Why Elon Musk is wrong about nanotechnology

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Credit: George Becker from Pexels

You might expect Elon Musk, the business magnate, engineer and serial entrepreneur would be a fan of all things techy. After all, his radical enterprises are built on pushing science to its limit. He's behind a raft of

visionary projects ranging from Tesla's driverless electric cars and SpaceX's self-landing reusable rockets to plans for 1,000kph "hyperloop" trains. But it appears there is a size limit to Musk's technophilia. He recently tweeted that he thinks nanotechnology is "BS".

Folks on Twitter got a bit cross about this blanket dismissal of a field of research that bridges engineering, chemistry and physics. But Musk stuck to his guns, backing up his assertion by linking to Uncylcopedia, a crowd-edited satirical website, of all things.

So is nanotech just a buzzword used to jazz up some otherwise dull research? Or is it a real branch of scientific discovery that's actually making a difference to the world?

Nano means small, really small. One nanometre is just one billionth of metre. At this scale we're dealing with individual molecules and atoms (a carbon atom is about 0.3 nanometres across). So nanotech is about arranging matter that's between one nanometre and 100 nanometres across in at least one dimension, to create usable medicines, electronics and materials.

The idea of deliberately doing science and engineering at this scale may well have started back in 1959, with a talk entitled There's Plenty of Room at the Bottomby the great physicist Richard Feynman. But, in fact, people in ancient times used nanotechnology to create stunning works of art, without realising the scales at which they were manipulating matter.

Quantum dots

Today we've purposefully harnessed nanotechnology to do some incredible things. Take quantum dots. They may sound like the name of a Belgian indie band but, in fact, these real and incredibly versatile nanomaterials are being used in medical imaging, display technologies

and photovoltaic solar cells.

A quantum dot is a particle of semiconducting material just a few nanometres in diameter. Due to their miniscule size, they have electronic properties that sit between what you would expect for a single molecule and a larger bulk material. One of the most useful outcomes of this is that the dots fluoresce (glow) with a colour that depends on the size of the particle. This means that by tweaking the size of the dot you can tune the colours they give off. And that property makes them an ideal candidate for use in your next flat screen TV.

Nanobiotechnology

Nature has a jump on us when it comes to nanotech. The protein molecules that replicate your DNA, digest your food and fight off infections are all nano-sized machines perfectly evolved to do a specific job in your bodies. This makes them ideal places to look for inspiration when trying to engineer something on the nanoscale.

A great example of this in action is a technique known as nanopore DNA sequencing. This technology involves proteins called porins that are normally used by bacteria to allow materials to enter and leave the cells. The porins are placed in a membrane to create channels or pores through it, and an electrical field is then applied. When DNA is forced through the pores the electrical current changes in response to the part of the DNA molecule (the base) that is in the pore.

By measuring the current as the molecule passes through the pore you can work out what the bases that comprise it are and sequence the DNA. This can be done at breakneck speed – up to 450 bases a second – using a tiny desktop device.

Graphene

You can't mention nanotech without graphene cropping up. It's been dubbed a wonder material due to its strength, conductivity and elasticity. Made up of two-dimensional arrays of carbon atoms arranged in a honeycomb pattern, graphene sheets can be just a few atoms thick but with a total area nearer the size of a poster.

When mixed with resins and plastics, the resulting material will be incredibly strong and lightweight. Graphene-based composite materials are already being used for a range of applications including sporting equipment and vehicle body panels. Meanwhile graphene's electrical properties mean it can also enhance battery technologies.

Doesn't that sound like something an electric car manufacturer might want to look into?

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