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- ▶ **Materials Technology**
 - ▶ **Classification of Materials**

Classification of Materials

- ▶ **Materials used in the design and manufacture of products**

- Plastics
- Wood
- Composites
- Ceramics
- Metals
- Fabrics



Steel, aluminium

Linen, cotton, nylon, Kevlar

Tungsten carbide tool bit

Balsa wood model

Acrylic lens

Layers of polycarbonate, aluminium & acrylic

Classification of Materials (Plastics)

- ▶ Plastics can be further classified as;
 - Thermoplastic
 - Thermoset
 - Elastomers

Thermoplastics	Thermosets	Elastomers
Acrylics	Epoxy resins	Rubbers
Nylons	Phenolic	Silicones
PVC	Polyesters	Polyurethanes
Polyethylene		



Phenol formaldehyde
PVC
polyethylene

Rubber

Classification of Materials (Wood)

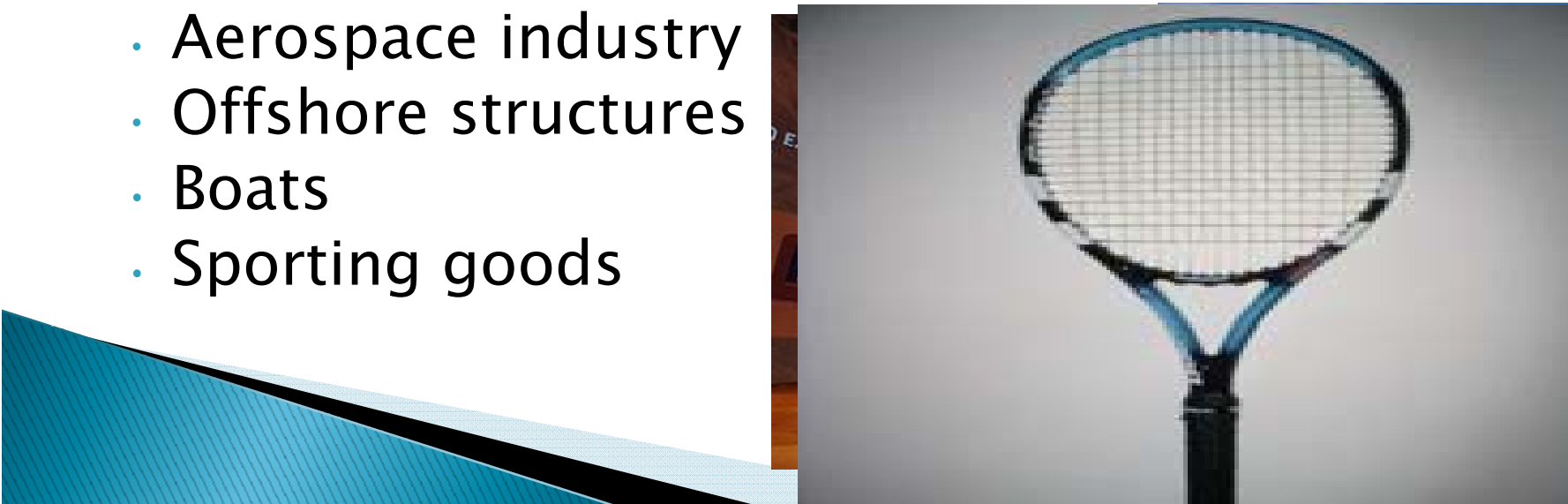
- ▶ Wood can be further categorised as;
 - Hardwood
 - Softwood
 - Manufactured board

Hard wood	Softwood	Manufactured Board
Oak	Pine	Plywood
Ash	Cedar	Blockboard
Beech	Fir	MDF
Sycamore	Spruce	Melamine board



Classification of Materials (Composites)

- ▶ A composite is a combination of two or more chemically distinct materials whose physical characteristics are superior to its constituents acting independently.
- ▶ Because of their high strength/stiffness to weight ratio they are widely used in the;
 - Aerospace industry
 - Offshore structures
 - Boats
 - Sporting goods



Classification of Materials (Composites)

- ▶ Examples of composites include;
 - Reinforced Plastics
 - Ceramic–matrix
 - Metal–Matrix
 - Laminates



Classification of Materials (Ceramics)

- ▶
- ▶ Ceramics are compounds of metallic and non-metallic elements, examples include:
 - Oxides (alumina – insulation and abrasives; zirconia – dies for metal extrusion and abrasives)
 - Carbides (tungsten-carbide tools)
 - Nitrides (cubic boron nitride, 2nd in hardness to diamond)



Classification of Materials (Metals)

► Metals can be further classified as Ferrous & Non-Ferrous, some examples include;

Ferrous	Non-Ferrous
Steels	Aluminium
Stainless Steels	Copper
High Speed Steels	Brass
Cast Irons	Titanium



Classification of Materials (Fabrics)

- ▶ Fabrics can be further classified as natural and synthetic

Natural	Synthetic
Cotton	Nylon
Canvas	Polyester



Classification of Materials (Smart Materials)

▶ A smart material can be described as a material that has a useful response to external influences or stimuli.

There are many examples of smart materials in everyday use that are not modern developments they include;

- Metal springs
- Light bulbs self regulate because as the filament temperature increases their resistance rises
- Ancient civilisations have long used porous ceramics for self regulating cooling



Wine Cooler

Materials)

▶ Other more modern examples of smart materials include;

- Shape memory polymers and alloys

 - Heat shrink tubing and packaging

 - Automatic actuators – open/close greenhouse windows

 - Thermostats for heating control

- Smart Link Silicone

 - Allows rotary motion between shafts up to 360°

- Smart Fluids

 - Motion control gel – CD tray opening/closing, camera lenses

 - Ferro fluids – earthquake dampers in buildings, hard disks

- Piezoelectric Materials

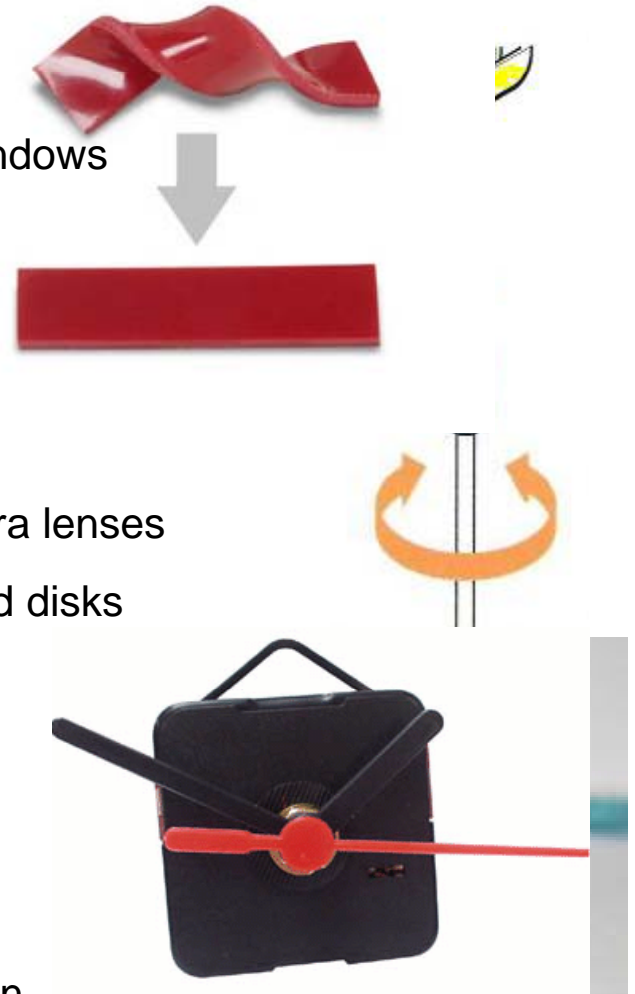
 - Sensors, musical cards, motors, actuators, clocks

- Smart Wire

 - Actuators, linear, angular and rotary

 - Anthropomorphic actuation – human like robotic motion

- Chameleon Colours



Classification of Materials (Smart Materials)

▶ Other more modern examples of smart materials include;

- Polymorph

This is a unique polymer that fuses in hot water and can then be moulded to any form. When solid it has similar properties to nylon

Used to make the moulds for the vacuum formed seat and fuel tank of this motorcycle project



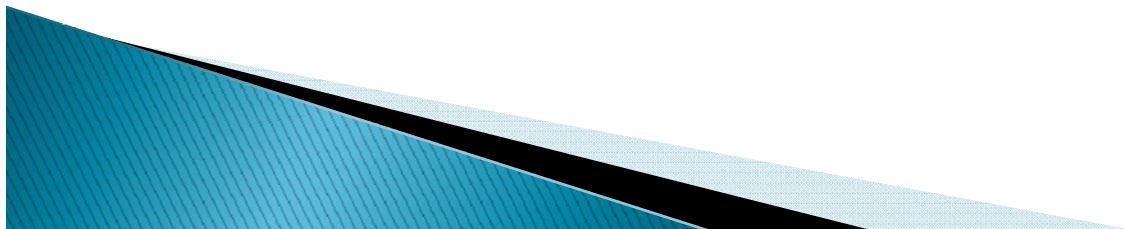
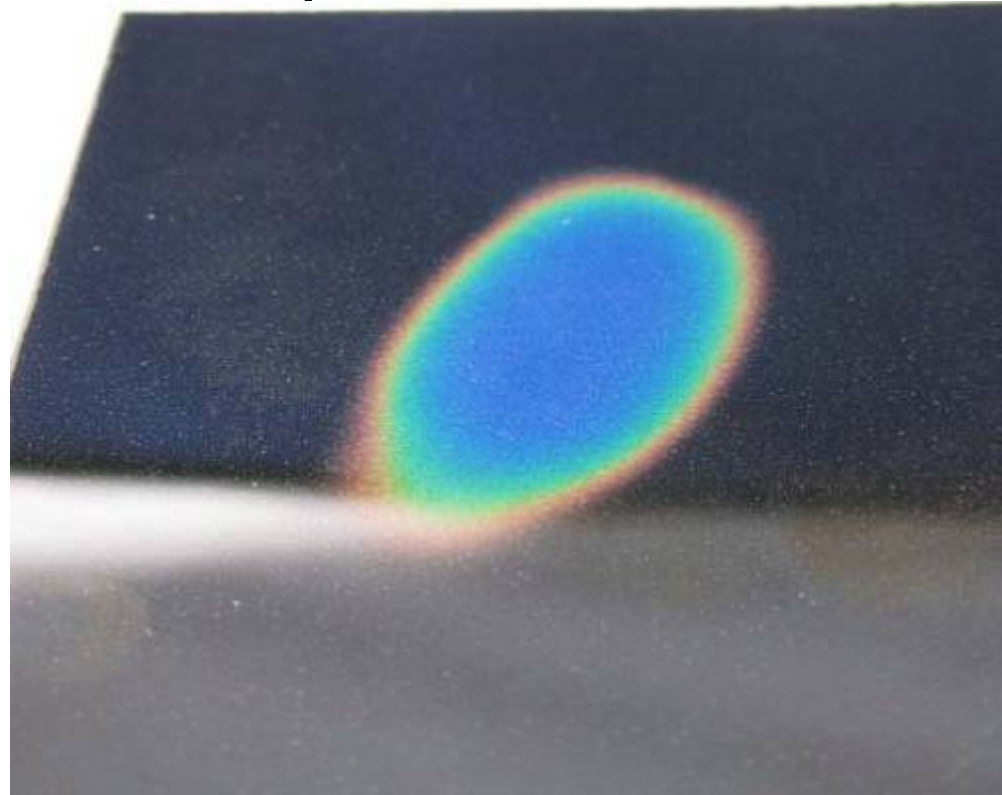
Classification of Materials (Smart Materials)

(Smart Materials)

▶ Other more modern examples of smart materials include;

- Thermocolour Sheet

This is a self adhesive sheet whose colour changes according to the temperature. Used for thermometers, heat warning patches and novelty advertising of products

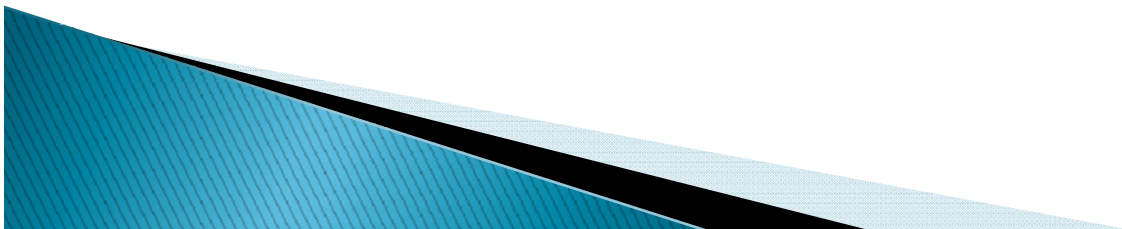
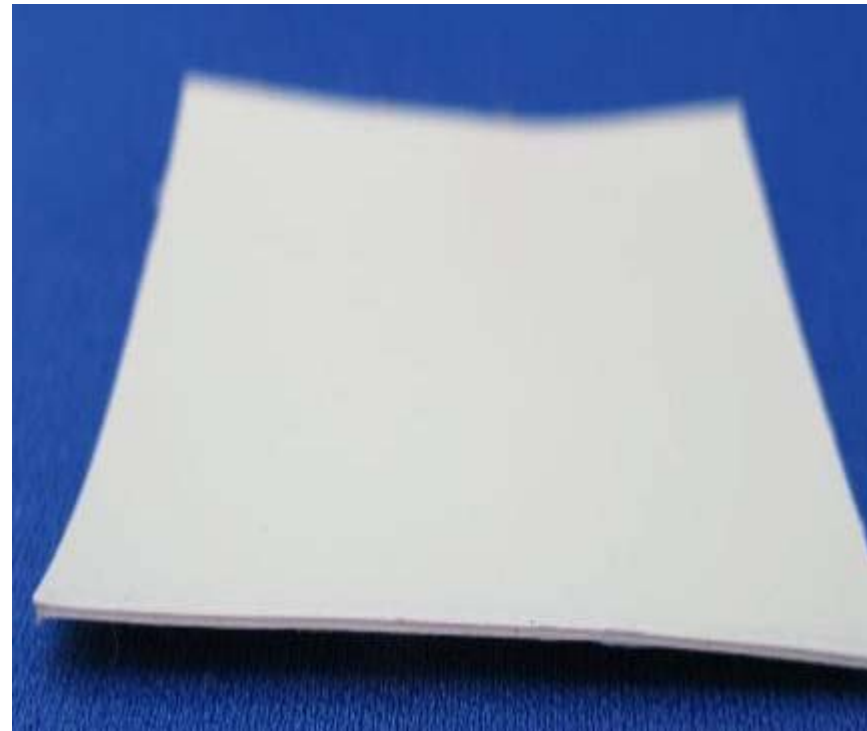


Classification of Materials (Smart Materials)

(Smart Materials)

- ▶ Other more modern examples of smart materials include;
 - Phosphorescent Sheet

This is a sheet that absorbs light energy and re-emits it as white light for up to eight hours. Used extensively for emergency lighting in the event of a power cut

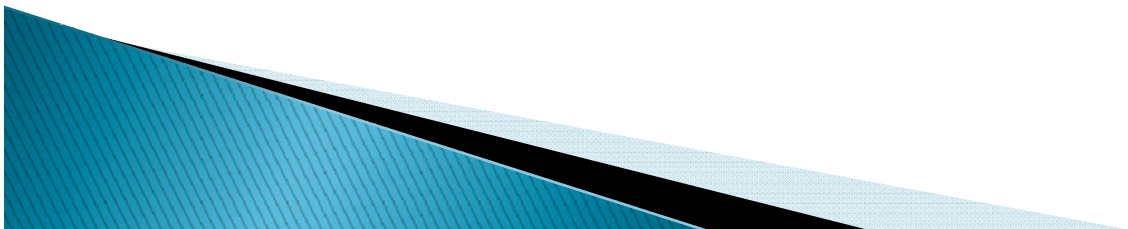
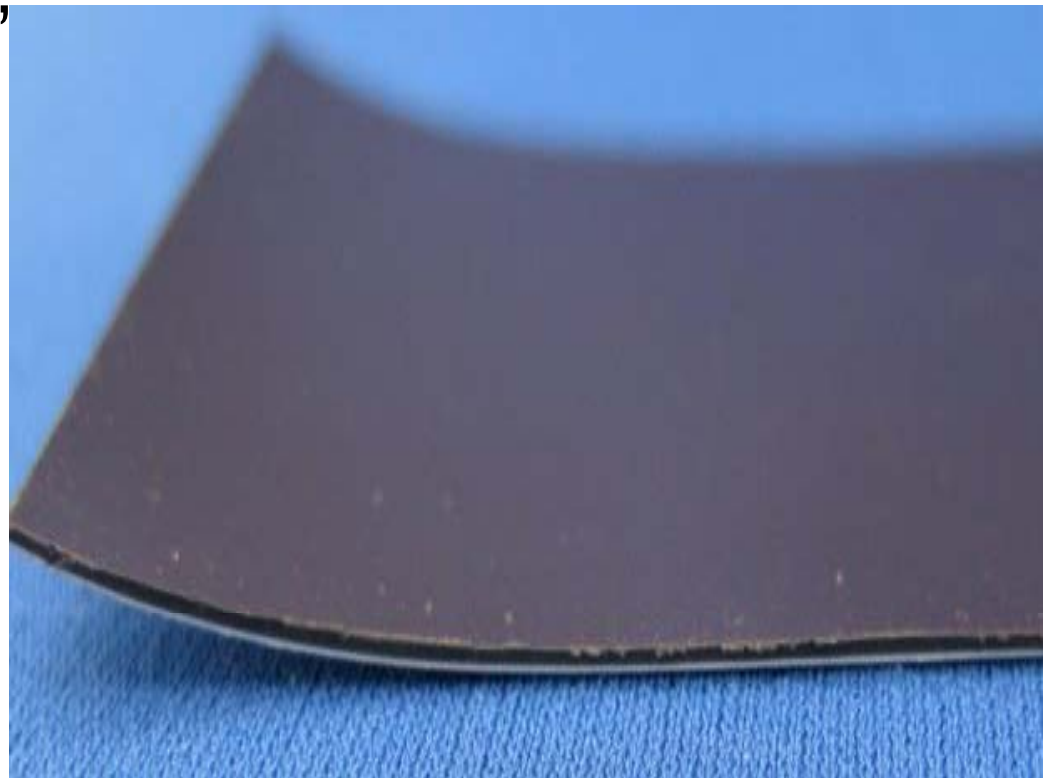


Classification of Materials (Smart Materials)

▶ Other more modern examples of smart materials include;

- Magnetic Sheet

This is a flat polymer magnetic sheet as used in fridge magnets. Also available in thin A4 sheets that can be printed on



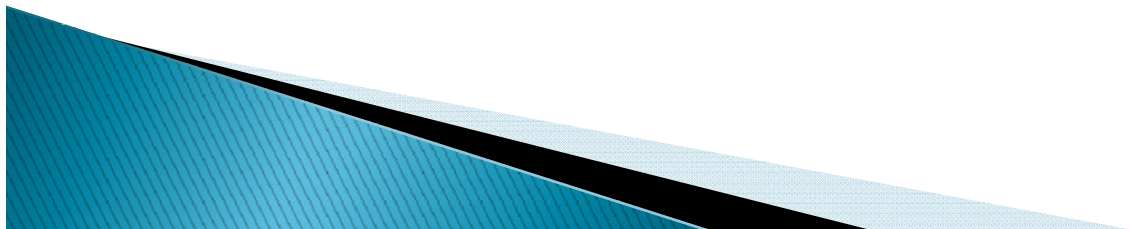
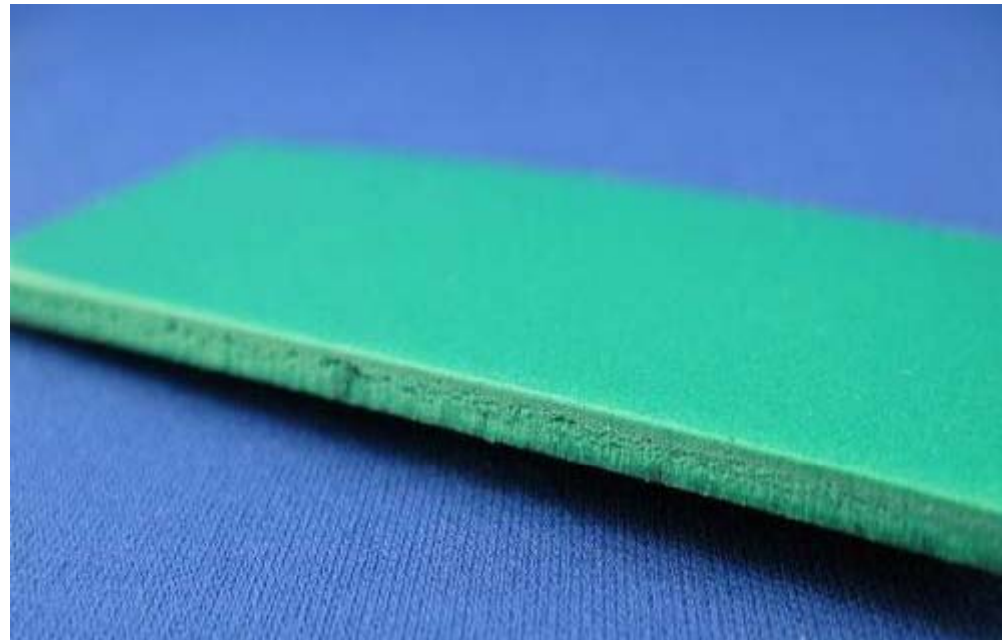
Classification of Materials

(Smart Materials)

▶ Other more modern examples of smart materials include;

- Rigid PVC Foam Plastic

This is a new generation of sheet material used widely for signs and exhibitions. Thermoforms very well. It is widely used for 'plug and yoke' mouldings



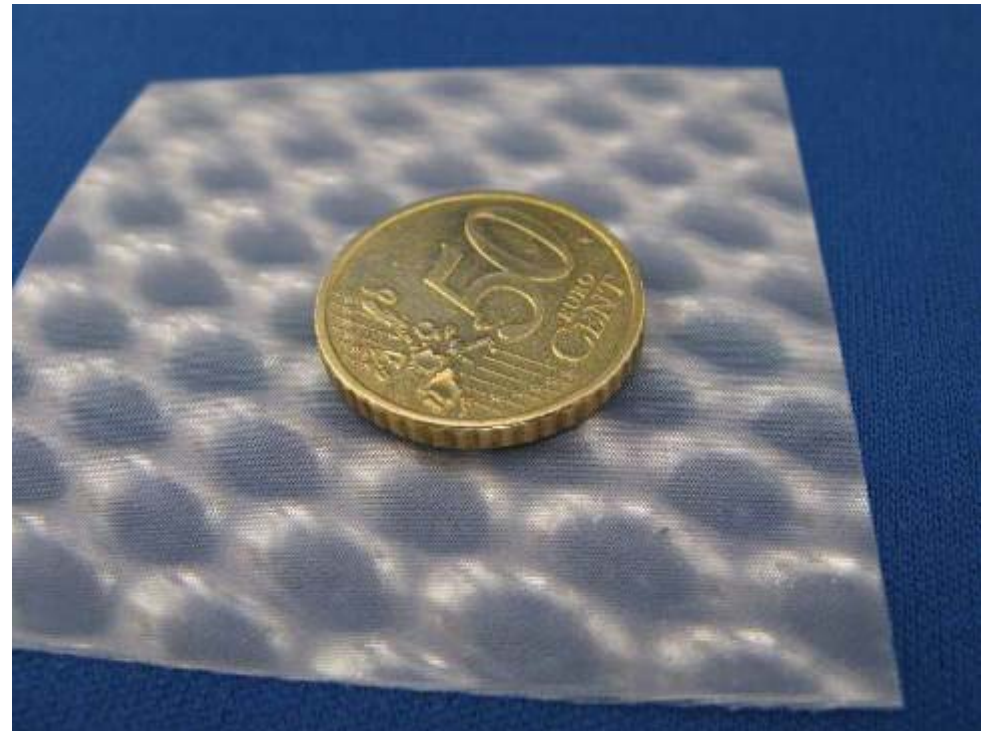
Classification of Materials

(Smart Materials)

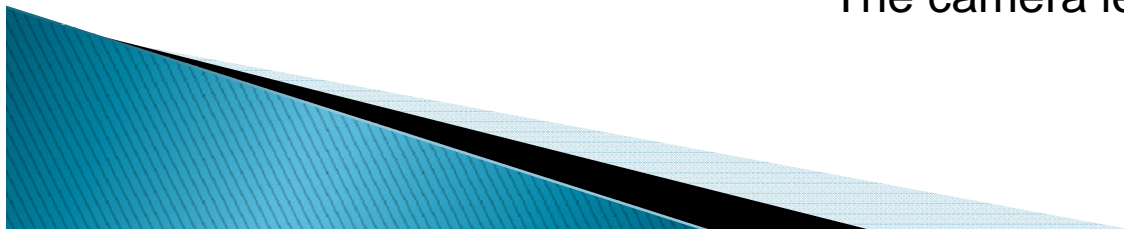
▶ Other more modern examples of smart materials include;

- Lenticular Sheet

This sheet is about 1mm thick but gives the illusion that it is nearer to 6mm thick. An object placed on the sheet appears to sink below the surface



The camera lens does not capture the effect



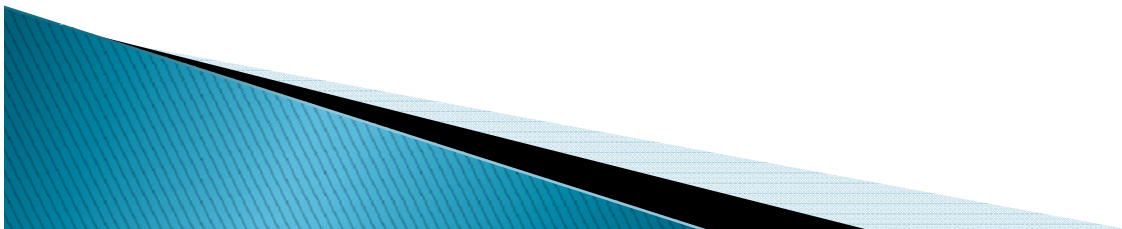
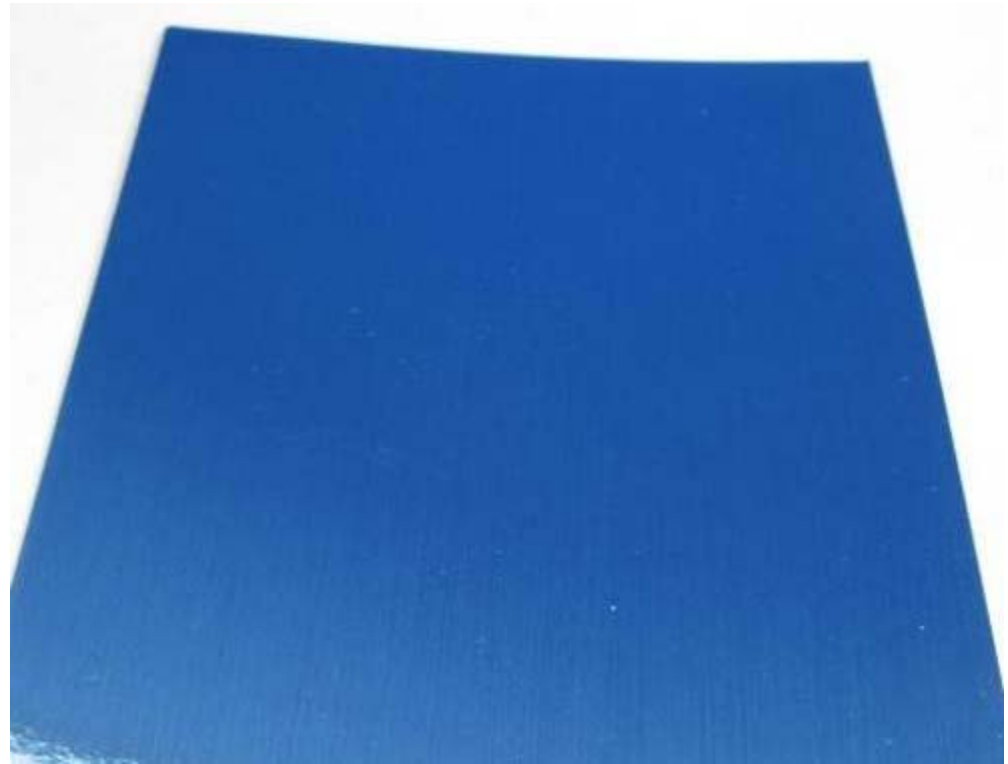
Classification of Materials (Smart Materials)

(Smart Materials)

▶ Other more modern examples of smart materials include;

- Anodised Effect Card

This is almost impossible to tell from the real thing. Ideal for project mock-ups. It is relatively cheap and cuts easily with a scissors or craft knife



Classification of Materials Materials)

(Smart

▶ Other more modern examples of smart materials include;

- Galvanised Effect Card

This is almost identical to the real thing. Ideal for project mock-ups. It is relatively cheap and cuts easily with a scissors or craft knife. Used for packaging of top branded goods



Classification of Materials

(Smart Materials)

▶ Other more modern examples of smart materials include;

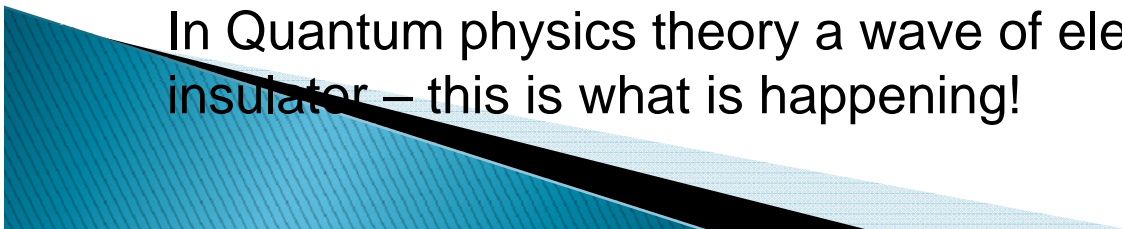
- Quantum Tunnelling Composite (QTC)

- A QTC in its normal state is a perfect insulator
- When compressed it becomes a perfect conductor
- If only lightly compressed its conductivity is proportional to the pressure applied

How does it work?

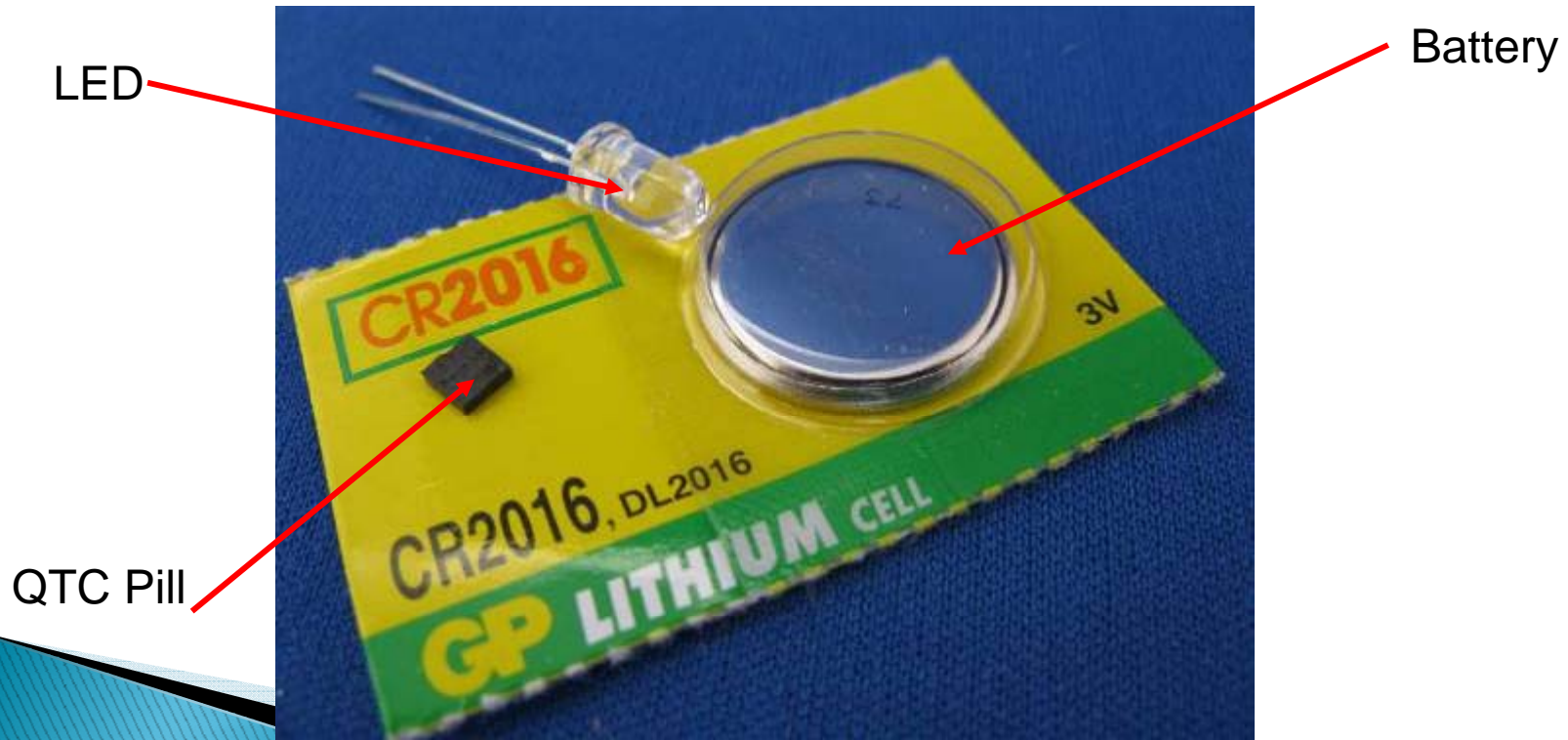
In normal physics an electron cannot pass through an insulation barrier.

In Quantum physics theory a wave of electrons can pass through an insulator – this is what is happening!



Classification of Materials (Smart Materials)

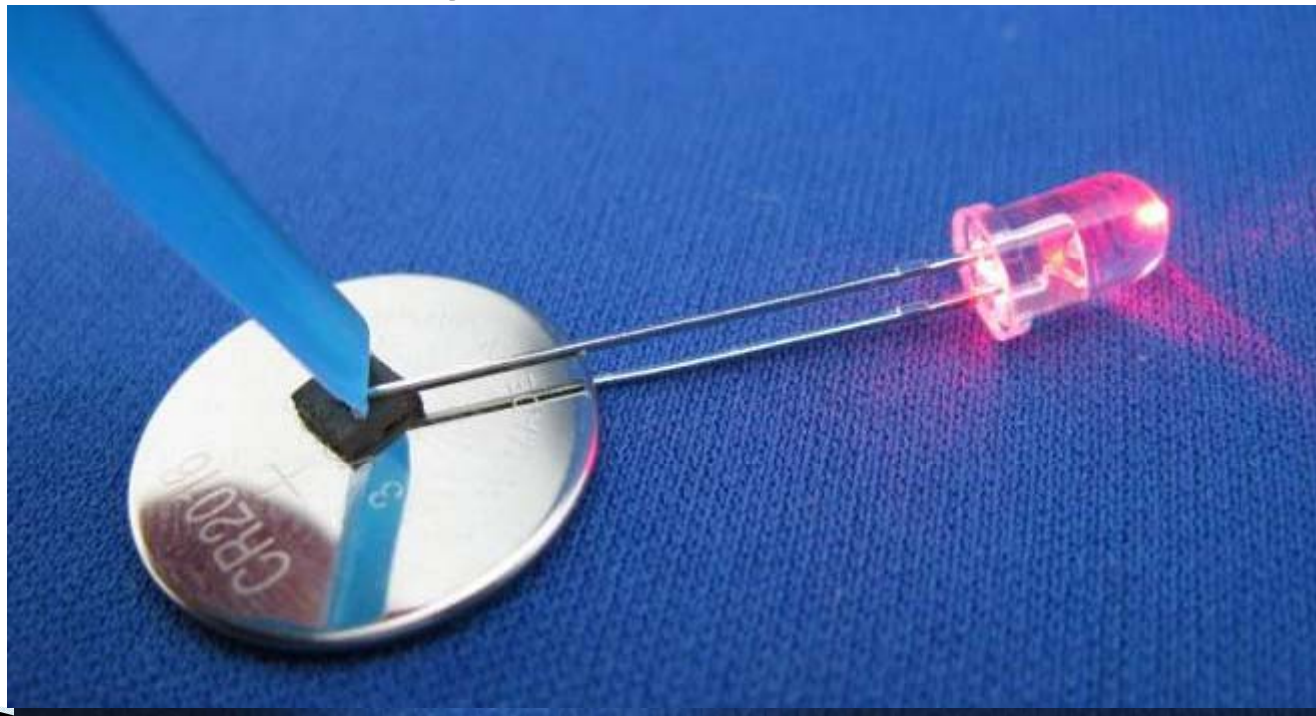
- ▶ Other more modern examples of smart materials include;
- Quantum Tunnelling Composite (QTC)



Classification of Materials (Smart Materials)

▶ Other more modern examples of smart materials include;

Quantum Tunnelling Composite (QTC)



Light Pressure being applied