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A Study on Green Nanotechnology in Automobiles

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ABSTRACT
Green engineering is the commercialization, design, processes, and products which are economically feasible. It decreases pollution at the source and decreases the danger to environment and human health. It enfolds the method to save human health and environment with large impact and cost effectiveness and process development of product.

The nanotechnology is also defined like a general-purpose technology because of its mature form. It provides longer lasting, built, safer, cleaner, and smarter items available for home, medicine, communications, transportation, industry, and agriculture. The nanotech provides high efficiency like electricity and computers in all aspect of life. The general-purpose technology has many commercial and military purposes like surveillance tools and weapons. The green nanotechnology is the developed clean technologies. It decreases risks to the environment and human health with the nanotechnology products and stimulates products with new nano-products.

KEYWORDS: *Nanotechnology, Green Engineering, Automobiles, Green Nanotechnology*

INTRODUCTION

GREEN ENGINEERING:

Green Engineering is the design, commercialization and use of processes and products that are feasible and economical while:

- Reducing the generation of pollution at the source.
- Minimizing the risk to human health and the environment.
- Green engineering embraces the concept that decisions to protect human health and the environment can have the greatest impact and cost effectiveness when applied early to the design and development phase of a process or product.

NANOTECHNOLOGY

Nanotechnology is the engineering of functional systems at the molecular scale. This covers current work and concepts that are more advanced. In its original sense, nanotechnology refers to the projected ability to construct items from the bottom up, using techniques and tools being developed today to make complete, highly advanced products. Nanotechnology is often referred to as a general-purpose technology. That's because in its mature form it will have significant impact on almost all industries and all areas of society. It offers better built, longer lasting, cleaner, safer, and smarter products for the home, for communications, for medicine, for transportation, for agriculture, and for industry in general. Like electricity or computers before it, nanotech will offer greatly improved efficiency in almost every facet of life.

Like electricity or computers before it, nanotech will offer greatly improved efficiency in almost every facet of life. But as a general-purpose technology, it will be dual-use, meaning it will have many commercial uses and it also will have many military uses -- making far more powerful weapons and tools of surveillance. Thus, it represents not only wonderful benefits for humanity, but also grave risks.

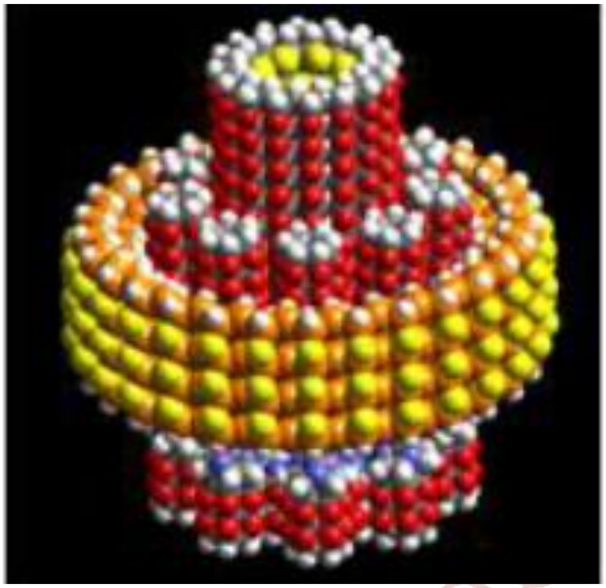

Figure 1

A key understanding of nanotechnology is that it offers not just better products, but a vastly improved means of production. A computer can make copies of data files essentially as many copies as you want at little or no cost. It may be only a matter of time until the manufacture of products becomes as cheap as the copying not only will allow making many high-quality products at very low cost, but it will allow making new nano factories at the same low cost and at the speed.

It represents a manufacturing system that will be able to make more manufacturing systems -- factories that can build factories -- rapidly, cheaply, and cleanly. The means of production will be able to reproduce exponentially, so in just a few weeks a few nano factories conceivably could become billions. It is a revolutionary, transformative, powerful, and potentially very dangerous -- or beneficial – technology.

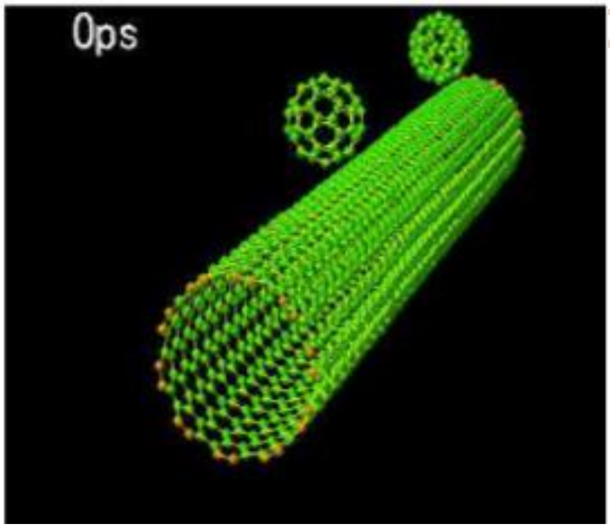

Figure 2

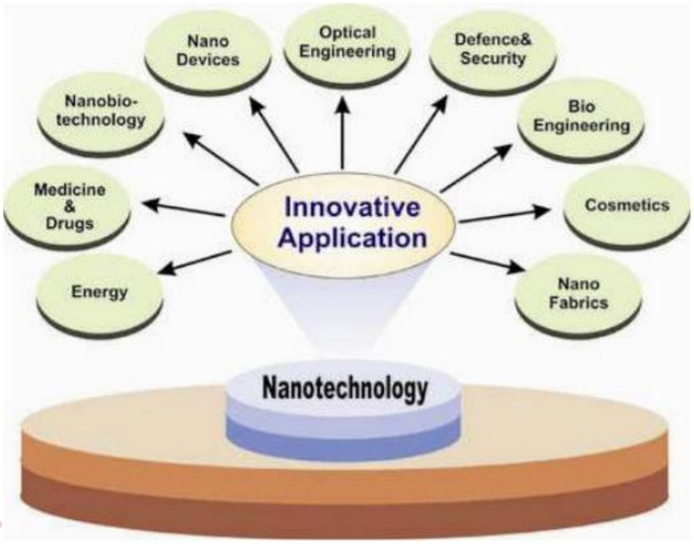

Figure 3

It is important to recognize some unique features about nanotechnology. First, it is the amalgamation of knowledge from chemistry, physics, biology, materials science, and various engineering fields. It epitomizes the concept of the whole being greater than the sum of theparts. Second, nanoscale science and engineering span different scales. Nanostructures and nanoscale phenomena are generally embedded in micro- and macrostructures, and their interactions are important. The connection between scales —nano to micro to macro—is also a critical aspect of integration.

GREEN NANOTECHNOLOGY

Green nanotechnology is the development of clean technologies, “to minimize potential environmental and human health risks associated with the manufacture and use of nanotechnology products, and to encourage replacement of existing products with new nano-products that are more environmentally friendly throughout their lifecycle.”

With automotive manufacturers striving to match stricter emission norms set by regulatory authorities, they have begun considering nanotechnology as a necessity. With precise structuring and exceptional physical and mechanical properties, nanomaterials-based products have the potential to redefine energy and materials applications. “Their ability to replace expensive platinum in fuel cells that are more environment-friendly than regular gasoline cars, are expected to act in their favour,” said a study from Frost and Sullivan. Take for instance NanoLub, a lubricant developed based on compounds discovered at the Weizmann Institute of Science, Israel, had nano-spheres and nanotubes of inorganic compounds. The particles have a unique structure of nested spheres that lubricate by a special mechanism greatly reducing friction and wear.

Our goals are to implement the principles of green nano-science to:

(1) Design environmentally benign nanoparticles, test for putative toxicity and redesign as necessary; we are developing methods to prepare libraries of functionalized metal nanoparticles in which the size, shape and functionality can be widely varied. We will study the accumulation of nanoparticles within organisms and the impacts of these nanoparticles on viability, gene expression and development. These data will be used to guide the development of more benign nanoparticles for a wide range of applications. The surface of these nanoparticles will be modified which will direct self-assembly, tune electronic or optical coupling, and further enhance the biologically safety of these nanoparticles.

(2) Develop greener methods for large-scale nanoparticle production through green nano-manufacturing technologies; we will identify acceptable nanoparticle formation reactions that can be carried out in a single solvent phase and that will permit control of particle size. From these studies we will scale up production and develop an integrated micro-reactor platform for deploying the single solvent phase chemistries. We are also exploring gas-phase production of ceramic nanoparticles in micro-reactors to produce materials that should expand our capabilities to produce novel devices for sensors and medicine.

(3) Discover efficient approaches for using nanoparticles in the development of novel nano-devices; Nanomaterials are driving innovation in optical and electronic devices, however, realizing the full potential of nanoscale matter in device technologies requires the integration of the nanoscale building blocks with other components of the device. Nanostructures can also be important precursors in the low-cost and greener manufacture of more traditional micro scale devices and to exotic new materials. Thus, developing environmentally-benign assembly methods and identifying approaches to interface nanomaterials with macroscopic structures are being explored to produce greener, high- performance devices and nanostructured materials.

A marriage of nanotechnology with green engineering serves two important purposes.

First, emerging nanotechnologies could be made clean from start. It would be foolhardy to develop a new nanotechnology infrastructure from an old industrial model that would generate another set of environmental problems. While nanotechnology will never be as green as Mother Nature, approaching a new nano approach to the technology 's development ultimately promises to shift society into a new paradigm that is proactive, rather than reactive, when it comes to environmental problems.

Second, green technologies that benefit the environment could use nanotechnology to boost performance. In other words, nanotechnology could help us make every atom count-for example, by allowing us to create ultra efficient catalysts, detoxify wastes, assemble useful molecular machines and efficiently convert sunlight to energy. It could potentially contribute for long term sustainability for future generations, as more green products and processes replace the old harmful and wasteful ones.

Figure 4 A huge amount of research and development activity has been devoted to nano-scale related technologies in recent years. The National Science Foundation projects nanotechnology related products will become a $1 trillion industry by 2015 [1].

Objectives:
1. Define the Mechanical Engineering In Nanotechnology
2. Study on Nanoparticle Thermal materials
3. Displays Using nanotechnology

Review of Literature:
Today, Nanotechnology has opened new doors for automotive sectors. The entire product lifecycle management can be mounted on the automation of this technology. Besides being promisingly sustainable, safe, comfortable, and ecofriendly, it is also commercially economical technology. CO2-free engines, safe driving, quiet cars, self-cleaning body, and windscreens etc. can be the key drivers for the idea of "nano in cars" to come alive [2]. Nanotechnology explicitly presents new opportunities

for worldwide accomplishments of automobiles. This technology is not only finding its way into every corner of car-world but is also bringing great benefits. Fundamentally, two main approaches are used in nanotechnology. Firstly, the "bottom-up" approach, where nano-objects are created by assembling individual atoms together, thus is reducing the randomness in structural formation. Secondly, the "top-down" approach, where nanoobjects are built from larger units without atomic level control. Reports show that nanotechnology is advancing as a core technology for automotive development. Many authors have emphasized on the use of nanocomposites in several domains like frames and body parts, engines, paints and coatings, suspension and breaking systems, lubrication, tires, exhaust systems, etc.

In addition, they may improve manufacturing speed and enhance environmental, thermal, and mechanical stability [3]. This means that car bodies will undergo less wear, better gliding, thinner coating, fewer lubrication, longer service intervals, and weight reduction. Lighter car bodies will use less material, without compromising the stiffness and crash resistance and will indirectly save fuel profoundly. This will also ensure greater safety and improved highway systems.

Nowadays nanotechnology is blended with many pronounced disciplines to obtain exemplary products. One such technological breakthrough is the MEMS technology. In fact, automotive components need to be produced in very large volumes not only to meet the demand, but also to meet the necessity of recovering the initial investments. MEMS ought to be a crucial solution for this setback. Due to the progress made in batch manufacturing of MEMS, large volumes of highly uniform devices can be created at relatively low cost [4].

The potential to commercialise nanotechnology for green innovation has become a particular focus of interest in recent years as nanotechnology research is beginning to be used in multiple concrete applications. With the growing potential of the technology, and in the face of urgent environmental challenges, strategies and investment in nanotechnology have moved from being science-driven to being more application- and challenge-driven, focusing on how technologies, and nanotechnology in particular, could help to address some major national and global challenges. This challenge-driven tendency is apparent in both OECD countries and emerging economies.9 The evolving policy landscape of most countries reflects a shift in focus from a concentration on funding basic research towards initiatives focused on improving the links between research and development for nanotechnology, for example stimulating technology transfer and demonstration projects. [5]

Research Methodology:

This literature study aims to provide an analysis of the state-of-the-art research into green nanotechnology in automobiles concerning the environment, health and safety concerns. A thorough and extensive literature search can provide useful information regarding the basic knowledge about safer and green nanotechnology in Automobile and indicate future research directions.

Result and Discussion:

The Role of Mechanical Engineering In Nanotechnology

Itis fair to ask what the role of mechanical engineering in nanotechnology will be. In fact, quite a bit of nano scale science and engineering is already performed by mechanical engineers.

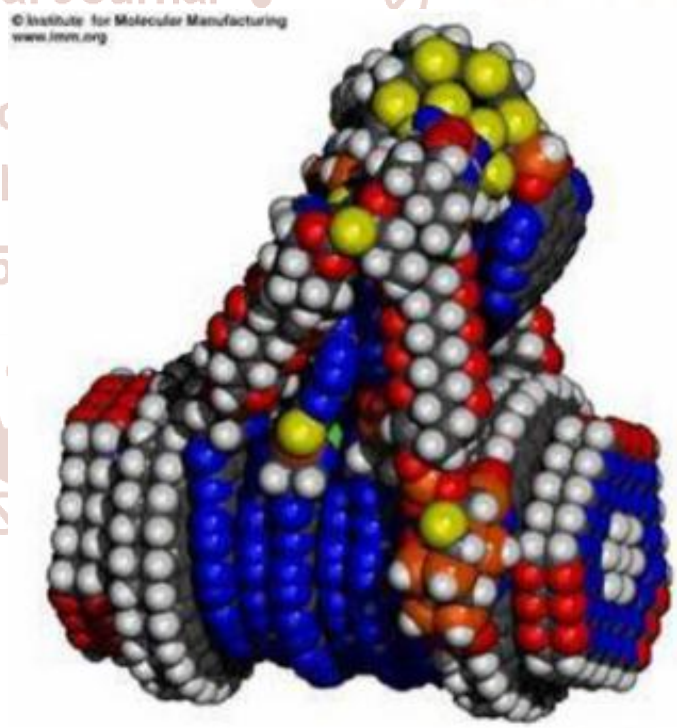

Figure 5

Mechanical engineering issues extend to instruments for nanoparticle and aerosol detection and characterization, as well as to various forms of nanoscale imaging. Magnetic data storage technology already has many features that fall well into the nanometer size range, and requires mechanical engineering knowledge and expertise to further its development. It is important to recognize some unique features about nanotechnology. First, it is the amalgamation of knowledge from chemistry, physics, biology, materials science, and various engineering fields. It epitomizes the concept of the whole being greater than the sum of the parts.

In addition, it is often difficult to isolate nanoscale phenomena as we do at customary scales. That is, thermal, electronic, mechanical, and chemical effects are often related to each other. By changing one, it is possible to influence the others. This, of course, emphasizes the need for interdisciplinary knowledge. There are many concepts in mechanical engineering that are critical in the development of nanotechnology. It is incumbent upon mechanical engineers to provide depth in these areas.

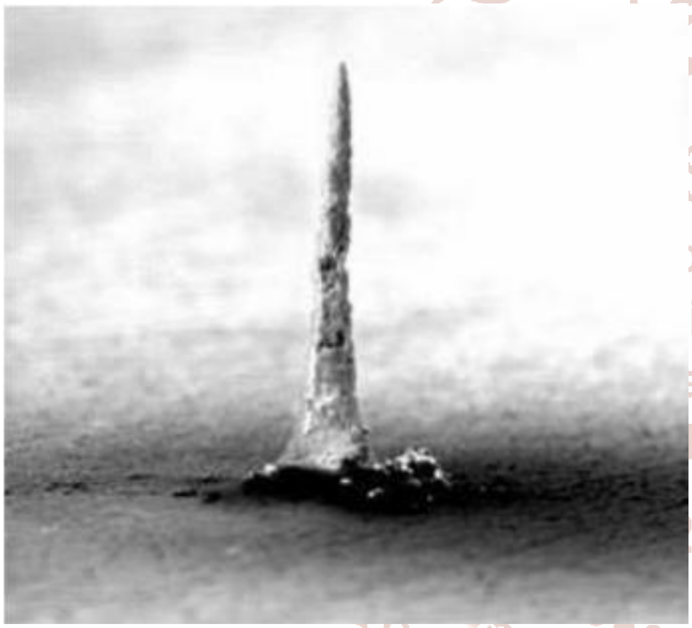

Figure 6

At present, nanotechnologists can create simple structures, like this silicon carbide tower. One of the most important issues related to nanotechnology is systems integration and packaging. Researchers have been able to study individual nanostructures and have even synthesized building blocks such as nanoparticles and nanowires. But how do we integrate these building blocks in a rational manner to make a functional device or a system? This step requires design based on the understanding of nanoscale science, and on new manufacturing techniques.

Figure 7

One of the biggest challenges in nanotechnology is manufacturing. Assembling large quantities of nanostructures in a rational and rapid manner requires tooling, imaging systems, and instrumentation, sensors, and control systems. After nanostructures are assembled into functional devices, they need to be packaged so that they can interact with their environment and yet retain the nanoness that provides the unique function and performance.

Nanoparticle Thermal materials

In spite of advances in efficiency of vehicle powertrain systems and electronics, the removal of waste heat continues to be an important challenge. With increasing focus on reduced component size and mass, the traditional approach of increasing the area available for heat exchange with a cooling fluid (air, water/ethylene glycol) to manage higher heat loads is not acceptable. Increasing thermal power densities requires innovations in new coolants and thermal coupling materials. The concept of using nano-fluids as a means of improving coolant performance was proposed over a decade ago [6].Reports of up to 100% increase in liquid thermal conductivity with the addition of nanometer scale particles motivated a large amount of scientific/technical inquiry in the ensuing years [7].

Mixtures of nano- and micro- scale particles add another dimension for controlling thermal, rheological and mechanical properties of particular interest is the use of carbon nano-tubes for TIM applications. The CNT is essentially a single atomic layer of graphite (graphene) which is rolled up onto itself. There are single- and multi-walled versions of CNT which can exhibit thermal conductivity in excess of 1000 Watts/meter ° Kelvin(for comparison, Cu = 400W/mK) and high tensile strength along the axis of the tube. Applications to TIM have involved two basic approaches:

1. Simple addition of CNT to the TIM matrix (grease, gel, etc.)
2. Growth of vertically aligned CNT 'carpets' on the heatsink or device package.

Displays using nanotechnology

Displays with improved performance and unique features are made possible by nanotechnology. Additionally, lower cost light emission sources, such as lasers are possible in the near future. Display technology, under rapid development for consumer electronic devices and home entertainment systems, is also being pursued for automotive applications. Improved performance, longer life, higher energy efficiency, unique presentation features, reduced package size and innovation become the value proposition for implementing this new technology.

Automotive displays are expected to directly utilize nanotechnology in a variety of ways. Light emitting devices, such as LEDs, OLEDs (Organic Light Emitting Diode),fluorescent or field-emissive displays, electro-luminescent and perhaps lasers, are utilizing nano-phosphors and nanolayer to improve their performance. For example, silver nanoparticles on the cathode surface allow surface Plasmon localization. This provides a strong oscillator decay channel that generates a two-fold increase of intensity for flexible OLED displays. Optical thin films, non-linear holographic reflectors, micro-lenses, and light conversion films are examples of materials that modulate or redirect electromagnetic radiation. Light projection systems, flat panel displays, including cameras and other optical detectors that provide the input signals are all expected to benefit from nanotechnology developments. One particular area of interest is nano-phosphors, since these materials possess strikingly different absorption and emission characteristics while operating with better efficiencies and life times than their related bulk phosphors. Since the particle size determines the band-gap energy, coupling nano-phosphors with new semiconductor materials (with and without doping) means that a wide variety of designed phosphors and new devices will likely be developed. Although many materials under consideration are somewhat exotic and expensive, inexpensive materials, such as zinc oxide, and titanium dioxide are also used in the nano-world. Considerable work is being done but much of it is in the realm of industrial secrecy. Most first generation nano-phosphors, Q-dots included, are based on toxic elements such as cadmium and lead. Alternative materials (manganese or copper-doped zincsulphide, D-dots) are coming onto the market. Although these materials are still relatively expensive, the cost will reduce as applications are identified and escalate the demand for material. Today nano-phosphors have many applications in display devices and more are being discovered. Photonic properties of these materials are indicative of their electrical properties. The arrangement of the electrons, dictated by energy states, sets the rules for how a material will interact with incident photons. In this regard, conductors, insulators, and semiconductors each have unique valance and conduction electron energy band arrangements. A dielectric or insulator material will absorb a photon when a valence band electron can be excited to a higher conduction band, the energy being greater than the band gap of the material. Most dielectrics are transparent to visible light since the energy of photons at these wavelengths are insufficient to promote the electrons. A conductive material is opaque since it will either absorb or reflect photons due to the many energy bands available for electrons to be promoted within the conduction band (intraband). It is these mi conductor materials (especially with doping) that allow controllable interaction with incident photons due to free electrons in the partially filled conductive band and the energy states available in the "adjustable" band gap energy.

Nanocomposites

Nano-composites are materials that incorporate nano-sized particles into a matrix of standard material such as polymers. Adding nanoparticles can generate a drastic improvement in properties that include mechanical strength, toughness and electrical or thermal conductivity. The effectiveness of the nanoparticles is such that the amount of material added is normally only 0.5-5.0% by weight. They have properties that are superior to conventional microscale composites and can be synthesized using simple and inexpensive techniques. [8]

Current Applications Of Nanocomposites

Applications of nano-composite plastics are diversified such as thin-film capacitors for computer chips; solid polymer electrolytes for batteries, automotive engine parts and fuel tanks; impellers and blades, oxygen and gas barriers, food packaging etc. with automotive and packaging accounting fora majority of the consumption. [9] The automotive segment is projected to generate the fastest demand for nano-composites if the cost/performance ratio is acceptable. Some automotive production examples of nano-composites include the following: Step assist - First commercial application on the2002 GMC Safari and Chevrolet Astro van; Body Side Molding of the 2004 Chevrolet Impala (7% weight savings per vehicle and improved surface quality compared with TPO and improved mar/scuff resistance); Cargo bed for GM's2005 Hummer H2 (seven pounds of molded-in-color nanocomposites);Fuel tanks (Increased resistance to permeation);under-hood (timing gage cover (Toyota) and engine cover(Mitsubishi). [10]

FUEL AND NANOTECHNOLOGY

Nanotechnology can address the shortage of fossil fuels such as diesel and gasoline by:

- Making the production of fuels from low grade raw materials economical
- Increasing the mileage of engines.
- Making the production of fuels from normal raw materials more efficient.

Nanotechnology can do all this by increasing the effectiveness of catalysts. Catalysts can reduce the temperature required to convert raw materials into fuel or increase the percentage of fuel burned at a given temperature. Catalysts made from nanoparticles have a greater surface area to interact with the reacting chemicals than catalysts made from larger particles. The larger surface area allows more chemicals to interact with the catalyst simultaneously, which makes the catalyst more effective. This increased effectiveness can make a process such as the production of diesel fuel from coal more economical and enable the production of fuel from currently unusable raw materials such as low-grade crude oil. [11]

Environmental Health & Safety

The unconventional size, crystalline structure, large surface area and physical/chemical properties of nano-materials promise unprecedented technological advances; however these same properties also present significant challenges to understanding, predicting and managing potential health, safety, and environmental risks. The toxicological characteristics of familiar chemical compositions become uncertain when reconfigured at the molecular level in the form of nano-materials. Nanomaterials may differ from their larger particle counterparts with regard to viable routes of exposure, movement of the material once in the body and interaction of the materials with the body's biological systems; all data which are essential for predicting health risks. Preliminary data indicate nanoparticles have the potential to be absorbed into the body via inhalation, ingestion, and through the skin. Occupational exposure is most likely to occur via inhalation or skin contact. While personal protective equipment (PPE) is often the preferred choice for minimizing employee exposures, the efficacy of traditional PPE toward specific nanomaterials is largely unknown.

Conclusion:

The GREEN NANOTECHNOLOGY IN AUTOMOBILES made is that the automotive industry is affected with nanotechnology implementation. The increased awareness of nanotechnology is sure to influence the industry business. With small nanomaterials, the physical and chemical properties like conductivity, optical sensitivity, melting point, etc. are changed to increase conventional material properties.

References:

1. J. of Nanoparticle Research, Kluwer Academic Publ., Vol.3, No. 5-6, pp. 353- 360, 2001 (based on the presentation at the symposium Global Nanotechnology Networking, International Union of Materials Meeting, and August 28, 2001)

2. Hartmut Presting, Ulf König, “Future nanotechnology developments for automotive applications,” Materials Science and Engineering C, pp.737–741, 2003.

3. Margarida C. Coelho, Guilhermina Torrão, Nazanin Emami, and José Grácio, “Nanotechnology in Automotive Industry: Research Strategy and Trends for the Future—Small Objects, Big Impacts”, Journal of Nanoscience and Nanotechnology, Vol. 12, 2012.

4. Arif Baig, Imran Mahmood, Shuvra Das, “Modeling MEMS devices for Automotive Applications,” 2004.

5. OECD/NNI Symposium on Assessing the Economic Impact of Nanotechnology, Background paper: Challenges for Governments in Evaluating Return on Investment from Nanotechnology and its Broader Economic Impact, Eleanor O’Rourke and Mark Morrison, Institute of Nanotechnology, United Kingdom. nano.gov/symposium

6. Choi S.U.S., in “Developments and Applications of Non-Newtonian Flows”, edited by Singer

D.A., Wang H.P., American Society of Mechanical Engineers, Vol.231/MDVol.66, p.99 (New York, 1995).

7. Keblinski P., Eastman J.A., Cahill D.G., Materials Today,p.36 (June 2005).
8. Marquis F.D.S., Chibante L.P.F., Journal of Materials, p.32 (December 2005).
9. Elliot J.A., Kelly A., Windle A.H., J. Mat.Sci.Ltrs. Vol.21, p.1249 (2002).
10. Prasher R., Proceedings of the IEEE Vol.94, No.8, p..1571(August 2006).
11. HuX.J., Padilla A.A., Xu J., Fisher T.S., Goodson K.E., J.of Heat Transfer, Vol.128, p.1109 (November 2006).