EMFUTUR technologies

GENERAL CATALOG

EMFUTUR technologies

NANOTECHNOLOGY is becoming the basis of the main technological innovations of the 21st century. Research and development in this field is growing rapidly throughout the world.
A major output of this activity is the development of **new materials in the nanometer scale**, including nanoparticles.
Material properties and functionality of the bulk tend to differ significantly when one or more of its dimensions are reduced down to between **100 to 1 nm**, the so called *"nanosize range"*.

The basic classes of nanomaterials are:

- Thin films (two dimensional, or 2D)
- Nanowires / nanotubes (one dimensional, or 1D)
- Nanoparticles / quantum dots (zero dimensional, or 0D)

Nanomaterial frameworks have been focused on structural designs, synthetic methods, characterizations, size-dependent properties and their applications. A number of applications in optics, electronics, sensing, photonic, magnetism, mechanics, self-assembly, catalysis and biomedicine have been extensively researched, yet challenges remain to combine each individual property into one multi-functional nanostructure and advance its use based upon that unique property.

EMFUTUR technologies

- Is providing the highest quality supplies for these future developments.
- Is a high quality Nanomaterials supplier.
- Offers nanoparticles, nanopowders, micron powders, Graphene and CNTs (carbon nanotubes) in small quantity for researchers and in bulk order for industry groups.
- Product quality emphases the significance of purest Nanomaterials with uniform composition free of impurities for advanced research and production purposes.

With a portfolio of products targeting the needs of almost all Nanotechnology work groups, we help our customers by delivering best products with the assurance of quality.

We provide our customers with:

- **High quality nanoparticles, nanopowders and nanowires.**
- **Volume pricing.**
- **Reliable service and prices.**
- **Technical assistance.**

Our products include:

- **Carbon Nanoparticles, Nanotubes, and Fullerenes.**
- **Metal oxides nanoparticles and nanopowders.**
- **Nitrides, Carbides, Arsenides, Antimonides, Borides and Carbonates nanoparticles and nanopowders.**
- **Nanopowder mixtures of various compounds.**
- **Metal nanoparticles, nanopowders and nanowires.**
- **Quantum dots CdTe, CdSe/ZnS (core/shell), ZnCdSe/ZnS (core/shell), CdSe, ZnO.**
- **Graphenes on transparent mica and other substrates.**

Some Applications: Micro and Nano electronics, Sensors and Actuators, Energy (storage and productions), Optical devices, Biomedical and Bionic, Drug delivery, Tissue Engineering Composite Materials, Abrasives, Catalysis and Photocatalysis, Magnetic Materials, Electromagnetic Shielding, Conductive Paints, Photonic Materials, Plasmonics..

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carbon allotropes

APPLICATIONS

- FIELD EMISSION
- CONDUCTIVES PLASTICS
- ENERGY STORAGE
- ADHESIVES & CONECTORS
- MOLECULAR ELECTRONICS
- STRUCTURAL COMPOSITES
- FIBRES AND FABRICS
- CATALYST SUPPORTS
- BIOMEDICALS

Carbon (C) is the 6th most abundant element found in the universe, and it has a variety of uses in our everyday lives. It can be found in group 14 of the Periodic Table, and the atomic number of carbon is 6. Carbon has electronic configuration [He]2s22p2, and main formal oxidation state +4 (there are other oxidation states, but all use all of carbon's valence electrons in bonding).
Alongside the central role of Carbon in Organic Chemistry, it forms numerous compounds, both inorganic and organometallic.

There are two main isotopes, with relative abundances: 12C (98.9%, I=0), and 13C (1.1%, I=0.5). I is the nuclear spin, and the half-integer value of the nuclear spin for 13C gives it its usefulness in structure determination by NMR.

Carbon is one of the most stable elements known to man. Elemental carbon occurs in several different forms, ie. it displays a complex allotropy. The primary source of carbon in today's world is the deposits of coal that are mined.

There are 3 allotropes of carbon that are found naturally - graphite, diamonds, and amorphous carbon. The quality that highlights its many uses is that, **this element can combine with almost any other element and form a variety of useful compounds**. The main forms are diamond and graphite, and they exhibit markedly different properties due to the very different structures they adopt.

Diamond and Graphite comparison

- Diamond is **hardest mineral** known to man (10 on Mohs scale), but graphite is one of the softest (1- 2 on Mohs scale).
- Diamond is the ultimate **abrasive**, but graphite is a very **good lubricant**.
- Diamond is an **excellent electrical insulator**, but graphite is a **conductor of electricity**.
- Diamond is usually **transparent**, but graphite is **opaque**.
- Diamond **crystallizes in the isometric system** but graphite **crystallizes in the hexagonal system**.

Carbon Common Uses

In its elemental form, carbon may **have limited uses**. But this element has the ability to manifest itself into a very useful substance for a number of things once it combines with other elements.

Here are some of the commonly found uses of this element.

- Used as a **base for the ink** that is used in inkjet printers.
- Used in the **rims of automobiles** as a black fume pigment.
- Vegetable carbon or activated carbon, is sometimes used as a **bleaching agent, or a gas absorbent**. It is also widely used in filtration systems.
- Carbon (in the form of carbon dioxide), is also used in **fizzy drinks**, **fire extinguishers**, and also as **dry ice** when it is in a solid state.
- In metallurgy, carbon monoxide is used as a **reduction agent** in order to derive other elements and compounds.
- Carbon in the form of 'Freon', is used in **cooling devices and systems**.
- Many **metal cutters**, and heat-resistant tools and devices **are also manufactured with carbon**.
- One of the most abundantly used materials on Earth, **plastic, is produced from synthetic carbon polymers**.

carbon allotropes

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Carbon is as important for nanotechnology as silicon is for electronics, and certainly carbon nanomaterials recently become available for applications are of special interests. Among these **fullerenes, nano-graphite, carbon nanotubes and nano-diamonds**, which are characterized by different proportion of the graphite-like (sp2), diamond-like (sp3) bonds and mixed sp2/sp3 atom bonding are the most studied and found already the most technological applications.

Carbon nanotubes, whiskers, and nanofibers are not only excellent tools for studying 1D phenomena, but they are also among the most important and promising nanomaterials and nanostructures. Carbon nanotubes are already used for insulation and reinforcement of composites, and many materials and structures incorporating nanotubes are yet under development. Extensions to conical and rod-like or wire-like structures provide the scope for new discoveries and novel applications. We may find ourselves in the carbon age within less than a decade.

EMFUTUR technologies welcome this by offering a range of **Carbon allotropes Nanomaterials**

Free web resources

www.nanogloss.com
www.azonano.com
www.nanotech-now.com
www.nanowerk.com

Books

Handbook of Carbon, Graphite, Diamond and Fullerenes - Properties, Processing and Applications
Edited by: Hugh O. Pierson
Publisher: William Andrew Publishing/Noyes Copyright / Pub. Date: © 1993 ISBN: 978-0-8155-1339-1
Electronic
ISBN: 978-0-8155-1739-9 No. Pages: 399

Carbon Nanotechnology
Recent Developments in Chemistry, Physics, Materials Science and Device Applications
Edited by Liming Dai / Copyright © 2006 Elsevier B.V.
ISBN: 978-0-444-51855-2

Some Journal papers

The era of carbon allotropes
Andreas Hirsch / **Nature Materials** 9, 868–871 (2010)
doi:10.1038/nmat2885

Magnetism of the carbon allotropes
R. C. Haddon / Nature 378, 249 - 255 (1995);
doi:10.1038/378249a0

SCIENCE AND TECHNOLOGY OF THE TWENTY-FIRST CENTURY: Synthesis, Properties,and Applications of Carbon Nanotubes
Mauricio Terrones / Annu. Rev. Mater.Res. 2003. 33:419–501
doi: 10.1146/annurev.matsci.33.012802.100255

Chemical synthesis and materials applications of carbon and carbon-related materials special issue of Macromolecular Chemistry and Physics,
guest-edited Klaus Müllen and Markus Antonietti
http://onlinelibrary.wiley.com/doi/10.1002/macp.v213.10/11/issuetoc

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Carbon nanotubes

The distinctiveness of the nanotube arises from its structure and the inherent refinement in the structure, which is the helicity in the arrangement of the carbon atoms in hexagonal arrays on their surface honeycomb lattices. The helicity (local symmetry), along with the diameter (which determines the size of the repeating structural unit) introduces significant changes in the electronic density of states, and hence **provides a unique electronic character for the nanotubes**.

These novel electronic properties **create opportunity for development of a range of fascinating electronic device applications**. The other factor of importance in what determines the uniqueness in physical properties is topology, or the closed nature of individual nanotube shells; when individual layers are closed on to themselves certain aspects of the anisotropic properties of graphite disappear, **making the structure remarkably different from graphite**.

The combination of size, structure and topology endows nanotubes with important **mechanical properties** (e.g., high stability, strength and stiffness, combined with low density and elastic deformability) and with **special surface properties** (selectivity, surface chemistry), nanotubes, for the first time represent the ideal, most perfect and ordered, carbon fiber, the structure of which is entirely known at the atomic level. It is this predictability that mainly distinguishes nanotubes from other carbon fibers and puts them along with molecular fullerene species in a special category of prototype materials.

Among the nanotubes, **two varieties**, which differ in the arrangement of their graphene cylinders, share the limelight. **Multi-Walled NanoTubes (MWNT)**, are collections of several concentric graphe-ne cylinders and are larger structures compared to **Single-Walled NanoTubes (SWNTs)** which are individual cylinders of 1–2 nm diameter. The former can be considered as a mesoscale graphite system, whereas the latter is truly a single large molecule. However, SWNTs also show a strong tendency to bundle up into ropes, consisting of aggregates of several tens of individual tubes organized into a one-dimensional triangular lattice. One point to note is that in most applications, although the individual nanotubes should have the most appealing properties, one has to deal with the behavior of the aggregates (MWNT or SWNT ropes), as produced in actual samples.

Owing to their electronic, mechanical, optical, and chemical characteristics, carbon nanotubes attract a good deal of attention from physicists, chemists, biologists, and scientists from other fields. Possible applications in the fields of molecular electronics, nanomechanic devices, information display, sensors, energy storage, and composite materials are of interest for industry. Since their discovery in 1991, several demonstrations have suggested potential applications of nanotubes. These include the use of nanotubes as electron field emitters for vacuum microelectronic devices, individual MWNTs and SWNTs attached to the end of an Atomic Force Microscope (AFM) tip for use as nanoprobe, MWNTs as efficient supports in heterogeneous catalysis and as microelectrodes in electrochemical reactions, and SWNTs as good media for lithium and hydrogen storage. The lack of availability of bulk amounts of well-defined samples and the lack of knowledge about organizing and manipulating objects such as nanotubes (due to their sub-micron sizes) have hindered progress in developing applications. The last few years, however, have seen important breakthroughs that have resulted in the availability of nearly uniform bulk samples. There still remains a strong need for better control in purifying and manipulating nanotubes, especially through generalized approaches.

Products: MWCNT, SWCNT, Industrial CNT, MWCNT Dispersed

APPLICATIONS

- REFRACTORY MATERIALS
- CHEMICAL INDUSTRY
- ELECTRICAL APPLICATIONS
- METALLURGY
- COATINGS
- LUBRICANTS
- PAINT PRODUCTION
- GRINDING WHEELS
- AEROSPACE APPLICATIONS

When you write with a pencil, the marking is created by these sheets sliding off and settling onto the paper. Graphite has been used since the 15th century, but today the applications of graphite have far surpassed use as a writing tool. Graphite is made of extremely strong fibers composed of series of stacked parallel layer sheets. Graphite is black and lustrous, optically opaque, unaffected by weathering, with a pronounced softness graded lower than talc.
Its greasy friction-resistant properties allow for applications in lubricating oils and greases, dry-film lubricants, batteries, conductive coatings, electrical brushes, carbon additives and paints.

Graphite represents a typical layered polymeric crystal and each fullerene can be considered as a molecule which can form molecular crystals (fullerites).

In graphite each carbon atom is covalently bonded to three carbon atoms to give trigonal geometry. Bond angle in graphite is 120oC. Each carbon atom in graphite is sp2 hybridized. Three out of four valence electrons of each carbon atom are used in bond formation with three other carbon atoms while the fourth electron is free to move in the structure of graphite.

Basic trigonal units unite together to give basic hexagonal ring. In hexagonal ring C-C bond length is 1.42 Angstrom. In graphite these rings form flat layers. These layers are arranged in parallel, one above the other. These layers are 3.35 Angstrom apart and are held together by weak van der Waals forces only. These layers can slide over one another. Thus it is very soft. Fourth electron of each carbon atom forms delocalized p-bonds which spread uniformly over all carbon atoms. Due to this reason graphite conducts electricity in the direction parallel to its planes.

Products:

- Graphene nanoplatelets
- Graphene ink
- Graphene oxide
- Graphene films

EM nanoparticles

NANOMATERIALS

- METAL NANOPARTICLES
- METAL OXIDE NANOPARTICLES
- NITRIDES
- CARBIDES
- SILICON NANOPARTICLES
- GALLIUM ARSENIDE
- GALLIUM ANTIMONITE
- TITANIUM BORIDE
- TITANIUM CARBONITRIDE
- NANOBLENDS

Nanotechnology, nanoscience, nanostructure, nanoparticles are now widely used words not only in scientific literature but also in everyday life. Nanoscale materials are very attractive for possible machine, which will be able to travel through the human body and repair damaged tissues or supercomputers which small enough to fit in shirt pocket

Nanostructured materials have potentials application in various areas, such as biological detection, controlled drug delivery, low-threshold laser, optical filters, and sensors, and may others. Metal nanoparticles have been used a long time ago. Recent analyses revealed that nanoparticles are the secret of Damascus steel which used to make sword and Glass Lycurgus Cup which has unique color... It is like just unintentionally were developed technique to produce nano-objects and use their unique properties. After the modern device developed to analyzed material in nanoscale, scientists can prove nanotechnology has been developed and become an exciting subject for science today.

Characterization results can be seen at http://www.sciencedirect.com/science/article/pii/S0925838803011277

Blades made from Damascus steel were produced from about 500 AD in Damascus. It became renowned because its extreme strength, its sharpness its resilience and the beauty of their characteristic surface pattern. The fascinating legend tells that it can cut clean through rock and still remain sharp enough to cut through a silk scarf dropped on the blade. Many scientists try to disclose these special properties and encounter multiwalled carbon nanotube in steel.

Another famous example is the famous Glass Lycurgus Cup from the Romans times (4th century AD). Modern analytic techniques revealed that it contains silver and gold nanoparticles in approximate ratio 7:3 which have size diameter about 70 nm. The presence of these metal nanoparticles gives special color display for the glass. When viewed in reflected light, for example in daylight, it appears green. However, when a light is shone into the cup and transmitted through the glass, it appears red. This glass can still be seen in British museum.

The Lycurgus Cup 1958,1202.1 in reflected and transmitted light. Scene showing Lycurgus being enmeshed by Ambrosia, now transformed into a vine-shoot. Department of Prehistory and Europe, The British Museum. Height: 16.5 cm (with modern metal mounts), diameter: 13.2 cm. © The Trustees of the British Museum

Nanoparticles (1-200nm) have unique electronic, optical, and catalytic properties. Their properties are connected also to the preparation method to control the shape and size of nanoparticles, provide exciting building blocks for nanoscaled assemblies, structure, and devices. Miniaturization of structures by mechanic methods and electron-beam lithography is reaching the theoretical limits of about 50 nm. For further miniaturization of chemical object, alternative approaches must be developed and also to find the applications.

* Please ask for Custom Manufacturing Nanoparticles : **mail@emfutur.com**

EM quantum dots

In the large family of nanomaterials, the 0D materials are important building blocks of novel artificial materials with huge technologic impact in an broaden number of area of applications. 0D materials are tiny parts of the matter with size in nanometer scale in all three space directions. Atom clusters and clusters of atomic clusters can be considered zero-dimensional nanostructures.

APPLICATIONS

- COLORS IN STAINED GLASSES
- COMPOSITES
- LASER DIIODES
- LED'S
- OPTICAL DEVICES
- ABSORBER MIRRORS
- PHOTOVOLTAICS
- NANOPHOTONICS
- BIOLOGICAL LABELS
- PHOTODETECTORS

The importance of the nanometer scale comes from the fact that in this range of dimensions the materials properties change significantly from those at larger scales. This is the size scale where so-called quantum effects rule the behavior and properties of particles. Properties of materials are size-dependent in this scale range. When particle size is made to be nanoscale, properties such as melting point, fluorescence, electrical conductivity, magnetic permeability, and chemical reactivity change as a function of the size of the particle..

Quantum Dots are 0D structures confining charge carriers in three dimensions. The carrier confinement is a quantum effect. It totally changes the density of states for the confined particles, compared with the density of states for particles in a larger piece of the material. For an ideal isolated Quantum Dot, there are discrete energy levels, corresponding to a delta-shaped density of states with no states in between the delta peaks. This behavior is known from atoms; in this sense, Quantum Dots can be considered as a kind of artificial atoms where the energy levels can be adjusted by design. There are two ways to do that: by controlling the quantum dot dimensions or the material composition. In reality, large ensembles of quantum dots are normally used, and their size distribution leads to a broadening of density of states distribution, i.e. to inhomogeneous broadening.

Quantum Dots can be fabricated from certain semiconductors. They have an extremely narrow emission spectrum that is directly connected with the particles size. The smaller the particle the more its emission is blue shifted and conversely the larger the particle size, the more its emission is red shifted, thus allowing for the emission of the complete visible light spectra from the same material.

Quantum dots are useful for a large number of applications:

- The oldest application of quantum dots is the achievement of beautiful colors in stained glasses.
- Quantum dots have found applications in composites.
- Quantum dots make possible the fabrication of laser diodes with very low threshold pump power and/or low temperature sensitivity.
- Quantum dots can be used in white light-emitting diodes (LEDs): they are excited with a blue or near-ultraviolet LED and emit e.g. red and green light (acting as a kind of phosphor), so that overall a white color tone is achieved.

Free web sources:
http://www.sciencedaily.com/releases/2012/05/120508173349.htm
http://ce.sysu.edu.cn/mzw/Publications/p2011/15664.html
http://www.materialstoday.com/search/default.aspx?query=quantum%20dots
http://decodedscience.com/novel-developments-for-semiconductor-quantum-dots/2969
http://www.technologyreview.com/news/422857/the-first-full-color-display-with-quantum-dots/

APPLICATIONS

- MICROELECTRONICS
- SOLAR CELLS
- COMPOSITES
- SENSORS
- OPTICAL DEVICES
- FERROMAGNETIC
- CELL MANIPULATION
- NANOPHOTONICS
- ANTIFUNGAL
- FLEXIBLE DEVICES

Among the nanomaterials, particularly the 1D-materials are highly desirable, as their geometric shape and high surface area impart high functionally. Nanowires are considered as building blocks for the next generation of electronics, photonics, sensors and energy applications.

One-dimensional nanostructures offer unique opportunities to control the density of states of semiconductors, and in turn their electronic and optical properties. Nanowires allow the growth of axial heterostructures without the constraints of lattice mismatch. This provides flexibility to create heterostructures of a broad range of materials and allows integration of compound semiconductor based optoelectronic devices with silicon based microelectronics.

For example, metal nanowires are likely to become an integral part of future nanodevices, at least as the elements interconnecting the functional components such as nano-transistors.

Additional to the provision of electrical connection to nano-circuits, the metal nanowires are expected to be utilized as the functional components in various applications ranging from high density perpendicular data storage to nano-sensors, from high-sensitivity nano-electrodes to metamaterials, and so on.

Nanowires are widely studied and the number of papers published in the field is growing exponentially with time. Already nanowire lasers, nanowire transistors, nanowire light emitting diodes, nanowire sensors and nanowire solar cells have been demonstrated.

EMFUTUR Technologies anticipate the market needs in this innovative direction providing high quality NANOWIRES

Some free web references:

http://www.intechopen.com/subjects/nanotechnology-and-nanomaterials/books/all

http://www.intechopen.com/books/nanowires-implementations-and-applications

http://pubs.rsc.org/en/content/ebook/978-1-84973-058-7

Products: Cobalt, Nickel, Silver, ..

nano-micro salts

APPLICATIONS
- STEEL MANUFACTURING
- MEDICINES
- HEALTH CARE
- DRIERS
- FUEL CELL APPLICATIONS
- PHARMACEUTICALS
- ELECTROPLATING
- CERAMICS
- CASTALYST

In chemistry, salts are ionic compounds that result from the neutralization reaction of an acid and a base. They are composed of cations (positively charged ions) and anions (negative ions) so that the product is electrically neutral (without a net charge). These component ions can be inorganic such as chloride (Cl−), as well as organic such as acetate (CH3COO−) and monatomic ions such as fluoride (F−), as well as polyatomic ions such as sulfate (SO42−).

There are several varieties of salts. Salts that hydrolyze to produce hydroxide ions when dissolved in water are basic salts and salts that hydrolyze to produce hydronium ions in water are acid salts. Neutral salts are those that are neither acid nor basic salts. Ionic compounds can be dissolved in water or other similar solvents. The exact combination of ions involved makes each compound have a unique solubility in any solvent. The solubility is dependent upon how well each ion interacts with the solvent, so there are certain patterns. For example, all salts of sodium, potassium and ammonium are soluble in water, as are all nitrates and many sulfate salts except barium sulfate, calcium sulfate (scarcely soluble) and Lead(II)sulfate. On the other hand, ions that bind strongly to each other forming highly stable lattices are less soluble, because it would be harder for these structures to break apart for the compounds to dissolve. For instance, most carbonate salts are not soluble in water. A carbonate is a compound that contains the CO32- ion. Inorganic carbonates are ionic compounds that combine metal cations with the carbonate ion.

Here are just a few examples of carbonates and their end-uses (there are hundreds!): **Limestone** (CaCO3) is used in refining iron ore and manufacturing steel, making agricultural lime, making cement, in scrubbers that remove sulfur from flue gases, and the manufacture of soda ash.
Manganese carbonate (MnCO3) is widely used as additive to plant fertilizers to cure manganese deficient crops, health care, medicine and foods, ceramics as a glaze colorant and flux, and in concrete stains, pigments, catalyst, drier, mechanical parts, phosphates processing, solid oxide fuel cell applications, solid-state synthesis of lanthanum strontium manganite, raw material for synthetic MnO2.
Soda ash (Na2CO3), or sodium carbonate, is used in the manufacture of glass, paper, rayon, soaps, and detergents. It is also used as a water softener, since carbonate can precipitate the calcium and magnesium ions present in "hard" water. Soda ash is also used to control pH (carbonate solutions neutralize acids, producing only carbon dioxide and water). Sodium carbonate is used in the chemical industry to synthesize many different sodium compounds, including sodium bicarbonate (baking soda), sodium silicate (used in detergents), sodium tripolyphosphate (a detergent builder), sodium hydroxide (lye), sodium chromate and sodium dichromate (used in chrome plating), sodium aluminate (used in refining aluminum), and sodium cyanide (for electroplating).
Potash (K2CO3), or potassium carbonate, is used in the manufacture of glass. Lithium carbonate (Li2CO3) is used in the production of glasses, ceramics, pharmaceuticals, and aluminum.
Strontium carbonate (SrCO3) is used to manufacture CRT tubes for televisions and computers. It also is used in red fireworks.

Nickel carbonate (NiCO3) is used in electroplating and in the manufacture of ceramics. Cobalt carbonate (CoCO3) is used as a catalyst in the refining industry, as a ceramic pigment, and as a mineral supplement for livestock.

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Beyond the future

carbon allotropes

Carbon Nanotubes (Multiwalled, Single Walled, Double, Short,..)
Fullerenes C60, C70, ..
Graphite
Graphene nanoplatelets
Monolayer graphene layer
Graphene oxide
Reduced graphene oxide
Carbon Black

APPLICATIONS
Field Emission
Conductive plastics
Energy storage
Thermal materials
Fibers and Fabrics
Biomedical
Orthopedic prostheses
Refractory materials
Lubricants
Aerospace applications

nanowires

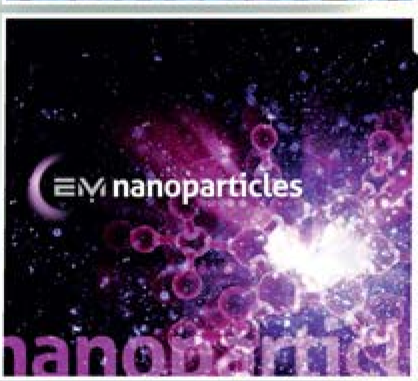
Cobalt
Nickel
Copper
Silver
Titanium
Aluminum
Gold
Lead Zirconate Titanate
Lead Titanate
Manganese Oxide / Vanadium Oxide / Tungsten Oxide

APPLICATIONS
Microelectronics
Solar Cells
Composites
Sensors
Optical devices
Ferromagnetic
Catalysis
Cell manipulation
Antifungal
Flexible devices

quantum dots

CdTe
CdSe/ZnS
ZnCdSeS
ZnO
ZnCuInS/ZnS
ZnCdSe/ZnS

APPLICATIONS
Colors in stained glasses
Composites
Laser diodes
Led's
Optical devices
Absorber Mirrors
Photovoltaics



nanoparticles

Carbides
Metal Nanoparticles
Metal oxide nanoparticles
Nanoblends
Nitrides
Silicon Nanoparticles
Titanium Boride
Titanium Carbonitride
Gallium Antimonide / Arsenide

APPLICATIONS
Colors in stained glasses
Composites
Laser diodes
Led's
Optical devices
Absorber Mirrors
Photovoltaics

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