

Nanotechnology

- 1 Nanotechnology is science and engineering at the scale of atoms and molecules. It is the manipulation and use of materials and devices so tiny that nothing can be built any smaller. Nanomaterials are typically between 0.1 and 100 nanometres (nm) in size – with 1 nm being equivalent to one billionth of a metre (10^9 m).
- 2 This is the scale at which the basic functions of the biological world operate – and materials of this size display unusual physical and chemical properties. These profoundly different properties are due to an increase in surface area compared to volume as particles get smaller – and also the grip of weird quantum effects at the atomic scale.
- 3 Unwittingly, people have made use of some unusual properties of materials at the nanoscale for centuries. Tiny particles of gold for example, can appear red or green – a property that has been used to colour stained glass windows for over 1,000 years.
- 4 Experimental nanotechnology did not come into its own until 1981, when IBM scientists in Zurich, Switzerland, built the first scanning tunnelling microscope (STM). This allows us to see single atoms by scanning a tiny probe over the surface of a silicon crystal. In 1990, IBM scientists discovered how to use an STM to move single xenon atoms around on a nickel surface.
- 5 Engineering at the nanoscale is no simple feat, and scientists are having to come up with completely different solutions to build from the 'bottom-up' rather than using traditional 'top-down' manufacturing techniques. Some nanomaterials, such as nanowires and other simple devices have been shown to assemble themselves given the right conditions, and other experiments at larger scales are striving to demonstrate the principles of self-assembly. Micro-electronic devices might be persuaded to grow from the ground up, rather like trees.
- 6 In the short term, the greatest advances through nanotechnology will come in the form of novel medical devices and processes, new catalysts for industry and smaller components for computers. In medicine, for example, we are already seeing research on: new ways to deliver drugs with contact lenses; the directing of drugs to tumours with tiny 'smart bombs'; gold 'nano-bullets' that seek and destroy tumours; starving cancer with nanoparticles; diagnosing diseases such as Alzheimer's, monitoring health and fighting sickness with tiny probes; and growing new organs from scratch.

1 Answer these questions about the word combinations used in the text.

- 1 In the first paragraph which adjective is used with *device*?
- 2 In the second paragraph which verb is used with *properties*?
- 3 In the third paragraph which noun is used with *make*?
- 4 In the fourth paragraph which adjective is used with *nanotechnology*?
- 5 In the fifth paragraph which adverb is used with *different*?
- 6 In the sixth paragraph which adjective is used with *advances*?

2 What other words of the same part of speech as in exercise 1 could be used with *device*, *properties*, *make*, *nanotechnology*, *different* and *advances*? Suggest at least two others.

3 What do these adverbial expressions used in the text mean?

- 1 unwittingly (para 3)
- 2 in the short term (para 6)
- 3 from scratch (para 6)