NANOTECHNOLOGY

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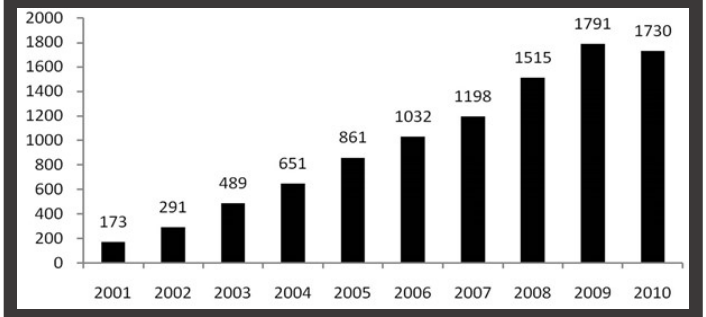
Introduction

Nanotechnology is the science of designing, producing and applying small structures and devices on the nanoscale (= one billionth of a metre). In practice, it consists of a broad spectrum of other domains, such as organic chemistry, molecular biology, semiconductor physics, engineering,... Able to revolutionize medicine, solve the energy problem and reinvent our technology, nanotechnology is the most advancing and promising field in modern physics. Nanotechnology will definitely change our world in the imminent future, or maybe even today?

A brief history

Richard Feynman introduced the concept of nanotechnology in 1959 while talking about a technique to manipulate individual atoms. Years later, a conceptual framework was created. This, along with the invention of the scanning tunnelling microscope and the discovery of fullerenes, made it possible for nanotechnology to truly emerge as a field during the late 1980s.



(Number of publications on nanotechnology per annum)

Principles of nanotechnology

The quantum realm

At the nanoscale, not all rules of physics and chemistry still apply to everything. At this level, particles can behave like a particle or as a wave, which causes strange things; the quantum effects. Because of this, physical properties change, which enables revolutionary applications.

Two approaches for manufacturing

The **"top-down"** approach is essentially the breaking down of bulk material to get nano-sized particles. Scientists characterize the surface of atoms with scanning probe microscopy and etch or carve them with small needles to create nanostructures.

In the **"bottom-up"** approach, materials and devices are assembled atom by atom or molecule by molecule. Chemical synthesis, molecular recognition and the MBE technique (laying down precise layers of atoms on one another) enable this.

Current applications

First generation applications

Current applications of nanotechnology do not involve atomic control of matter. These are 'passive' nanomaterials in daily products, such as:

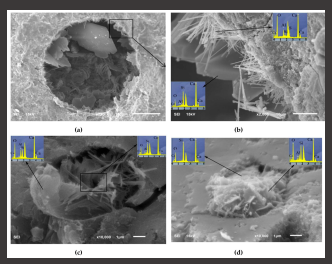
- titanium dioxide in sunscreen, cosmetics, surface coatings
- carbon allotropes used to produce gecko tape
- silver in food packaging, clothing, disinfectants, and household appliances
- cerium oxide as a fuel catalyst
- bandages infused with silver nanoparticles to heal cuts faster
- carbon nanotubes for stain-resistant textiles

Usage in electronics

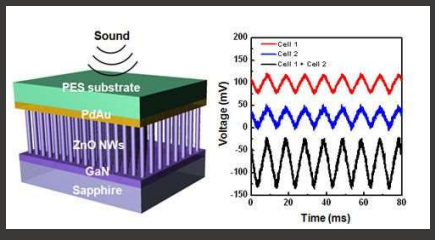
The greatest possibilities towards the application of nanotechnology can be found in the electronics industry. Some realized examples are:

- the use of carbon nanotubes in semiconductor chips
- potential use of carbon nanotubes and other nanomaterials in fuel cells and by the solar industry for use in photovoltaics.
- IBM has even developed carbon nanotube transistors
- Nantero is today's leader in carbon nanotube memory chips

(Pillcam, an application of nanotechnology in medical imaging)



(Usage of nanoparticles in reinforced concrete)



(Generation of electricity by using sound waves)

How nanotechnology will change your life

One of the most useful applications could be in medicine, like wearable fitness technology, implants, sensors, ... Real-time monitoring and targeted drug delivery could become reality. The future of medical imaging will never be the same!

Another application of this technology could be all kinds of sensors in structures and buildings. If cracks appear, nanoparticles could repair them. By using these materials, buildings could be made water-repellent or indestructible.

Finding new ways to generate electricity is a major issue. In the future, nanotechnology could enable objects to harvest energy from their environment, from movement and sunlight to temperature changes and glucose.