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Editorial

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What are the Uses and Applications of Nanoparticles?

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Nanomaterials can occur naturally, be created as the by-products of combustion reactions, or be produced purposefully through engineering to perform a specialised function. Due to the ability to generate the materials in a particular way to play a specific role, the use of nanomaterials spans across a wide variety of industries, from healthcare and cosmetics to environmental preservation and air purification.

The healthcare field, for example, utilises nanomaterials in a variety of ways, with one major use being drug delivery. One example of this process is whereby nanoparticles are being developed to assist the transportation of chemotherapy drugs directly to cancerous growths, as well as to deliver drugs to areas of arteries that are damaged in order to fight cardiovascular disease. Carbon nanotubes are also being developed in order to be used in processes such as the addition of antibodies to the nanotubes to create bacteria sensors.

In aerospace, carbon nanotubes can be used in the morphing of aircraft wings. The nanotubes are used in a composite form to bend in response to the application of an electric voltage. Elsewhere, environmental preservation processes make use of nanomaterials too - in this case, nanowires. Applications are being developed to use the nanowires - zinc oxide nanowires - in flexible solar cells as well as to play a role in the treatment of polluted water.In the cosmetics industry, mineral nanoparticles – such as titanium oxide – are used in sunscreen, due to the poor stability that conventional chemical UV protection offers in the long-term. Just as the bulk material would, titanium oxide nanoparticles are able to provide improved UV protection while also having the added advantage of removing the cosmetically unappealing whitening associated with sunscreen in their nano-form. The sports industry has been producing baseball bats that have been made with carbon nanotubes, making the bats lighter and therefore improving their performance. Further use of nanomaterials in this industry can be identified in the use of antimicrobial nanotechnology in items such as the towels and mats used by sportspeople, in order to prevent illnesses caused by bacteria.

Nanomaterials have also been developed for use in the military. One example is the use of mobile pigment nanoparticles being used to produce a better form of camouflage, through injection of the particles into the material of soldiers' uniforms. Additionally, the military have developed sensor systems using nanomaterials, such as titanium dioxide, that can detect biological agents. The use of nano-titanium dioxide also extends to use in coatings to form self-cleaning surfaces, such as those of plastic garden chairs. A sealed film of water is created on the coating, and any dirt dissolves in the film, after which the next shower will remove the dirt and essentially clean the chairs. Controlling the size, shape and material of the nanoparticle enables engineers to design photovoltaics (PV) and solar thermal products with tailored solar absorption rates. Absorption of solar radiation is much higher in materials composed of nanoparticles than in thin films of continuous sheets of material.

The Sol-Gel process is a method for producing solid material from nanoparticles. Whilst it is generally viewed as a relatively new industrial technology, it is used extensively in a number of industries, such as abrasive powder manufacture, coatings production and optical fibres. time point)., more than 20% of patients with metastatic melanoma who received a single round of treatment were alive 10 years later with no evidence of disease.

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