use nanoparticles of zinc oxide which absorb ultra-violet rays but leave the formulation clear rather than white.

Self-cleaning glass produced by Pilkingtons. This has a thin coating of titanium dioxide nanoparticles which break down organic matter via their absorption of sunlight and make the surface water repellent. This breaks down dirt which is then washed off by rain leaving the glass clean.

Used in a lot of paints as pigments.

Anti-fungal foot spray with nanoscale zinc oxide particles, reducing clogging.

Fabric where the molecules in the fibres have been changed is used to make trousers which are waterproof and highly resistant to wear and tear.

Near-future products include better research tools or aids to diagnosis.

the future...

The next stage in nanotechnology exploits the unusual properties of nanoparticles, creating products from the bottom up.

Overcoming some of the limitations of present, silicon-based technology to make smaller, lighter, cheaper computers which require less power to run but have the power of today's computer centres in one PC.

Miniature data storage systems capable of storing the stock of a national library.

Chips containing movies with more than 1000 hours playing time.

Targeted pharmaceuticals which can be taken orally and are released over time enabling lower dosage and a reduction in side effects.

Sensors able to detect single molecules. These could be used to monitor pollution.

Ultra-strong, light composite materials for planes and engineering.

websites

Go to www.sciencemediacentre.org/nanotechnology.htm to access all the links below

A to Z of Nanotechnology www.azonano.com

Institute of Nanotechnology www.nano.org.uk

Institute of Physics – What is Nanotechnology:
http://www.iop.org/EJ/abstract/0957-4484/14/1/001

Foresight – Nanotechnology review
http://www.foresight.org/NanoRev/

Royal Society
http://www.royalsoc.ac.uk/nanotechnology/

Royal Society / Royal Academy of Engineering review of Nanotechnology http://www.nanotec.org.uk/

BBSRC – Bionanotechnology
http://www.bbsrc.ac.uk/news/features/01oct/01_10_nano.html

NanotechWeb http://www.nanotechweb.org/

Nanoscience at Cambridge
http://www.nanoscience.cam.ac.uk/

London Centre for nanotechnology www.london-nano.ucl.ac.uk/lcn/index2.htm

Innovation in Nanotechnology Exploitation (INEX)
http://www.inex.org.uk

International Center for Technology Assessment
http://www.icta.org

US National Nanotechnology Initiative
http://www.nano.gov/html/about/nnco.html

National Physical laboratory
http://www.npl.co.uk/nanotech/

Center for Biological and Environmental Nanotechnology
http://www.ruf.rice.edu/~cben/SocietalImplication.shtml

smc Science Media Centre
where science meets the headlines

Nanotechnology in a Nutshell

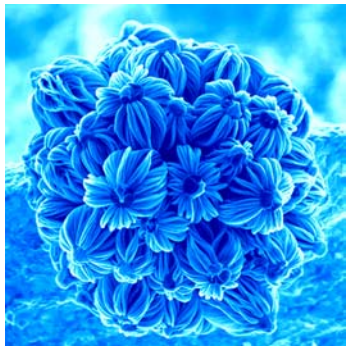
This is part of the 'Science in a Nutshell' series, produced by the Science Media Centre. It is designed to be a resource for busy news-desks, especially those that lack ready access to a science correspondent. 'Nanotechnology in a Nutshell' provides you with a clear explanation of some of the terms that are now regularly used in stories about **nanotechnology**.

This is intended as a handy guide, useful when nanotechnology hits the headlines. It is not meant to teach you nanotechnology from scratch.

If you'd like to know more about nanotechnology, or any other areas of science in the headlines, please contact the Science Media Centre: 0207 670 2980 / smc@rigb.org

www.ScienceMediaCentre.org

Scientists and press officers may also find this guide useful in helping them to prepare simple explanations of nanotechnology terms in the context of a media interview.



Nano Bouquet

The "nano-flowers" are 'grown' from tiny droplets of the liquid form of the metal gallium on a silicon surface by varying the temperature and pressure of a chemical process.

Image taken by Ghim Wie Ho, Nanoscale Science Laboratory at Cambridge University

nanotechnology is...

the science of the very, very small.

virtually any science that involves understanding the world at the atomic level.

manipulating material on the scale of atoms and molecules.

precision chemistry.

a 'bottom up' approach that starts with atoms and builds them up into the components that you need, rather than whittling small components from larger objects.

about nanotechnology...

science working across the boundaries of the traditional academic areas such as physics, chemistry and biology.

derived from the word 'nano', meaning 'dwarf' in Greek.

investigating lots of new properties of materials which they have at such small sizes. These properties can be used in all sorts of new ways, designing materials to possess added strength or heat resistance, which can then be used to improve on old industries such as medicine, energy storage, computing etc.

not just man-made – there are natural nanoscale machines inside every cell in our body, converting the food you eat into energy, or reading your DNA.

engineering at the molecular level on scales of a billionth of a metre.

more on the scale

nm is shorthand for nanometre. We measure our world in centimetres and metres; we measure the atomic world in nanometres. A nanometre is one billionth of a metre.

Normal office paper is about 100,000 nanometres thick.

One nanometre is about a million times smaller than the size of a pinhead.

One nanometre is about one fifty thousandth the width of a human hair.

glossary

Atom the smallest unit of a chemical element. A basic building block of any material.

Catalyst A chemical that speeds up other chemical reactions.

Carbon Nanotube A flat sheet of carbon atoms rolled into a very thin, cylindrical tube like rolled up chicken wire. Nanotubes can be 100 times stronger than steel but 6 times as light. They are potentially useful in electronics, and in nanoscale construction. Also called 'nanowires'.

Grey Goo Not just science fiction; this is science fantasy. Self-replicating nanobots are imaginary devices which turn everything around them into exact copies of themselves. If let loose, they will be able to convert all matter around them into copies of themselves, so creating a seething grey goo of self-replicating nanobots. An idea introduced in a book by Eric Drexler and popularized by Prince Charles among others, but remains completely imaginary.

Green Goo Grey goo's environmental cousin and equally imaginary. Where as grey goo involves nano-sized, self-replicating machines, green goo involves nano-sized, self-replicating, biological machines which may behave in unpredictable and uncontrollable ways.

Electron microscope / Atomic force microscope (AFM) / Scanning – Tunnelling Microscope (STM) Techniques to help scientists see ever-smaller structures, normally invisible under even the most powerful optical microscopes, enabling individual atoms to be 'seen'.

Molecule A collection of atoms that are stuck to each other. A molecule of water contains only three atoms (one of oxygen and two of hydrogen), while a strand of DNA contains millions.

Nanoparticle Any chunk of material smaller than 100 nanometres. May contain only a few thousand atoms. Potentially very useful in the future (see Applications section) as particles act differently when they are this small. This is where most concerns about nanotechnology arise as, with all these new properties, it may turn out that some of them are bad for us.

Nanoscale In the world of atoms and molecules.

Nanosomes Small particles that mimic natural body chemicals. They could help to move medicines in and out of cells by mimicking the entrance and exit signals used by our bodies.

Nanotoxicity The idea that a substance may be toxic simply because of the unique properties it has from being so incredibly small, rather than because of its chemical make up.

Quantum Dots Clumps of 1000 to 100,000 atoms that interact with light in unusual and useful ways. For example, different sized quantum dots of the *same* material can reflect many different colours.

Self assembly Any molecule or structure that can 'build itself', rather as a house might build itself from a large pile of bricks.

Self-replicating nanobot See 'Grey Goo'.

Titanium Dioxide A mineral, mined from the earth that absorbs ultraviolet radiation very well. It is used in sun creams to protect us from sunburn. Some fear that when used at nano-particle size, these could move through the skin and into cells inside the body, potentially causing health problems.

applications

We have been using nanoparticles for hundreds of years, for example they are used to colour stained glass.

now...

Most of the current applications of nanotechnology use nanopowders rather than exploiting any additional properties that materials have at the nanoscale.

Nanoparticles are used in cosmetics as elements for easy absorption, pigments etc. For example, some sunscreens