Nanoparticles Notes

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Nanoparticles: material consisting of a few hundred atoms and between 1 nm and 100 nm in size. Nanoparticles are larger than atoms and simple molecules.

$$\mathbf{1\ nm = 1 \times 10^{-9}\ m}$$

Properties of Nanoparticles

Nanoparticles are used as they have a **very large surface area to volume ratio**. This means, as they are so small, there is a lot of surface and not a lot inside of them. A substance that is made up of nanoparticles is called a **nanoparticulate**.

Uses of Nanoparticulate Materials

Nanoparticulate materials have many uses. These include:

1. As ingredients in cosmetics, deodorants and sunscreens.
2. In electronic circuits and as catalysts.

Exam note: The most commonly assessed use at GCSE is sunscreens.

Sunscreens contain titanium dioxide nanoparticulate. This is transparent and absorbs harmful ultraviolet radiation from the sun.

Possible Risks of Using Nanoparticles

1. Some people are concerned that the small size of nanoparticles makes it possible to breathe them in, or for them to pass into cells.
2. Once inside the body, they might catalyse reactions that are harmful.
3. Toxic substances could bind to them because of their large surface area to volume ratios, harming health if the nanoparticles do get into the body. Modern nanoparticulate materials have only become common recently, so it is difficult for scientists to determine their risks.

Ceramic: a hard, durable, non-metallic material which is generally unaffected by heat, for example glass and china. There are two categories of ceramic; **clay and glass**.

Bricks, porcelain and china are clay ceramics. They are all made from clay, which is shaped and then heated to a very high temperature.

Glass ceramics are made by melting sand and letting it cool to form a solid. Glass has crystals in its structure, these allow light to pass through, so glass is transparent.

Polymers: substances made from unit molecules called monomers these join together to form large repeat units called polymers.

Metals: most are strong, hard, shiny solids with high melting points. They are good conductors of heat and electricity. They are ductile and malleable.

Composite Materials

Composite material: a mixture of two or more materials which are combined to produce a material with better qualities for example concrete. Most composite materials have two components:

1. The reinforcement.
2. The matrix

An example of a composite material is fibreglass. This is made of a combination of thin glass fibres which provide reinforcement, as they have a high tensile strength, and a polymer resin which forms the matrix around these glass fibres. Whilst the glass fibres provide high tensile strength, they are unfortunately brittle and could easily break. The polymer resin around the glass fibres provides a measure of flexibility and is hard wearing which counteracts the brittleness of the glass fibres.

Fibreglass, as a composite material, has positive properties from both components; it is strong yet light weight and tough.