

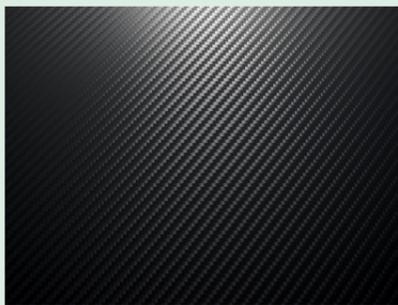
Modern materials

Specific modern materials are often designed for a particular purpose, or alternatively, the materials' properties are used by designers to improve products.

Carbon fibre is used in the design and manufacture of racing bicycles because of its:

- high strength and low weight
- ability to be shaped into complex forms
- smooth finish
- ability to be sprayed and lacquered to present a high-quality performance sporting product which outweighs products made from other materials like steels and aluminium alloys.

Carbon fibre is used in the form of matting to create the bicycle frame, with a plastic resin to form an incredibly strong material that can withstand enormous forces.



Kevlar is a trade name given to a modern fibre-based material which is commonly spun into sheets of fabric and used to produce protective clothing. Kevlar can be used with other materials to form a composite and is commonly used in the aerospace industry in jet engine linings.



SMART materials and products

- **SMART materials** change in reaction to external stimuli.

The use of SMART materials in products has had an innovating effect in a number of ways:

- products can often become more interactive as a result of the use of the SMART material
- products do not require user input to change, the SMART material reacts automatically
- products can be repaired or even self-repair once a fault develops
- products can become more efficient as a result of the use of the SMART material.

Nanomaterials

Nanomaterials are between 1 and 100 nanometres (one thousand-millionth of a metre). These tiny nanomaterials include carbon nanotubes, fullerene and quantum dots. Nanomaterials are used in car manufacturing to produce faster, safer and more efficient cars. They are also used to produce more efficient lighting and insulation systems. They also coat electronic components in computer systems.

Titanium is a very versatile, strong and lightweight metal usually used in alloys with other metals. Pure titanium is useful for replacement joints, limbs and dental implants as part of the healthcare industry. The human body does not react to titanium and therefore this material can be implanted into the human body without rejection or problem.

Innovative use of SMART materials

- **Thermochromic paints or pigments** - can allow a product to change colour with temperature change; coffee mugs and children's products use thermochromics to provide aesthetic feedback to the user.
- **Photochromic pigments or films** - can be applied to office windows and spectacles, to darken glass when sunlight is strong, and return to transparent when sunlight levels are low.
- **Shape memory alloys (SMAs)** - can be heated and 'programmed' to a specific shape. This shape becomes the memory shape that the material returns to once heated again. Perfect for children's spectacles which, once buckled or damaged, can be repaired quickly and simply.
- **Hydrochromic paint** - is used in mobile phone technology; it changes colour to identify if a mobile phone has sustained water damage.
- **Phosphorescent materials** - absorb day light and store it, so that once it is dark, a symbol or shape can appear illuminated or glow. Fun products like stars for children or watch face decals benefit from this.
- **Polymorph** - is a thermoplastic that can be heated and shaped repeatedly, hardening similar to nylon when set.