

What are nanotechnologies?

Nano originates from the Greek word meaning “dwarf”. A nanometre is one billionth (10^{-9}) of a metre.

Nanotechnology can be defined as “engineering at a very small scale” and this term can be applied to many areas of research and development – such as health and medicine, ICT and energy and the environment. Since there are many areas of application and many nano-enabled technologies and products, we refer to “nanotechnologies” (plural rather than singular).

Are nanotechnologies something new?

Nanoparticles are not new, they have existed in the natural world for millions of years, created by living things or by volcanic activity. Although scientists have manipulated matter at the nanoscale for centuries, calling it physics or chemistry, it was not until a new generation of microscopes was invented in the 1980s at IBM in Switzerland that the world of atoms and molecules could be visualised and manipulated.

How could nanotechnologies change our lives over the next 20 years?

In the next 20 years, our lives will change through technology innovations in the following ways:

Your cell phone will be your wallet, your ticket broker, your bank, your shopping buddy, and more:

doctors will get enhanced “super-senses” to better diagnose and treat you.

Are nanotechnologies currently used in products?

Yes. Nanoparticles of titanium dioxide and zinc oxide can absorb and reflect UV light while also being transparent to visible light and are already used in sunscreens. Zinc oxide nanoparticles are used to coat fabric, which gives it better protection from UV radiation and in some cases water repellent and stain resistant properties. Computer transistors are another area which use nanotechnologies to produce very small devices, hence reducing the size of the computer – the size of a transistor in a modern computer is about 40 nanometre.

What negative aspects might nanotechnologies bring to society?

There are worries that only the developed world will have the benefit of nanotechnologies – such as cleaner water, better drugs, etc., which overall improve life quality, so that the gap between developed and undeveloped countries will expand. Another concern is that nanotechnologies developed for one purpose could be used for another purpose, such as human enhancement: super intelligence or increased physical abilities.

Will nanotechnologies affect the environment?

Technologies generally do affect the environment. Nanoparticles could potentially have a toxic effect, but we need to understand the pathways through which they move into the environment. There is a lot of research going on to assess the potential harmful effects of nanotechnologies on humans and the environment. Many applications of nanotechnologies are aimed at improving the environment, such as solar cells, water nano-filtration, etc.

Are there health risks involved with nanotechnologies?

Health risks are not fully known at this time. Research has been and continues to be conducted to establish the toxicity of materials at the nano scale. Concerns have been raised regarding the ability of nano particles to travel through barriers within the human body.

How can I study something I cannot see?

Objects on the nanoscale are certainly too small to be “seen” with the naked eye and are often too small to be imaged with traditional basic optical microscopes. To image very small objects, specialist microscopes are used, such as electron microscopes or scanning probe microscopes. For example scanning tunnelling microscopy (STM) scan very small probes over a sample surface and can often image individual atoms and molecules by measuring the interaction between probe and surface.

I want to be nanoscientist. How can I achieve this goal?

There are some institutions where one can study for a first degree in nanotechnology but it is probably better to obtain a good first degree in one of the basic disciplines – whether a pure science, like physics or chemistry, or an engineering specialism, like electronic engineering or materials science. Then one can broaden one’s education at the postgraduate level, to get the essential interdisciplinary skills that are vital to make progress in nanotechnology.

What is special about things on a nano scale?

At this scale materials that we are familiar with can show new electrical, chemical and magnetic properties. We can manipulate individual atoms or even make tiny motors.