

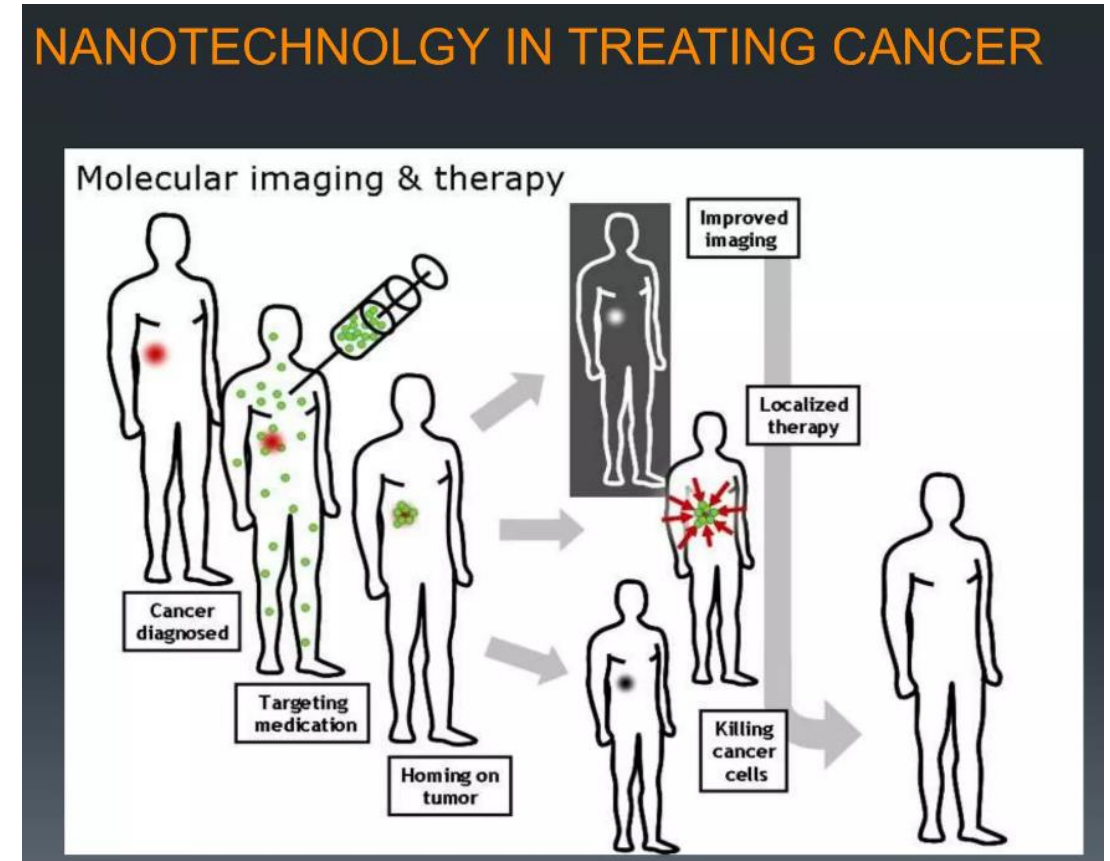
Nanotechnology

- **This technological branch manipulates the molecular structure of materials to change their intrinsic properties and obtain others with revolutionary**
- In 1959 the American Nobel prize and physicist Richard Feynman was the first to speak about the applications of nanotechnology at the California Institute of Technology (Caltech).
- With the 21st century, this area consolidated, was marketed and came into its own.**applications.**
- This technology is crucial for the progress and evolution of several scientific disciplines, including medicine, manufacturing, energy, and materials science and engineering.

- In the metric system, a nanometer refers to a unit of length.
- Technically, one centimeter = 1/100 of a meter while a nanometer (nm) = one billionth of a meter.
- Thus, all nanoscale structures typically have a dimensional range or length between 1 and 100 nanometers.
- A nanometer (10^{-9}) scale is smaller and primarily used to measure atoms and molecules.
- Many benefits of nanotechnology depend on the fact that it is possible to tailor the structures of materials at extremely small scales to achieve specific properties, thus greatly extending the materials science toolkit.
- Using nanotechnology, materials can effectively be made stronger, lighter, more durable, more reactive, more sieve-like, or better electrical conductors, among many other traits.

Nanotechnology Applications

- **Medicine**
- Researchers are developing customized nanoparticles the size of molecules that can deliver drugs directly to diseased cells in your body. When it's perfected, this method should greatly reduce the damage treatment such as chemotherapy does to a patient's healthy cells.



Electronics

- Nanotechnology holds some answers for how we might increase the capabilities of electronics devices while we reduce their weight and power consumption.
- Samsung, a telecom leader, designed a nanotech process that gives tiny chips more power than state-of-the-art chips.

Food

- In the food industry, nanotech is applied to intensify food flavor and color while performing food processing steps.
- It is also vital for food preservation as microbes can significantly reduce the food's shelf life.
- Considering the consequences, nanotech-based food packaging solutions are used to maintain the safety and quality of food products.
- Also, during the agricultural cultivation process, farmers can now use nanomaterials as this tends to keep a check on pesticide use on crops and yet deliver essential nutrients to them.
- Thus, from food production, processing, and preservation to packaging, nanotech has become an indispensable part of food science.

Energy applications of nanotechnology

- An important subfield of nanotechnology related to energy is nanofabrication.
- Nanofabrication is the process of designing and creating devices on the nanoscale. Creating devices smaller than 100 nanometres opens many doors for the development of new ways to capture, store, and transfer energy.

Companies are currently developing batteries using nanomaterials. One such battery will be as good as new after sitting on the shelf for decades. Another battery can be recharged significantly faster than conventional batteries.

Space

- Nanotechnology may hold the key to making space-flight more practical.
- Advancements in nanomaterials make lightweight spacecraft and a cable for the space elevator possible.
- By significantly reducing the amount of rocket fuel required, these advances could lower the cost of reaching orbit and traveling in space.

Fuels

- 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, and making the production of fuels from normal raw materials more efficient.

Better Air Quality

- Nanotechnology can improve the performance of catalysts used to transform vapors escaping from cars or industrial plants into harmless gasses.
- That's because 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.

Better Water Quality

- Nanotechnology is being used to develop solutions to three very different problems in water quality.
- One challenge is the removal of industrial wastes, such as a cleaning solvent called TCE, from groundwater.
- Nanoparticles can be used to convert the contaminating chemical through a chemical reaction to make it harmless.
- Studies have shown that this method can be used successfully to reach contaminants dispersed in underground ponds and at much lower cost than methods which require pumping the water out of the ground for treatment.

Chemical Sensors

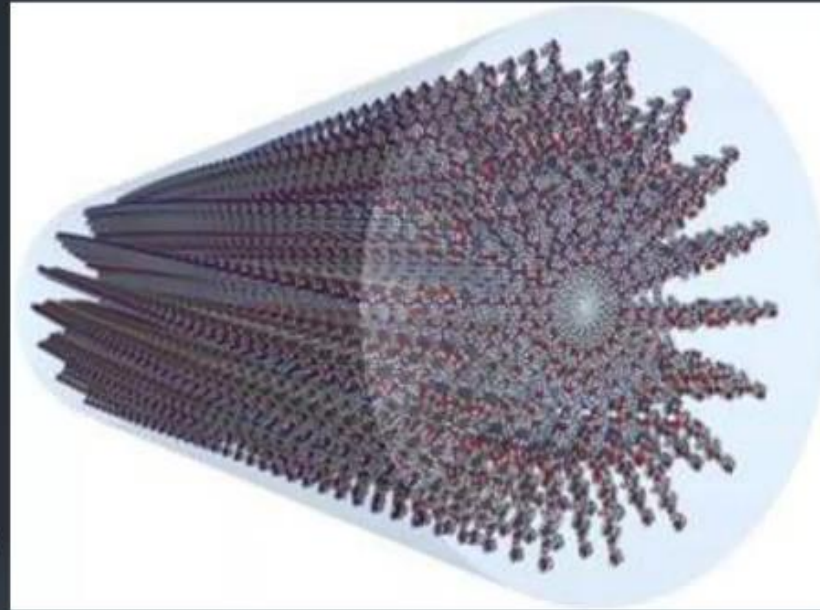
- Nanotechnology can enable sensors to detect very small amounts of chemical vapors.
- Various types of detecting elements, such as carbon nanotubes, zinc oxide nanowires or palladium nanoparticles can be used in nanotechnology-based sensors.
- Because of the small size of nanotubes, nanowires, or nanoparticles, a few gas molecules are sufficient to change the electrical properties of the sensing elements.
- This allows the detection of a very low concentration of chemical vapors.

Sporting Goods

- If you're a tennis or golf fan, you'll be glad to hear that even sporting goods has wandered into the nano realm.
- Current nanotechnology applications in the sports arena include increasing the strength of tennis racquets, filling any imperfections in club shaft materials and reducing the rate at which air leaks from tennis balls.

Fabric

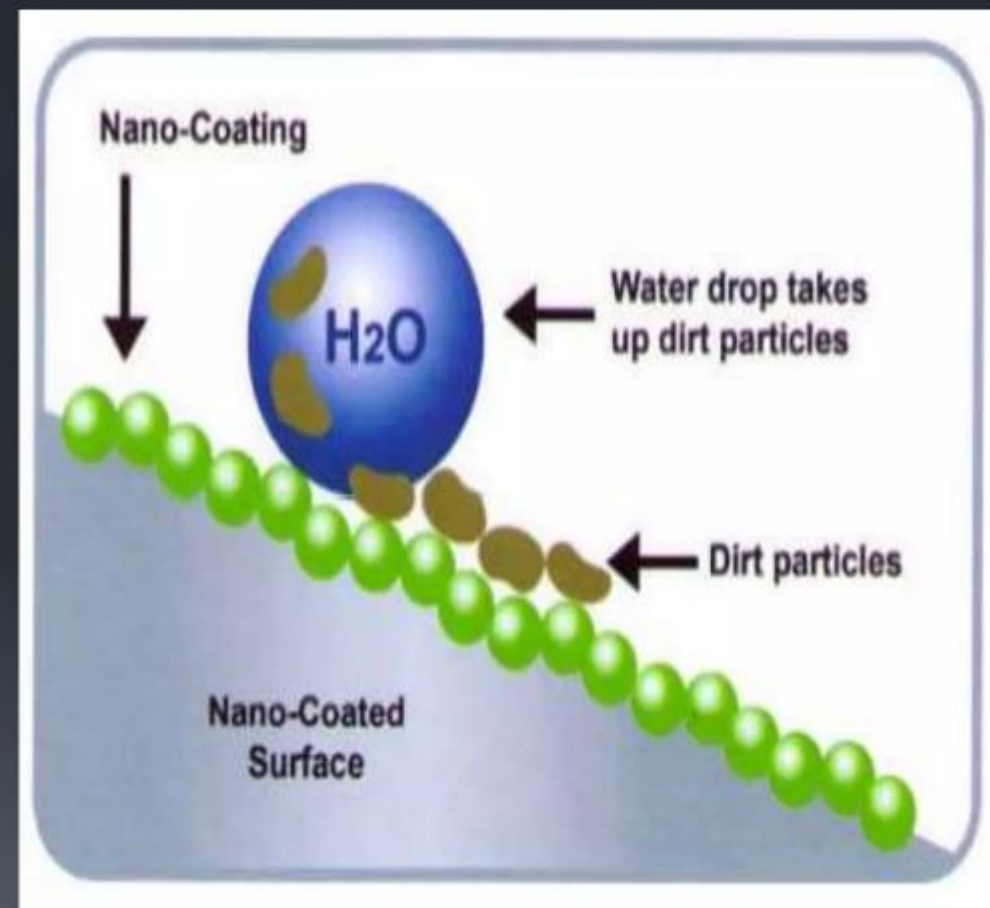
- The use of engineered nanofibers already makes clothes water- and stain-repellent or wrinkle-free.
- Textiles with a nanotechnological finish can be washed less frequently and at lower temperatures.
- Nanotechnology has been used to integrate tiny carbon particles membrane and guarantee full-surface protection from electrostatic charges for the wearer.



Industrial applications of nanotechnology

Surfaces and coatings-

The most prominent application of nanotechnology in the household is self-cleaning or "easy-to-clean" surfaces on ceramics or glasses. Nano ceramic particles have improved the smoothness and heat resistance of common household equipment such as the flat iron.



Obstacles and Hurdles

- Mass Production/Throughput and Cost Constraints
- Funding Requires Long-Term Investments
- Intellectual Property Issues - Patent Office that is Overwhelmed and Under-Qualified