NANOMATERIALS APPLICATIONS IN THE MACHINE BUILDING FIELD

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ABSTRACT:

Nanomaterials possess many unique chemical, physical, and mechanical properties. Nanostructural materials and devices exit in a large scale of forms. The significant property that makes nanoparticles different from other materials is the fact that nanomaterials have a massive surface area. Due to these beneficial properties, nanomaterials are being favorably considered for a wide variety of structural, non-structural, biomedical and microelectronic applications. The implementation and utilization of these new materials is strongly dependant on the microstructure and surface nanochemistry characteristics investigation and modeling. In this article are presented some examples who are demonstrating the enormous potential for this new class of materials to be used in machine building field.

1.INTRODUCTION

The dominating trends of science and technology go to the nanoscale. The significant property that makes nanoparticles different from other materials is the fact that nanomaterials have a massive surface area. Because of their very high surface area, nanoparticles are extremely reactive compared to its larger form. This property is used to create materials with distinctive characteristics for various applications. The impetuous demand for high efficiency, high performance materials coupled with stricter legislation regarding emissions and safety has underlined the importance of nanotechnology in the global machine building industry. Increasing versatility and the ability to offer cost-effective solutions are further motivating to adopt the nanotechnology by automotive manufacturers. The design and manufacturing of automobiles can be affected by nanotechnology and the related technologies up to 60% in 10 years. [1-3] Some important specific domains with great interest in developing the utilization of nanomaterials in the machine building field industry are:

- Reduced pollution
- Reduction of weight
- Recyclability
- Safety
- Better performance and engine efficiency (fuel saving)
- Aesthetics
- Longer life-cycling.

2. APPLICATIONS OF NANOMATERIALS IN THE MACHINE BUILDING FIELD

The automotive industry will benefit from the trend of nanotechnology by getting advanced power train, using new energy, reducing car weight, enhancing material functions, increasing comfort degree & flexibility, raising cost efficiency and increasing sometimes the life cycling. Almost all the automobile components can be improved by nanotechnology like is showed in figure 1.

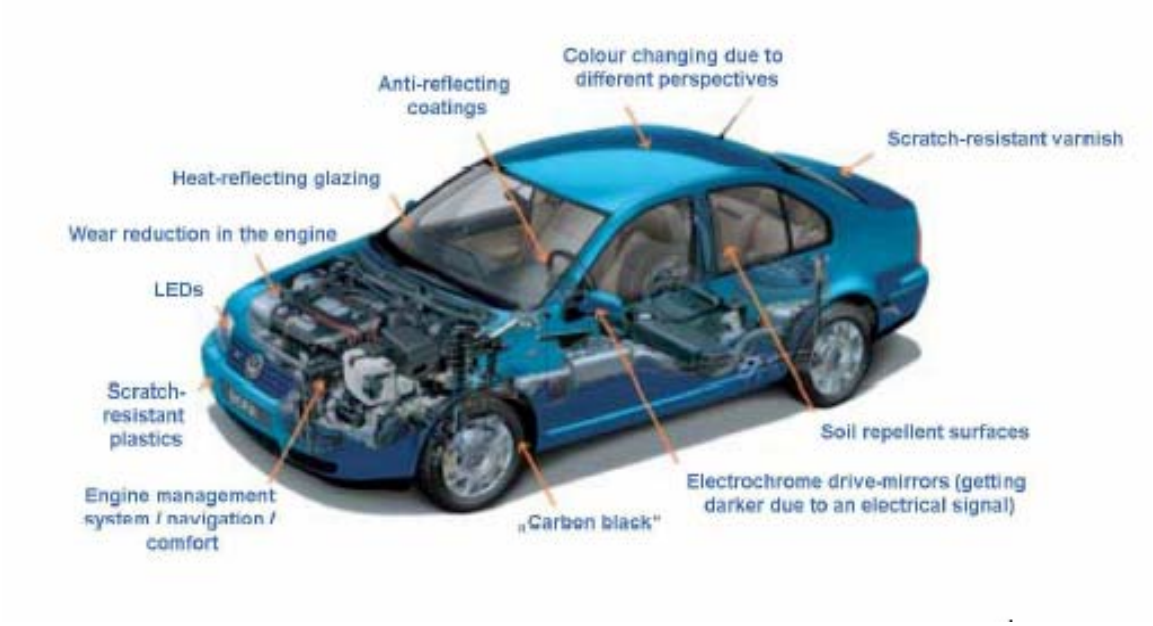

Figure1. Field of application of nanotechnology in the machine building field [2]

The machine building field can benefit from nanomaterials in several applications presented below like:

- Frames and body parts
- Engines and powertrain
- Paints and coatings
- Suspension and breaking systems
- Lubrication
- Tires
- Exhaust systems and catalytic converters
- Electric and electronic equipment

Frames and body

Polymer nanocomposites play an essential role concerning the materials used for frames and body. Examples of applications are the following: polypropylene and TPO-based automotive exterior claddings, clay nanocomposite for exterior parts, nanoscale clay minerals for use in lightweight plastic nanocomposites. All parts of the exterior car can theoretically be made by nanocomposites (nanoparticles in a polymer matrix). Are being recommended to produce interior trim items like door pillars, airbag covers, dashboards, dash mats, and filters for air control. [1]

Engines and powertrain

The new development in engine and powertrain technologies has the objectives to improve thermal and mechanical efficiency, performance, drivability and reliability in the mean time to reduce emissions and costs. For increased fuel economy the requirements in motor vehicles demand the use of new, lightweight materials, such as plastics, that can replace metal, but the best of these plastics are expensive. So the development of

technologies goes also to the nanocomposites of traditional polymers reinforced by nanometer-scale metal particles dispersed throughout. These reinforced polymers may present an economical solution to metal replacement. The resistance at corrosion, noise dampening, parts consolidation, and recyclability. Nanocrystalline structures (greater strength and temperature tolerance) can confer news opportunities in the internal combustion engine.

Paints and coatings

The behavior of bulk materials is dominated by the behavior of surfaces. Some effects witch iclude ultraviolet (UV) blocking, anti-static, and conductive capabilities are strongly dependend of the properties of surface. The incorporation of nanoparticles, thin film coatings is demonstrated to have stronger bonds and better flexibility, with little cost differences. These coatings are smoother, stronger, and more durable. Nanoparticles can be used as abrasives, and in paints, and in electrochromic coatings for windscreens, or windows surface disinfectants. Around the world many companies are using the properties of nanoparticles and are incorporating them within their coatings. Some examples of nanocoating applications are:

- Carbon nanotube based paints
- Corrosion protection coatings
- Ultraprecise polishing of surfaces
- Scratch-proof, transparent coatings
- Composites allowing water- and dirt-repellent effect.

Lubrication

The nanotechnology-based on solid lubricants can reduce friction between moving parts and minimize wear, save maintenance costs and greatly improve overall machine performance. In addition, it reduces energy consumption and decreases air pollution. An Example of nanocoating applications is the new cooling fluid and ferrofluid

Suspension and breaking systems

The viscosity from a thin liquid to a solid can be modified by injecting nano iron-based particles into certain fluids because creates a magnetic field that changes. This property allows a vehicle to instantly alter its suspension system and it's based on the conditions it senses.

Tires

New nano coating reduce weight, improve pressure retention and reduce recycling and incineration costs of tires. The replacement of carbon black in tires with nanoparticles of inorganic clays and polymers, leading to tires that are environmentally friendly and wear resistant. Nanostructured soot as an additive to increase tire life, reduce friction and fuel consumption.

Electric and electronic equipment

The machine building field is a major user of sensors and components for new integrated miniaturised systems, and MEMS have been a key driver in many of today's advanced safety systems. MEMS are currently used in two standard automotive applications: the air bag accelerometer, which first went small tech in the early 1990's, and the manifold air

pressure sensor, or MAP sensor, first used in the late 1970's. some examples of applications are the high transmittance IR polymers embedded with nanoparticles, high sensitivity IR sensors, cabin air quality monitoring, exhaust emissions detection, thin film display, electro-optical films, advanced functionalized textiles, interactive glasses (IPI), micro-shutter displays based on carbon nanotubes, new lighting sources and optical switches.

3. CONCLUSIONS

Nanomaterials possess many unique chemical, physical, and mechanical properties. Due to these beneficial properties, nanomaterials are being favorably considered for a wide variety of structural, non-structural, biomedical and microelectronic applications. Nanotechnology is providing the machine building industry novel and effective means to reduce costs, particularly in the case of paints, coatings or catalytic converters.

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