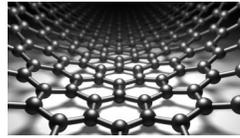


Core Technical Principles Developments in New Materials

A: Graphene

A very thin two-dimensional material layer of carbon that was first discovered and extracted from graphite in 2004.

- a very strong and light material
- harder than diamond
- around 200 times stronger than steel
- currently the lightest known material
- transparent
- conducts electricity and heat even better than copper
- extremely flexible which is unusual for such a tough, strong material



Uses: conductive ink, solar cells, modern tennis rackets
Future uses: aerospace, water purification, corrosion resistant paint, flexible electronics

B: Metal foam

A metal such as aluminium, steel or titanium can be made into a foam by injecting gas into the metal when it is in a liquid state. This creates a foam that is very lightweight and strong under compression.

Uses: lightweight car parts (for soundproofing and crash protection), bone implants, body armour, prosthetics for animals



C: Titanium

The fourth most abundant metal which makes up about 0.62% of the Earth's crust. In the 1930s a process was developed to allow titanium to be extracted easily.

- extremely corrosion resistant
- high strength-to-weight ratio
- difficult and expensive to machine
- can be alloyed with other metals such as aluminium

Uses: bone replacements, dental implants, bikes, ships, armour, aeroplanes, spacecraft



D: Modern Materials

New materials that have been developed to have properties that are useful when designing and making products. They are developed by inventing new or improved manufacturing processes.

E: Coated metals

By coating metals with a different material, their properties can be altered. Coated metals include anodised aluminium, nickel-plated steels, galvanised iron or steel and polymer coated aluminium or steel.

- anodised aluminium is aluminium with a coating of aluminium oxide. This increases resistance to corrosion and wear and makes it easier to paint and glue.
- nickel-plated steel uses electrolysis to add the metal nickel to a steel object. in order to make it corrosion resistant and to give it an attractive finish.
- galvanised iron or steel are coated with zinc to prevent corrosion.
- polymer coated aluminium or steel can be made by dip coating or powder coating the metal. Both processes create a layer of the polymer around the metal which reduces the impact of exposure to air and moisture and gives an attractive, colourful finish to the product.

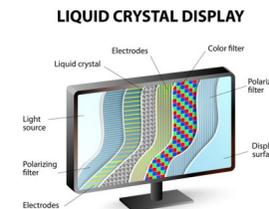
Uses: dishwasher racks, tool handles



F: Liquid crystal display

A liquid crystal display (LCD) is a laminated material with two layers of glass and a liquid core. It is a thin panel that allows light go through when a voltage is applied or blocks the light when the voltage is switched off.

- LCDs are used in flat screen displays that are thin, lightweight and energy efficient
- some LCDs need a back light to work (smart phones, computer monitors and televisions)



G: Nanomaterials

Materials made of tiny particles (nanoparticles). These particles have always existed but our ability to manipulate them for specific purposes is a fairly recent development.

Uses: sports equipment (to make the materials stronger without adding a lot of weight), clothing e.g. socks (due to their antibacterial properties to reduce the absorption of sweat).

H: Teflon

This is the trade name for a polymer called polytetrafluoroethene (PTFE).

- best known for being used on the surface of non-stick saucepans
- a slippery material, so used in clothing to make it difficult for dirt to stick to the fabric
- unreactive, so used to make pipes and containers for chemicals



I: Starch-based polymers

These were developed to replace the use of oil-based polymers. They are made from polylactic acid which can be found in high starch vegetables such as potatoes, corn and maize.

- made from renewable materials
- don't take as much energy to produce as the extraction of oil
- biodegradable unlike oil-based polymers
- some have been developed to be a food for marine life when they are discarded
- they are food safe

Uses: disposable cutlery, food packaging, packaging peanuts



J: Keyword

- Modern material: a material that has recently been developed for specific applications

K: Video and web-links

- GCSE bitesize: <https://www.bbc.com/bitesize/guides/zfq8jty/revision/1>

Revision Checklist

I can recognise and characterise different types of modern materials	
I understand how the physical and working properties of a range of modern materials affect their performance	
I can identify the uses of a range of modern materials	