

OCR B GCSE Chemistry

Topic 4: Material choices

Why are nanoparticles so useful?

Notes



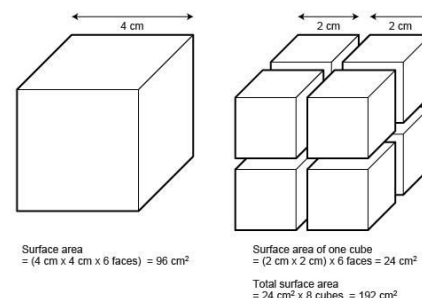


1. Compare 'nano' dimensions to typical dimensions of atoms and molecules

- Nanoparticles are 1-100 nanometers across.
- They contain a few hundred atoms.
- Nanoparticles, are smaller than fine particles (PM2.5), which have diameters between 100 and 2500 nm (1×10^{-7} m and 2.5×10^{-6} m).
 - Coarse particles (PM10) have diameters between 1×10^{-5} m and 2.5×10^{-6} m.
 - Coarse particles are often referred to as dust.
- As the side of cube decreases by a factor of 10 the surface area to volume ratio increases by a factor of 10

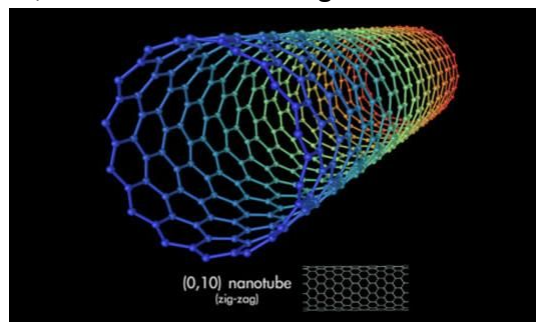
2. Describe the surface area to volume relationship for different-sized particles and describe how this affects properties

- In nanoparticles – surface area to volume ratio is very large
- Atoms on the surface of a material are often more reactive than those in the centre, so a larger surface area means the material is more reactive



3. Describe how the properties of nanoparticulate materials are related to their uses including properties, which arise from their size, surface area and arrangement of atoms in tubes or rings

- They have a high surface area to volume ratio, and therefore make good catalysts.
- They can also be used to produce highly selective sensors.
- Nanotubes could make stronger, lighter building materials.
- New cosmetics, e.g sun tan cream and deodorant. They make no white marks.
- Lubricant coatings, as they reduce friction. These can be used for artificial joints and gears.
- Nanotubes conduct electricity, so can be used in small electrical circuits for computers.





4. Explain the properties fullerenes and graphene in terms of their structures

- Fullerenes
 - Carbon can also form fullerenes with different numbers of carbon atoms.
 - Molecules of carbon atoms with hollow shapes
 - They are based on hexagonal rings of carbon atoms, but they may also contain rings with five or seven carbon atoms
 - The first fullerene to be discovered was Buckminsterfullerene (C₆₀), which has a spherical shape
 - Carbon nanotubes
 - Cylindrical fullerenes with very high length to diameter ratios
 - Their properties make them useful for nanotechnology, electronics and materials
- Graphene
 - Graphene
 - Single layer of graphite
 - Has properties that make it useful in electronics and composites (good electrical conductor-same as graphite and is very thin)

5. Explain the possible risks associated with some nanoparticulate materials including:

- Possible effects on health due to their size and surface area
 - Might be able to enter the brain from the bloodstream (due to the small size) and cause harm
- Reasons that there is more data about uses of nanoparticles than about possible health effects
 - Many think that more tests should be done before they start to be used
- The relative risks and benefits of using nanoparticles for different purposes:
 - for some uses, the risks would be seen to outweigh the benefits, and vice versa for others

6. Estimate size and scale of atoms and nanoparticles including the ideas that:

- Nanotechnology is the use and control of structures that are very small (1 to 100 nanometres in size)
- Data expressed in nanometers is used to compare the sizes of nanoparticles, atoms and molecules





7. Interpret, order and calculate with numbers written in standard form when dealing with nanoparticles

- A positive power used in standard form means that the number is very large e.g. 6.02×10^5 is the same as 602000 (move the decimal place over to the right 5 times since 5 is the exponent/power)
- A negative power used in standard form, means that the number is very small e.g. 6.02×10^{-5} is the same as 0.0000602 (move the decimal place over to the left 5 times since -5 is the exponent/power)

8. Use ratios when considering relative sizes and surface area to volume comparisons

- for example: if the surface area is 24 and the volume is 8, then the surface area to volume ratio will be 24 to 8 or 3 to 1, we would express this mathematically as 3:1

9. Calculate surface areas and volumes of cubes

- Surface area:
 - o Multiply the length by the width to find the area
 - o Multiply the area by six (because a cube is made up of six perfect squares)
- Volume:
 - o Multiply the length by the width by the height (for a cube each of these is exactly the same, therefore you can multiply the length of any size three times)

