnologies in Automobiles

The demand of automobiles is increasing rapidly especially in the countries like China, India, Brazil and Korea. The rising economies of these countries will further increase the demand of automobiles. In order to achieve safety, comfort and environment friendliness, automobile companies are investing heavily in research and development. In this context, nanotechnologies are likely to play an important role. Nanotechnology is opening new doors for innovative products and imaginative applications in automobile sector.

### Nanotechnology for Car Body

**Nano Steel** - A high strength yet light weight material for car body can be produced by using Carbon Nanotubes.The small size of only five to ten nanometer of carbon nitride is responsible for this outstanding properties.

**Corrosion Protection** - Widely used Chrome III (Cr3+) does not offer long term protection. By the use of nanotechnologies it has been made possible to enhance protection by the use of SiO2 nano particles in the electrolyte. The passivation achieved through galvanization processes consists of a Cr3+ enriched layer and a layer containing SiO2 nano particles in a Cr3+ matrix.

### Nanotechnology for Chassis and Tyres

Soot and Silica are the most important chemical ingredients used for reinforcing in tyres. By using nano structured soot as filler in tyres, prolonged durability and higher fuel efficiency can be achieved. These nano structured soot particles have a coarser surface than those that have been used till date. Nano particles result in increased surface energy thereby increasing the interaction with the natural rubber molecules.

### Nanotechnology for Shell of the Car

**Scratch Resistance** - Nanotechnology holds great promise in reducing the weight of the glass by the substitution of mineral glass by polymer glass. In order to make polymer glass scratch and impact resistant , it is coated with paints having extremely hard aluminum oxide nano particles placed in the substrate matrix during the hardening process resulting in high abrasive resistance with increased impact strength.

**Ultra Thin Layers for Mirrors and Reflectors** - Fluor-organic material which exhibits both hydrophobic and oelophobic qualities when segregated on a work piece. This layer with a thickness of 5 to 10 nanometers creates a super smooth surface and has ease of cleaning water drops, oil, dust, dirt etc. It offers good dynamic friction properties and thus longer durability of the layer.

### Nanotechnology for Engine and Transmission System

**Reduction in Friction amongst Moving Parts** - Coating materials with imbedded nano crystals with a size from 60 nm to 130 nm on the basis of iron carbide and boride result in extremely high surfaces with low friction properties. Nano structure ceramics (Zircon, Alumina) or nano reinforced ceramics (Alumina + Silicon Nitride) are being extensively studied for engine jacketing. Nano crystalline ceramics like Si3N4 or SiC are also being used in ball bearings and valve springs.

**Improving Fuel Injection** - Nanocrystalline piezoelectric materials are used (Lead-Zirkone Titanate) in injectors regulating the distance which is in nanometer range.





# Nano Automobiles
## Nanotechnology: Drive of the future

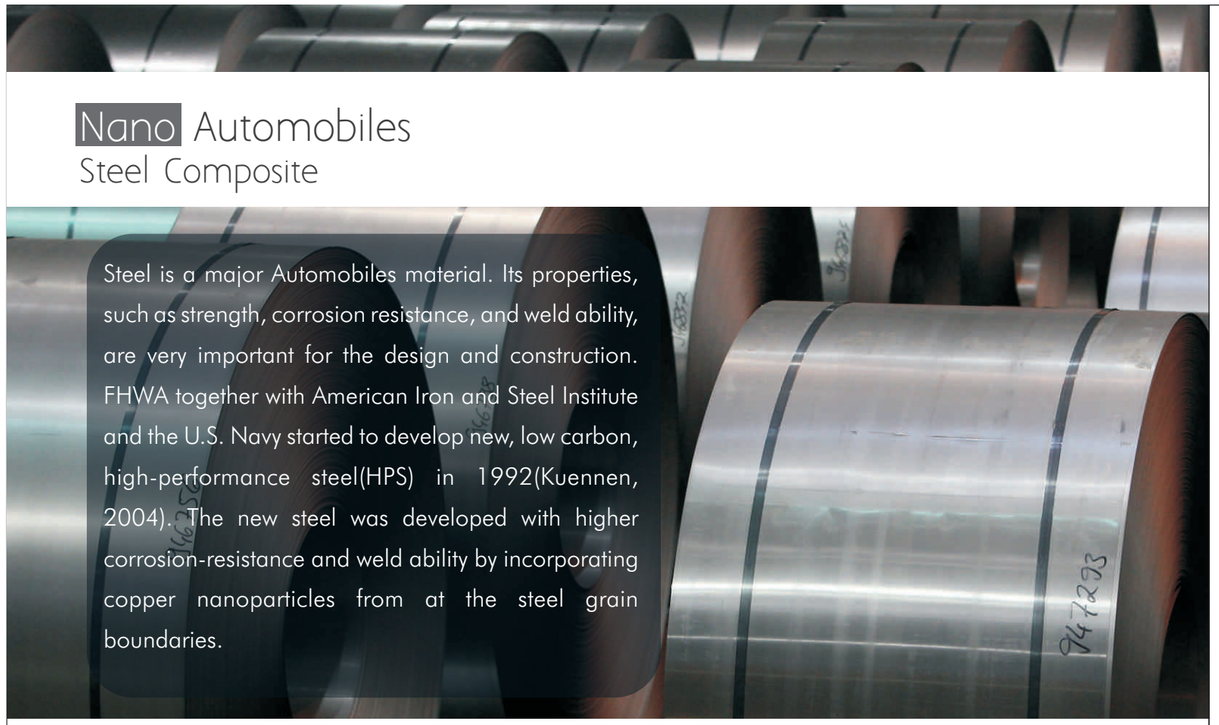
Chassis. In the same manner that the engine and its parts were made lighter, the same benefit happened in the case of the chassis. Aside from being lighter, chassis and engines were also made more durable, making them withstand daily workload on the road.

Engine and transmission systems. In contemporary cars, a large share of the vehicle's weight is due to the weight of the engine and the transmission system of the vehicle. As a result, cars are fuel-hungry because of the need to push forward such a heavy machine. Nonetheless, with the advent of alloys, engines were made lighter somewhat but not sufficient to make them fuel-efficient. The answer came with the arrival of nanotechnology. With nanotechnology, engines and parts were made a lot lighter, thus eliminating the need to consume more fuel just to power the vehicle forward.

One of the most advanced examples of nanotechnology in cars involves the production of paint that is constituted in microvolumes. The idea is to create a surface that automatically heals itself whenever it is scratched or tainted with some foreign mark. This procedure allows for the paint to release nano paint particles that automatically spreads to cover up the scratched area. It works instantly you'll hardy notice the surface was scratched at some point.

Another of the advanced applications of nanotechnology for cars involves the production of mirrors and side panels that are made out of nano particles. Being so, they filter the rays of the sun, smoke, and other pollutants in the atmosphere. The same technology allows radio and phone signals as well as sound waves to freely enter the cars so that the occupants of the vehicle will not be made oblivious to the world outside. This is beneficial for those who have some form of hearing defects; even with all the windows closed, you may still be able to hear the honking of the horn of the next car.

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-06-680 | Industrial-grade MWNTs (>80%, OD:20-40 nm) | Increase Flexural Strength |
| NS6130-03-640 | Carbon Nanotubes (MWCNT, OD: 20-30nm, 99%) | Increases Conductivity |
| NS6130-01-121 | Carbon Nanofibers (Purity: >96%, OD: 500nm) | Strength & Flexibility |
| NS6130-01-127 | Copper Nanopowder (Cu,99%, 100-250 nm, metal basis) | Automatically Healing |
| NS6130-06-637 | Electrical-grade SWCNTs (>,99%,OD:2-3nm) | Filtration at nano level |



# Nano Automobiles
## Steel Composite

Steel is a major Automobiles material. Its properties, such as strength, corrosion resistance, and weld ability, are very important for the design and construction. FHWA together with American Iron and Steel Institute and the U.S. Navy started to develop new, low carbon, high-performance steel(HPS) in 1992(Kuennen, 2004). The new steel was developed with higher corrosion-resistance and weld ability by incorporating copper nanoparticles from at the steel grain boundaries.

Sandvik Nanoflex TM is new stainless steel with ultra-high strength, good formability, and a good surface finish developed by Sandvik Nanoflex Materials Technology. Due to its high performance, Sandvik Nanoflex TM is suitable for application where requires lightweight and rigid designs. For certain applications, the components could be even thinner and lighter than that made from aluminium and titanium due to its ultra-high strength and modulus of elasticity. Its good corrosion and wear resistance can keep life-cycle costs low. Attractive or wear resistant surfaces can be achieved by various treatments (Sandvik Nanoflex Materials Technology).

MMFX2 is nanostructure-modified steel, produced by MMFX Steel Corp. Copared with the conventional steel, it has a fundamentally different microstructure- a laminated lath structure resembling “plywood”. This unique structure provides MMFX2 steel with amazing strength (three times stronger), ductility, toughness, and corrosion resistance. Due to the high cost, the stainless steel reinforcement in concrete structure is limited in high risk environments. The MMFX2 steel could be an alternative because it has the similar corrosion resistance to that of stainless steel, but at a much lower cost.

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-06-680 | Industrial-grade MWNTs (>80%, OD:20-40 nm) | Increase Flexural Strength |
| NS6130-03-640 | Carbon Nanotubes (MWCNT, OD: 20-30nm, 99%) | Increases Rate of Energy Trf |
| NS6130-01-121 | Carbon Nanofibers, Purity: >96%, OD: 500nm (MW | Increases Rate of Energy Trf |
| NS6130-01-127 | Copper Nanopowder (Cu,99%, 100-250 nm, metal basis) | Increases Rate of Energy Trf |





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# Nano ConsuMer Goods

Household | Optics | Textiles | Cosmetics | Agriculture | Sports | Nano Foods

## Nanobased Consumer Applications

# Nano Consumer Goods
## Houshold Products

Nanotechnology is already being used in various cleaning products to make your life easier and have less environmental impact.

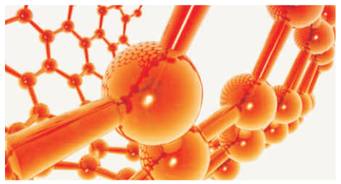
Companies are looking into using nanoparticles in soap that make it work better while producing less environmentally harmful byproducts. For example, EnviroSan Products offers a product called Solution 2000, and Nano Green Sciences produces a cleaning product called Nano Green. Both products contain organic nanoparticles, called micelles, which range in size from 1 to 4 nanometers in diameter. Several micelles bond to grease molecules, tying up all the atoms in the grease molecules that are attached to a surface, such as your countertop. After these micelles latch on, you can easily wipe away the grease molecules.

Some companies, such as AltimateEnviroCare Services and EcoActive Surfaces, are using titanium oxide nanoparticles as part of a film that uses the energy in light to kill bacteria on surfaces. Titanium oxide nanoparticles are called photocatalysts because of their capability to use energy in light to start the chemical reaction that kills the bacteria.

OxiTitan is a spray that coats a surface with zinc nanoparticles and titanium dioxide nanocrystals. This coating reacts with water in the air to break water down into oxygen and hydroxide ions. These ions then react with bacteria, viruses, volatile organic compounds, and mold, turning these organic molecules into carbon dioxide and less harmful organic molecules.

Some companies are using antibacterial materials that contain silver nanoparticles. Daido Special Steel Corporation has developed at spray called HGT Nano Silver Photocatalyst that is a combination of silver nanoparticles and titanium dioxide nanoparticles. This product performs when light is available, with the silver nanoparticles enhancing the photocatalytic performance of the titanium nanoparticles.

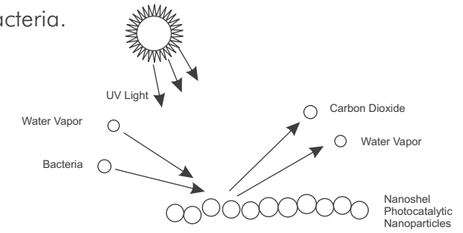
However, because silver nanoparticles kill bacteria even when light is not available, the treated surface will have antibacterial properties even in the dark. At this time, the product is available only in Japan.



A micelle Nanoparticles is an aggregate of surfactant molecules dispersed in a liquid colloid.

APS : 1-4nm

Photocatalytic nanoparticles breaking down bacteria.




Photocatalytic nanoparticles breaking down bacteria.

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-03-394 | $TiO_2$ Degussa, P-25 ($TiO_2$, anatase/rutile, 99+%, 300-400nm) | Photocatalytic Nanoparticles |
| NS6130-01-101 | Silver Nanopowder (Ag, 99%, 80-100nm) | Anti Bacterial |
| NS6130-03-362 | Zinc Oxide Nanopowder (ZnO, 99+%, 10-30 nm) | Create Micelles Bond |



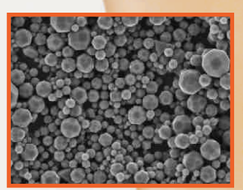
For questions, product data, or new product suggestions, please contact NANOSHEL at info@nanoshel.com

# Nano Consumer Goods
## Cosmetics & Self Care

Sunscreen contains titanium dioxide ($TiO_2$) and zinc oxide (ZnO) which block out ultraviolet light that comes from the sun. As we know, the whiter the sunscreen means the stronger it is at blocking light. But by breaking down the $TiO_2$ and ZnO to nano sized particles, the cream becomes transparent when applied to the skin allowing you to get the same amount of protection for your skin without being covered in white cream. This form of nanotechnology is also used in lotions and moisturisers.

Another common use of nanotech is using silver nanoparticles in personal care products. The silver nanoparticles are very effective at breaking down and killing bacteria. The particles are used throughout the world to maintain cleanliness in body care products such as hair brushes, tooth brushes, electric razors, hair dryers, hearing aid, foot massagers and make up instruments.

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-03-353 | Titanium Oxide Nanopowder ($TiO_2$, rutile, 99.9%, 30nm) | Block UV Rays |
| NS6130-03-361 | Zinc Oxide Nanopowder (ZnO, 99%, 35-45nm) | Block UV Rays |
| NS6130-01-103 | Silver Nanopowder (Ag, 99%, 30-50nm) | Anti Bacteria |



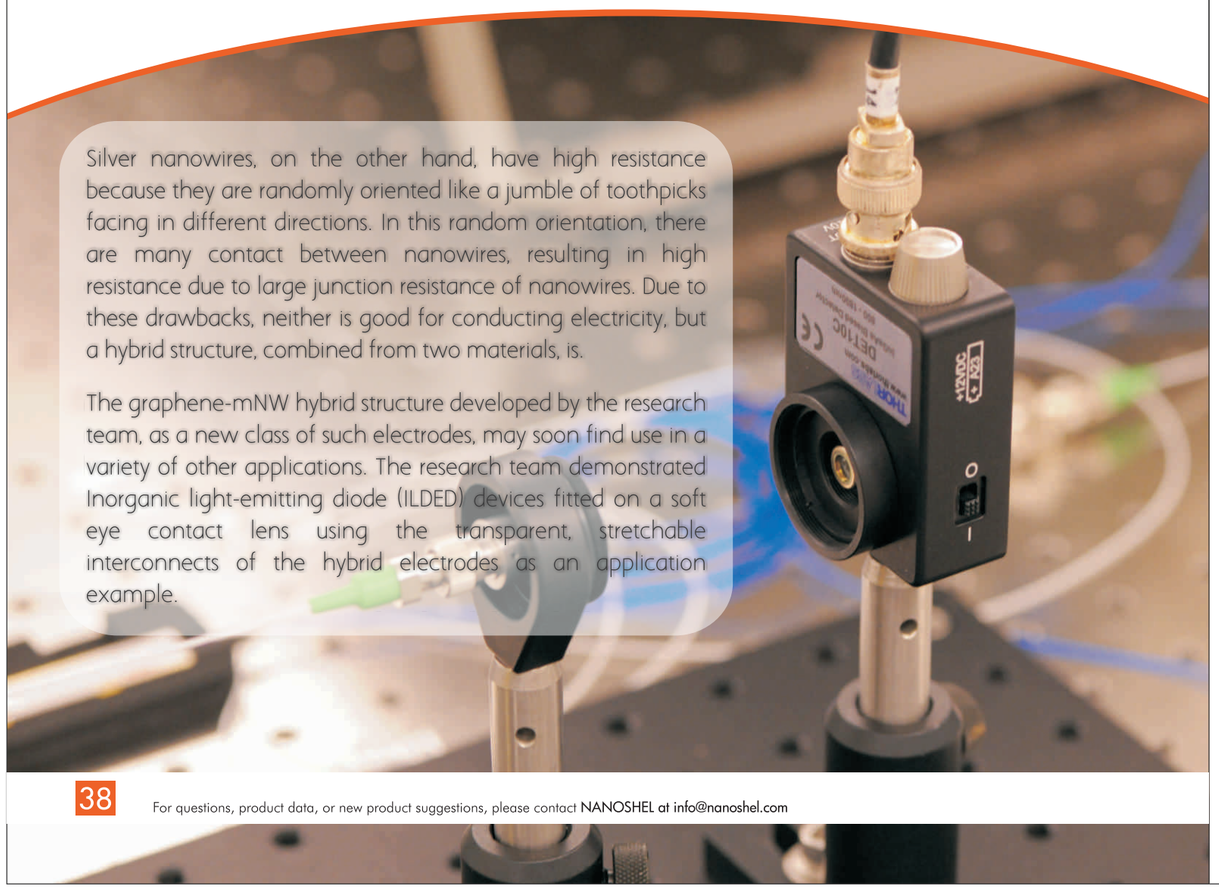
# Nano Consumer Goods
## Optics

Stretchable, transparent graphene-metal nanowire electrode: Eye contact lenses, picture-taking and scanning, possibly, a wearable black box

Transparent electrodes are in and of themselves nothing all that new - they have been widely used in things like touch screens, flat-screen TVs, solar cells and light-emitting devices. Currently transparent electrodes are commonly made from a material known as indium tin oxide(ITO). Although it suffices for its job, it's brittle, cracking and losing functionality if flexed. It also degrades over time, and is somewhat expensive due to the limited quantities of indium metal.

As an alternative, the networks of randomly distributed mNWs have been considered as promising candidates for next-generation transparent electrodes, due to their low-cost, high-speed fabrication of transparent electrodes.

Graphene is also well known as good a candidate for transparent electrode because of their unique electrical properties and high mechanical flexibility. However, scalable graphene synthesis methods for commercialization produces lower quality graphene with individual segments called grains which increases the electrical resistance at boundaries between these grains.

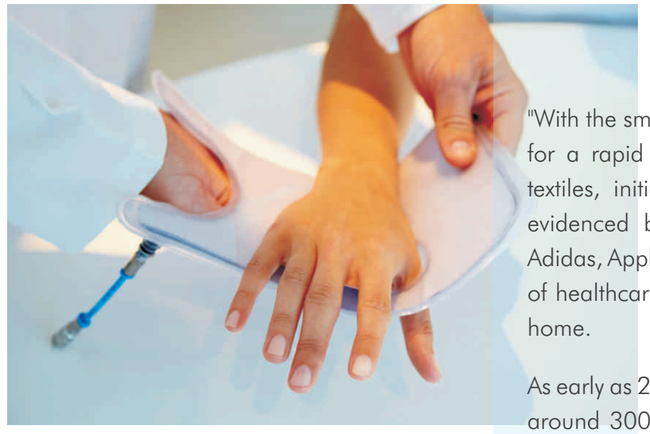


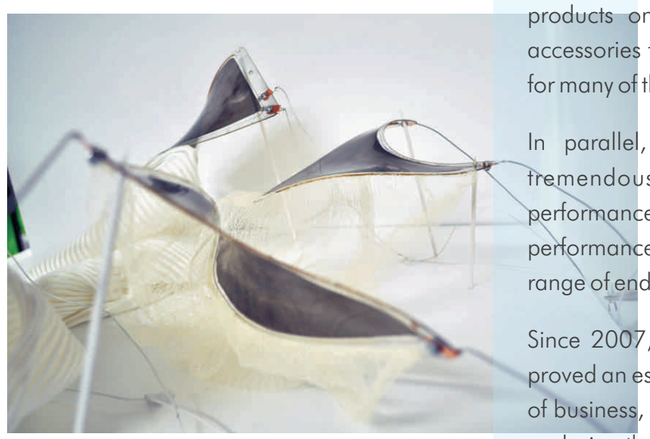
Silver nanowires, on the other hand, have high resistance because they are randomly oriented like a jumble of toothpicks facing in different directions. In this random orientation, there are many contact between nanowires, resulting in high resistance due to large junction resistance of nanowires. Due to these drawbacks, neither is good for conducting electricity, but a hybrid structure, combined from two materials, is.

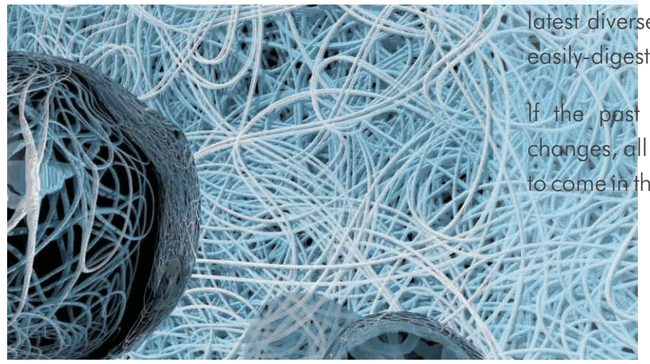
The graphene-mNW hybrid structure developed by the research team, as a new class of such electrodes, may soon find use in a variety of other applications. The research team demonstrated Inorganic light-emitting diode (ILDED) devices fitted on a soft eye contact lens using the transparent, stretchable interconnects of the hybrid electrodes as an application example.











# Nano Consumer Goods
## Textiles

"With the smart phone now ubiquitous, the scene is set for a rapid escalation of intelligent clothing and e-textiles, initially in the sports monitoring field as is evidenced by the latest products from brands like Adidas, Apple and Nikeand in the next wave in the fields of healthcare, lifestyle, transportation, energy and the home.

As early as 2016, for example, there are expected to be around 300 million body-worn wireless sensor-based products on the market, making the transfer from accessories to integrated textile components inevitable for many of them.

In parallel, nanotechnology has been making a tremendous impact on the functionality and performance of not only textiles, but virtually all performance materials, and across an equally diverse range of end-markets.

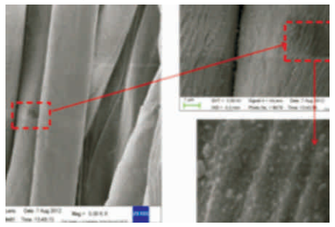
Since 2007, Smart Textiles and Nanotechnology has proved an essential guide to these fascinating new fields of business, charting all the exciting developments and exploring their implications, while bringing together the latest diverse company and product information in an easily-digested format.

If the past five years has seen some unparalleled changes, all the indications are that there is much more to come in the next five.

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-03-353 | Titanium Oxide Nanopowder ($TiO_2$, anatase/rutile, 99%, 20nm) | Block UV Rays |
| NS6130-03-361 | Zinc Oxide Nanopowder (ZnO, 99%, 35-45nm) | Block UV Rays |
| NS6130-01-103 | Silver Nanopowder (Ag, 99%, 30-50nm) | Anti Bacterial |

# Nano Consumer Goods
## Smart Conductive Textiles

Researchers has developed a technique for chemically bonding a nano-silver layer onto fibres in a textile. The step change advantage of our method is that the conductive path is applied by an additive method and can be patterned to form circuits. The silver is bound around individual fibres in each thread giving 100% coverage (Fig 1), with good adhesion and flexibility. Excellent resistivity of

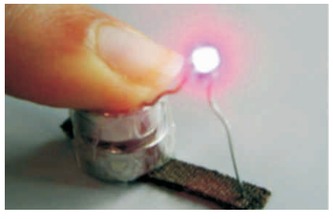


the textile has been achieved, <0.2Ω/sq. The nanosilver coated fabric can be used in a wide range of applications such as wound dressings, hygienic clothing and medical applications where the presence of bacteria is hazardous. For example, it can be used for the fabrication of face masks, surgical gloves and military uniforms where the infection of the wound can have severe effect. The high flexibility of fabric textiles allows them to be employed in the health, leisure and sports industries.

Since the conductive pattern is incorporated within the textile, it ensures that sensors are repeatedly positioned in the same location on the body. This will lead to improved accuracy of the sensor by preventing sensor misplacement.

It also adds a negligible weight and thickness to the clothes and multiple electronic circuitry patterns can be placed on a garment in a single setup. As an example, wireless wearable sensors for home monitoring of physiological data of a heart could, for instance, overcome shortcomings of currently available technology such as "Holter monitoring" and significantly improve the diagnosis and treatment of cardiovascular diseases.

In general, there is an increasing demand for wearable electronics from industries such as sport and fitness, consumer electronics, medical and healthcare, and defence applications. Manufacturing flexible and complex electronic circuitry patterns could be successfully solved by the use of this method and can be applied in the future design of intelligent clothing. This additive process permits complex circuit traces to be added to fabrics for a wide range of uses. Devices or sensors can be positioned by directly building them into fabric, which offers a novel approach for providing information routing within fabric, which is a major hurdle in electronic textile development.

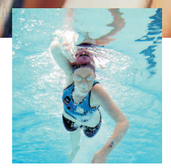


| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-01-101 | Silver Nanopowder (Ag, 99%, 80-100nm) | |
| NS6130-01-102 | Silver Nanopowder (Ag, 99%, 50-80nm) | |
| NS6130-01-103 | Silver Nanopowder (Ag, 99%, 30-50nm) | |









Swim suits that act like a coating far slicker than Teflon. The water bounce of it and swimmers can literally skim across the pool.
NS6130-09-901 Clay Nanopowder (>99+%, 80-150 nm)

Improved tennis balls that bounce longer due to an engineered nano-composite gas barrier.
NS6130-09-901 Clay Nanopowder (>99+%, 80-150 nm)

Golf ball that spin more accurately due to the shifting of weight at an atomic scale inside the ball.
NS6130-09-901 Clay Nanopowder (>99+%, 80-150 nm)

Stronger and lighter snow ski. They are now five- times stiffer because of nanotubes.
NS6130-06-640 Carbon Nanotubes (>99+%, 20-30 nm)

Lighter bikes and faster racing with bicycle handles composed of ultra-light carbon nanotubes
NS6130-06-640 Carbon Nanotubes (>99+%, 20-30 nm)


Shoe Sole won't chip or crack thanks to an extra-tough nanotech coating called fullerenes
NS6130-06-640 Carbon Nanotubes (>99+%, 20-30 nm)

# Nano Consumer Goods

## Nano Foods

Not much research is being put into the use of nanotechnology in food but there is much potential in this branch of the science. There is a lot of general speculation about how nanotechnology can be used in our food products from ways to add different flavours, to more futuristic ideas like developing foods that can change in response to your nutritional needs or taste preferences.

On the Project on Emerging Nanotechnologies list of the 609 known nano-products there are only three foods; a brand of canola cooking oil called Canola Active Oil, a tea called Nanotea and a chocolate diet shake called Nanoceuticals Slim Shake Chocolate.The company producing the canola oil, Shemen Industries of Israel, claims it contains preservatives called "nanodrops" which carry vitamins and minerals throughout the digestive system. The maker of the milkshake, RBC Life Sciences Inc of the USA, uses "nanoclusters" to enhance the taste and health benefits found in cocoa without the added sugar.

Clay nanocomposites are being used to provide an impermeable barrier to gasses such as oxygen or carbon dioxide in lightweight bottles, cartons and packaging films.

| | | |
|---|---|---|
| NS6130-09-901 | Clay Nanopowder (>99+%, 80-150 nm) | Improve Barrier Properties |

Storage bins are being produced with silver nanoparticles embedded in the plastic. The silver nanoparticles kill bacteria from any material that was previously stored in the bins, minimizing health risks from harmful bacteria.

| | | |
|---|---|---|
| NS6130-01-101 | Silver Nanopowder (Ag, 99%, 80-100 nm, metal basis) | Kill Bacteria |

Researchers are using silicate nanoparticles to provide a barrier to gasses (for example oxygen), or moisture in a plastic film used for packaging. This could reduce the possibly of food spoiling or drying out.

| | | |
|---|---|---|
| NS6130-03-344 | Silicon Oxide Nanopowder ($SiO_2$, 99+%, 20-30 nm) | Barrier to gasses |

Zinc oxide nanoparticles can be incorporated into plastic packaging to block UV rays and provide anti bacterial protection, while improving the strength and stability of the plastic film.

| | | |
|---|---|---|
| NS6130-03-361 | Zinc Oxide Nanopowder (ZnO, 99+%, 35-45 nm) | Improve Strength & Stability |

Nanosensors are being developed that can detect bacteria and other contaminates, such as salmonella, at a packaging plant. This will allow for frequent testing at a much lower cost than sending samples to a lab for analysis. This point-of-packaging testing, if conducted properly, has the potential to dramatically reduce the chance of contaminated food reaching grocery store shelves.

| | | |
|---|---|---|
| NS6130-03-352 | Titanium Oxide Nanopowder ($TiO_2$,99+%, 30 nm) | Nanosensors |





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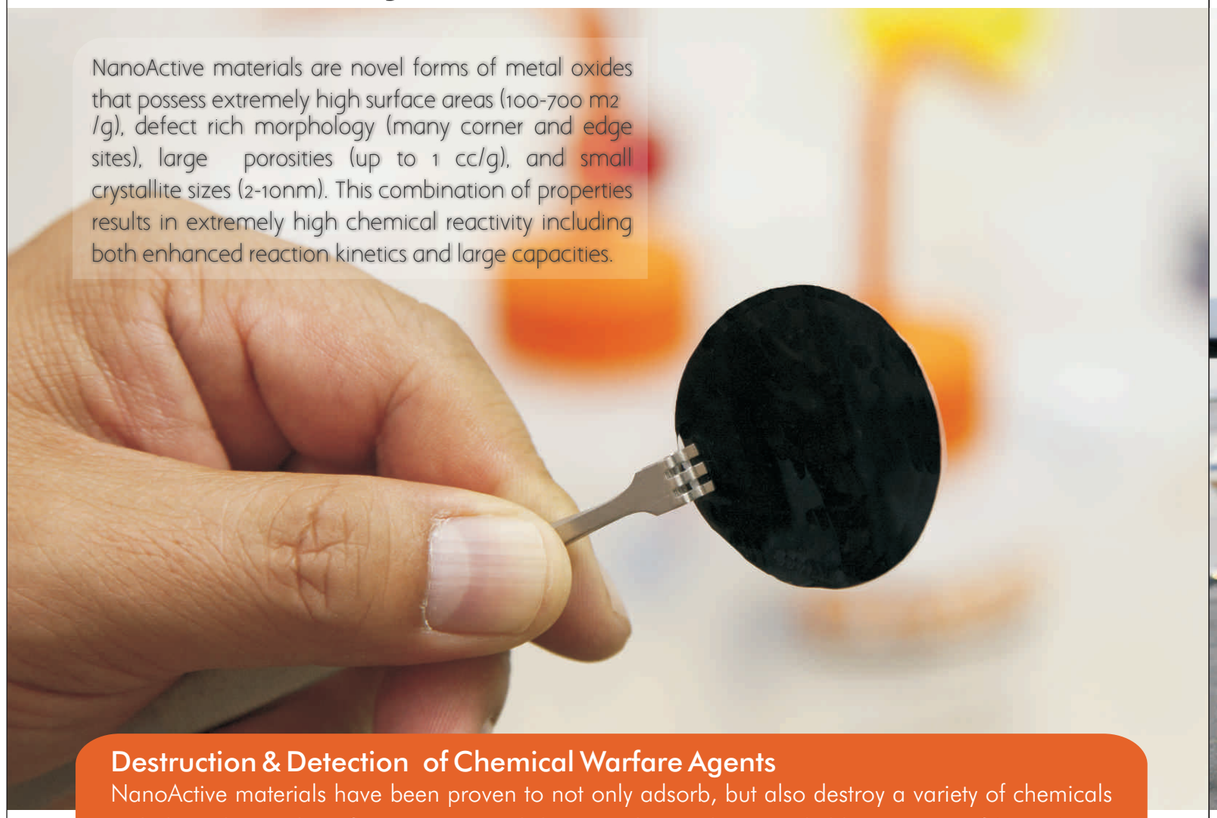
# Nano Defense & Security

Chemical Warfare Agents | Tag & Track Quarry Using Nanoparticles | Sensors for Warfare Agents

# Nanobased Consumer Applications

# Nano Defense & Security
## Chemical Warfare Agents



NanoActive materials are novel forms of metal oxides that possess extremely high surface areas (100-700 m2 /g), defect rich morphology (many corner and edge sites), large porosities (up to 1 cc/g), and small crystallite sizes (2-10nm). This combination of properties results in extremely high chemical reactivity including both enhanced reaction kinetics and large capacities.

### Destruction & Detection of Chemical Warfare Agents

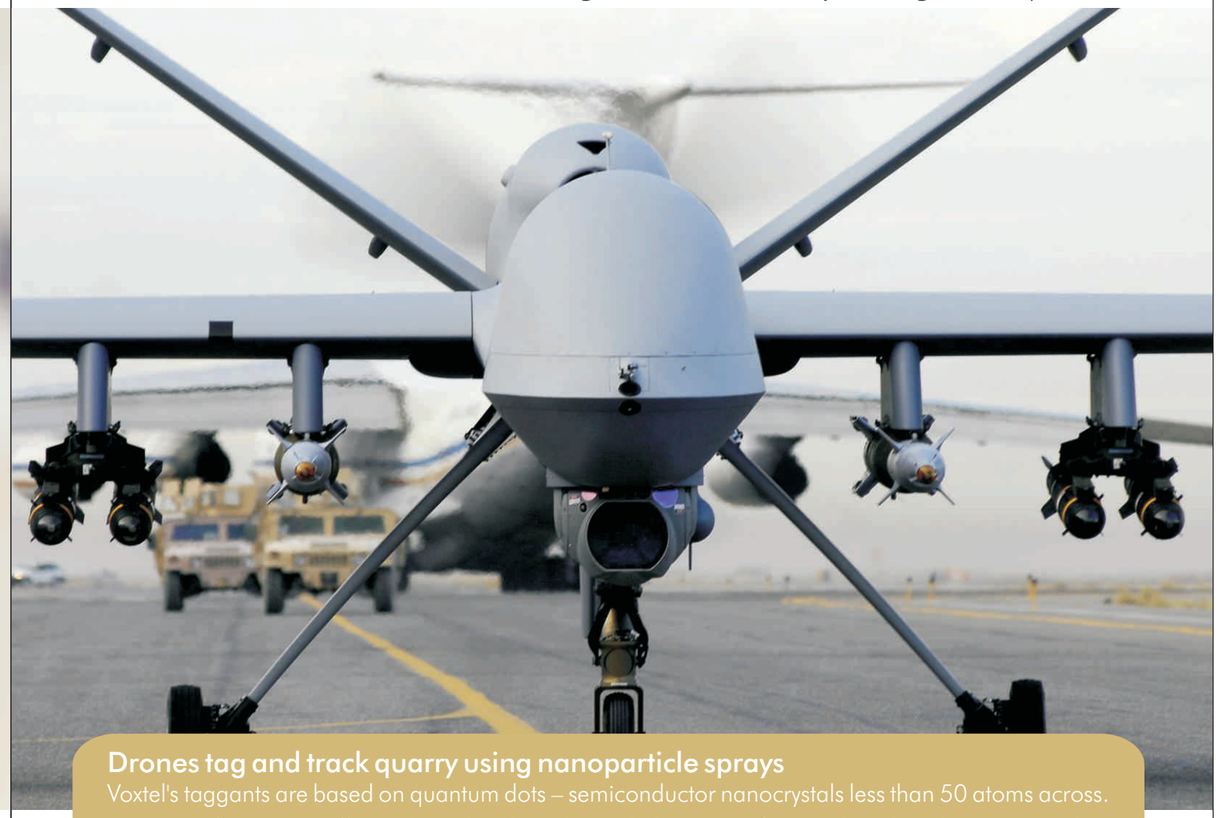
NanoActive materials have been proven to not only adsorb, but also destroy a variety of chemicals including chemical warfare agents and their simulants. The remarkable reactivity of NanoActive materials towards nerve and blistering agents and destruction below quantifiable levels, has been proven by independent testing at Battelle Memorial Institute and Edgewood Chemical and Biological Center (ECBC). Nanoshel has developed a series of reactive nanoparticles (NanoActive materials) with remarkable properties that can be applied to the U.S. defense arsenal against chemical and/or biological attack. They are based on nanocrystalline metal oxides, such as MgO, TiO2, and Al2 O3, and have been shown to be effective against a broad range of chemical agents at both ambient and high temperatures. Reactive nanoparticles, produced by Nanoshel, are non-flammable, non-toxic, and have a long storage life, are extremely light, and easy to disperse.

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-03-303 | Aluminum Oxide Nanopowder ($Al_2O_3$, gamma, 99%, 20nm) | NanoActive materials |
| NS6130-03-329 | Magnesum Oxide Nanopowder (MgO, 99.9%, 60nm) | NanoActive materials |
| NS6130-03-355 | Titanium Oxide Nanopowder($TiO_2$, rutile, 92%, 30nm) | NanoActive materials |





# Nano Defense & Security
## Tag & Track Quarry Using Nanoparticles



### Drones tag and track quarry using nanoparticle sprays

Voxtel's taggants are based on quantum dots – semiconductor nanocrystals less than 50 atoms across. Because of quantum effects, they absorb and emit light at specific wavelengths. The company has demonstrated a taggant powder that, when illuminated with an invisible ultraviolet laser, can be detected by infrared cameras 2 kilometres away. The powder is delivered as an aerosol that clings to metal, glass and cloth, and batches can be engineered to have distinct spectral signatures. The nanocrystals would be sprayed by a hand-launched drone such as the Raven (pictured). With a wingspan of less than 1.5 metres, it is quiet and has a range of several kilometres. A larger Predator

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-02-255 | Cadmium Sulphide Nanopowder (CdS, 99%, <50nm) | Semiconductor Nanocrystals |
| NS6130-02-244 | Cadmium Telluride Nanopowder (CdTe, 99%, <50nm) | Semiconductor Nanocrystals |
| NS6130-02-288 | Zinc Sulphide Nanopowder (ZnS, 99%, 30-50nm) | Semiconductor Nanocrystals |
| NS6130-01-143 | Silicon Nanopowder (Si, 98%, <50nm) | Semiconductor Nanocrystals |

# Nano Defense & Security
## Sensors for Warfare Agents


Nanosensor is a new technology of highly integrating between nanotechnology and chemical sensors. For the advantage of good stability, high sensitivity, strong anti-interference and so on, it has good application foreground in the latest filed of gaseous sample detection. In this work, a novel analytical system based on nanosensor array and probabilistic neural network (PNN) was developed to detect chemical warfare agents such as sarin and mustard gas. The array consisted of four quartz crystal microbalance with a fundamental frequency at 10MHz.

To improve the selectivity and sensitivity, four nano-membrane materials such as nano-zeolite modified with copper ion (CuZSM-5), modified carbon nano-tubes (CNT), hydrogen bond acidic fluorinated polymethyldrosiloxane (mTFPS) and polyepichloro-hydrin (PECH) were synthesized and selected as the Sensitive membrane material of chemical warfare agents. Then, a nanosensor array with these nano-film materials was developed. Combined with pattern recognition methods, a qualitative and quantitative identifying mode has been set up. The signals obtained from the array were analyzed with PNN to identify the toxic gases. The success rate of identification was 96.15%. The study integrate a variety of modern high-tech, which has novel methods and a high level of technology, an independent innovation research has been made for China's anti-chemical warfare detector technology, opening up a new generation of chemical detectors and equipment developed in new field.

| Stock Number | Product Description | Application |
|---|---|---|
| NS6130-01-127 | Copper Nanopowder (Cu, 99%, 100-250nm) | Sensitive Membrane Material |
| NS6130-06-601 | Carbon Nanotubes (SWCNT, 99%, OD 2-3nm) | Sensitive Membrane Material |
| NS6130-09-905 | Zeolite Nanopowder (99%, <80nm) | Sensitive Membrane Material |



For questions, product data, or new product suggestions, please contact NANOSHEL at info@nanoshel.com

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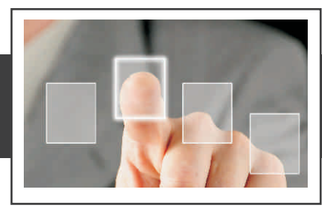
# Strategic Innovative Nano Technologies

- Shape Memory Polymer
- Shape Memory Polymer Composite
- Cooper & Nickel Foam
- Nanoshel Conductive Nanotubes (CALIB)
- Pyrolytic Graphite
- Nanoshel Monocrystalline Silicon Wafers
- Sputtering Targets
- Metal Crucibles
- Superhydrophobic Surfaces
- Nanoclays for Nanocomposite
- Nanocomposite
- Nano Filtering System
- Customized Nano Lubricants
- White Polymer Light Emitting Diodes
- Smart Nano Material in Construction Industry
- Thermal Interface Material
- Electron Microscope Metal Grids
- Silver Coated Microspheres - EMI Shielding
- Aluminium Paste
- Nano Solar Cell With Carbon Nano Tubes
- Nanotechnology Solution Abrasive Erosion



# Nanobased Innovations