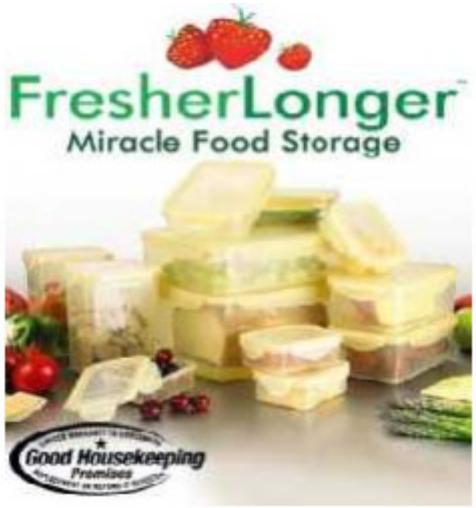
Chapter 5 Application fields of nanomaterials

4.1- Introduction:

Nanomaterials can be widely used in the short, medium and long term in many sectors and become part of our daily lives. Some are in the industrial production phase.

4.2- Environment

The use of nanomaterials is envisaged for the reduction of pollutant emissions, the treatment of effluents in particular by photocatalysis and the purification of gases, the production of ultrapure water from seawater. Nanomaterials can be developed in particular in the form of nano-functional organic membranes, catalysts, filters, nano-porous ceramics and aerogels.



Plastic containers and plastic bags

Nano Silver Baby Mug Cup and
Baby Milk Bottle

4.3- Energy

The challenges in terms of energy relate more to improving the performance of energy systems, developing clean energies and saving energy.

Research focuses on the development of materials for the storage of hydrogen (in particular carbon nanotubes), use as a nanostructured thermal barrier (such as aerogels).

A new generation of photovoltaic cells, more economical lighting of smart windows.

More efficient insulating materials.

Nanoparticles are used as catalyst supports in the automotive industry.

Ceramic membranes

Photo catalysis,

Propellants and explosives,

Anti-scratch coatings, thermal spray coating

4.4- Textiles

The objective of the textile industry is to improve the quality and functionalities of textiles by developing interesting mechanical properties or even by integrating communicating objects. In particular, fiber-polymer nanocomposites are being developed, due to their high strength, transparency, flame retardant properties and very low weight.

4.5- Chemistry and materials

The challenges of the chemical industry relate essentially to the development of nanocomposites with a polymer matrix, the extension of the fields of application of polymers and the improvement of certain properties (lightening and strengthening of structures, improvement of optical properties, increase in durability, but also resistance to fire, high temperatures and thermal shock). The aim is to obtain multifunctional and more efficient ceramics, pigments, powders and catalysts, adhesive-free bonding technologies, new welding technologies, functional layers (anti-adhesive, antistatic, etc.), paints, photo-active and self-cleaning windows and clothing, etc.

4.6- Cosmetics

The cosmetics industry seeks to improve the properties of cosmetic products such as hold, transparency, shine and optical properties. To this end, studies relate in particular to the use of nanoparticles in nano-dispersions and in microemulsions. Several types of applications are developed by the cosmetics industry, in particular:

- filtration of ultraviolet radiation;
- resistance of sun creams to water;
- adaptation to the environment by photochromic effect;

- new visual effects;
- anti-aging skin

4.7- Health

It is the market for inorganic particles used to produce antimicrobial agents, biological markers for research and diagnosis, biomagnetic separation processes, drug delivery vehicles, contrast media for resonance imaging magnet, orthopedic devices and sunscreens.

Nanomaterials can in particular make it possible to improve current drugs, to deliver tailor-made drugs only to specific organs, to obtain biocompatible surfaces for implants and oral vaccines from nanoparticles.

- Gold nano-beads: One of the most publicized areas of nanomedical research is the use of gold nano-beads for the detection and treatment of cancerous tumors.
- It illustrates well the overlap between detection and therapy: nano-beads are both imaging agents and therapeutic agents.
- The concept of nano-beads dates back to the early 1950s, but they were created decades later when it became possible to manufacture nanoscale particles.
- produce magnetic nanoparticles from biological supports as well as biocompatible materials.
- With regard to healthcare, nanomaterials will make it possible to realize implanted miniaturized diagnostic means in order to obtain early diagnoses, in surgery to improve tissue engineering and implants with coatings improving biocompatibility and bioactivity, DNA analysis, construction of ultra-precision devices, analysis and positioning systems, better optical systems, high-density biochips, biodetection of pathogens, detection of proteins, etc.


Nanotechnology can repair damaged, punctured or clogged vessels after a heart attack. The first artificial heart was created by Alain Carpentier.

4.8- Automotive

- We seek to use nanomaterials in the automotive industry to reduce the weight of vehicles, to increase the resistance of automotive parts, particularly to scratches, to increase the resistance to temperature of certain parts, to reduce fuel consumption energy, limit greenhouse gas emissions and increase passenger safety and comfort. Research focuses in particular on nanocomposites with a polymer matrix, making it possible to increase the resistance of materials while reducing the weight of parts.
- Nanomaterials could also help increase fuel combustion efficiency and increase engine thermal efficiency. Layers of nanometer-thick polymers could modify the thermal properties of glazing and create an athermal interior (which already exists for windshields).
- On the other hand, due to the large exchange surface of nanoparticles, an interesting application would be their use in catalytic converters for the treatment of combustion gases. Exterior paints with color effects, resistant to scratches, elastic and on which dirt does not take hold are also considered.

4.9- Aeronautics and space

- Nanomaterials are also the subject of much research in the aeronautics and space sector in order, in particular, to improve the performance and reduce the weight of materials, increase the lifespan, reduce consumption and improve engine performance.
- To achieve these objectives, research is carried out in particular to improve the surface deposition processes on mechanical parts and to produce coatings

allowing mechanical protection, against corrosion, against chemical attacks and constituting a thermal barrier.

4.10- Electronics and Communications

In the electronics and communications industry, nanomaterials enable numerous applications such as: high-density memories and miniaturized processors, new solar cells, batteries and combustion cells, digital logic components, screens dishes with bright illumination, a silica/organic substances coupling. They allow for faster processing speeds and greater recording capacity.

4.11- Glass and glassware

The glass industry wishes to develop reinforced glass glazing using glass matrix composites aimed at protecting the surface of the glasses thanks to coatings comprising in particular a rainproof function, a self-cleaning function and specific optical properties (reflective function, coloring, anti-reflection, UV absorption).

4.12- Ceramics and building materials

- The ceramic products industry is seeking to reinforce ceramics by introducing nanopowders such as silicon nitride nanoparticles which make it possible to reinforce alumina. The building industry is developing miniaturized sensors which will be integrated into the home in order to improve comfort and safety. Research is underway to produce more resistant coatings or ones with anti-dirt or anti-slip properties.
- On the other hand, in the field of civil engineering and major structures, improving safety involves strengthening construction materials.