

What is a SMART material?

- A 'smart material' can be defined as a material whose physical properties change in response to an input e.g. making them simpler or safer to use.
 - A smart material reacts to external stimulus / changes in the environment without human intervention.
- Designers and manufacturers are utilising SMART materials in a whole range of mass consumer products which often makes them simpler or safer to use.

Smart Material	Property
Hydrochromic ink	Changes colour with water
Thermochromic pigment/ paint	Changes colour with heat
Photochromic materials/dye	Changes colour with light
SMA -Shape Memory Alloy	Changes shape with heat
Phosphorescent Material	Glow in the dark
QTC- Quantum Tunnelling Composites	Soft electrical switch
Polymorph	A thermoplastic used for modelling which can be re-heated and reshaped.

Phosphorescent Materials

Absorb day light, store it and release it during periods of darkness. This has been extensively used for safety lighting, signage, watch faces and those glow in the dark stars kids have on their bedroom ceilings.



QTC (Quantum Tunnelling Composite) is a simple soft switch material that allows an electrical current to flow when compressed. We can use it in children's toys or in many textiles products such as the jacket below



Polymorph is a clever thermoplastic which we can use for prototyping and is especially useful when it comes to modelling ergonomic grips. As it is thermoplastic you can reheat and reuse this material as many times as you wish.



Thermo-chromic paints can be added to any surface like these mugs or a textiles or card based product to react to heat.



Hydro-chromic paint is added to the charger socket of the Apple iPhone so apple knows when there has been water damage which voids the warranty.



Thermo-chromic pigments are added to plastics and react to specific temperatures. One use is enhancing the safety of a babies bowl.



Shape Memory Alloys (Nitinol) change shape easily but always return to their original shape when they are heated or an electrical current is used. There are many applications such as dental braces, heart surgery and unbreakable spectacles.



Photochromic pigments react to changes in light (ultraviolet UV). One example is reaction lenses where they darken with sunlight.



Electroluminescent Materials can produce a brilliant light when an electric current is passed through. Light generated in this way produces no heat. Uses: Clothing, illuminate emergency exits.



Micro- encapsulation

Self-healing polymers react to stress fractures by releasing a resin from the microcapsules into the new crack created due to the stress. Used in self-healing concrete.



Microcapsules ruptured by fracture



Polymer resin is released into fracture



Resin hardens and heals damage

Piezoelectric material reacts to movement or stress and it creates electricity. Piezo transducer- Using a thin layer of piezoelectric material, small transducers vibrate when an electrical signal is sent through the contacts. These are used in mobile phones, toys.



Thermo-chromic
Hydro-chromic
Photo-chromic
SMA (Smart Memory Alloy)
Phosphorescent
QTC- Quantum tunnelling composite
Polymorph
Micro-encapsulation
Electroluminescent materials/film
Piezoelectric materials



To help you remember the uses focus on the spelling for clues to its reactions, such as those below.

Thermo = heat
Photo = think light from a photo flash
Hydro = water
Chromic= colour change

Design and Technology

Title: Smart Materials