Bulk and surface properties of matter – nanoparticles

Compare size of nanoparticles with the sizes of atoms and molecules

 $1nm = 1 \times 10^{-9}m$ Contain a few hundred atoms Bigger than simple molecules

Fullerenes are nanoparticles

High surface area:volume ratio: gives nanoparticles different properties to 'bulk' chemical it's from

grater proportion of atoms available to interact with substances that come in contact

nanoparticulate material proportions in relations to their uses – surface area:volume ratio of particles they contain

Sunscreens - titanium dioxide: doesn't leave white marks on skin - small size, absorbs UV

Nano-medicine: fullerenes absorbed more easily

Lubricant coatings using fullerenes: artificial joints / gears

Nanotubes: conduct electricity, used in tiny electric circuits

Make plastics more strong/durable without adding mass – sports equipment

Silver nanoparticles added to polymer fibres: gives them antibacterial properties – surgical masks / wound dressing Huge surface area to volume ratio: good catalysts - reactions take place on surface of catalyst: more collisions with surface = faster rate of reaction

risks of nanoparticulate materials

Don't break down easily - build up in cells Side-effects/long-term impacts not known – new technology Small size – breathed in / pass through membranes Can catalyse harmful reactions

Cheap Less dense – used for products that need low mass Thermal/electrical insulators Degrade/breakdown – don't latters **Ceramics** Insulate heat/electricity Brittle

Brittle Strong/hard-wearing Don't degrade/corrode – last long Clay Mineral – formed from weathered/decomposed rock Soft – easy to mould Hardened with high temperatures

composites

Fibreglass/concrete Made from one material & embedded in another Expensive Can be designed to have specific properties for specific purpose

Metals

Conduct heat/electricity High-density Malleable – variety of shapes Some corrode - some corrosion resistant Less brittle – likely to deform but won't shatter Can be mixed with other elements to form alloys Glass Transparent/strong Moulded when hot Brittle when thin Soda-lime glass: made by heating limestone / sand / sodium carbonate

heat-resistant