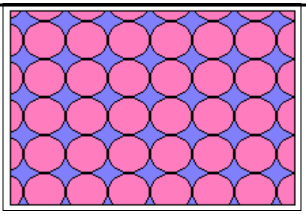
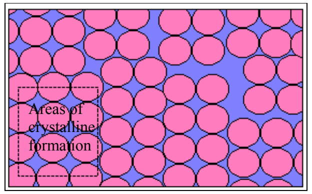
Chapter 5 Looking inside materials



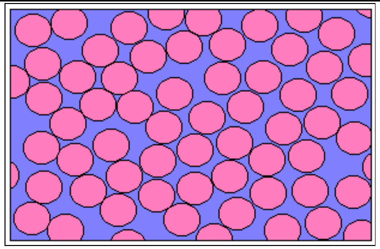
Crystalline:- Periodic repetition of a basic pattern of atoms, in three dimensions

eg Gem stones

Polycrystalline:- Crystalline structure within grains/crystals. Random arrangement of crystals

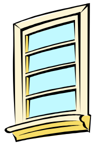


eg Metals



Amorphous:- no order to crystals or atoms

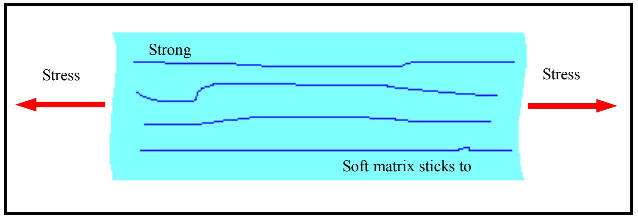
eg Glass

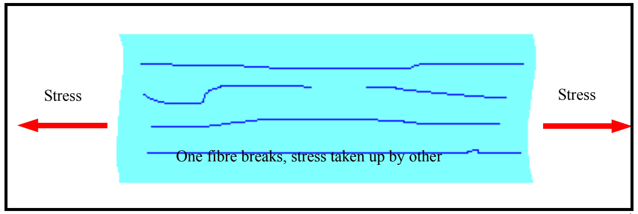


Fracture energy = total energy used to fracture / specimen cross-sectional area

Tensile strength = breaking force / specimen cross sectional area

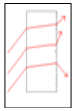
- Fibre reinforced materials are tough because cracks can't propagate through the soft matrix





Reflection and refraction

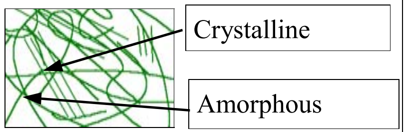
Frosted Glass: This is translucent. It lets most light though, but you cannot see things clearly through it. Light is reflected at all angles by a rough surface.



Car window glass: This is transparent until shattered in an accident. Then it appears white and opaque. Light is reflected and refracted many times by tiny fragments, emerging in many directions.

Polymers can be: Transparent or Opaque

In polythene, light is reflected and refracted at boundaries between crystalline and amorphous regions, which have different refractive indices. Perspex, which is all amorphous, is transparent.



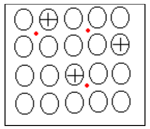
Frequent reflections and refractions make things translucent or opaque!

Semi conductors

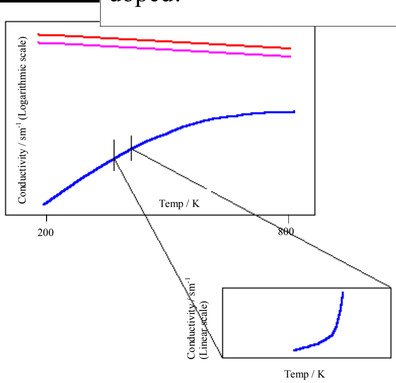
Conduct much less well than metals!

Only a few atoms are ionised (1 in 10^{12})! Only these conduct electricity.

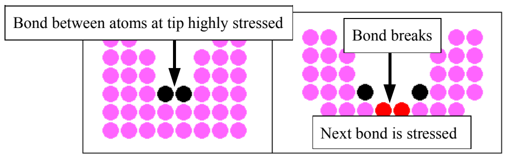
Pure



semicondeutors conduct better on heating because more atoms become ionised. Pure semiconductors can be doped!



- Under tensile stress, cracks propagate through material



Properties – The bonding and structure of a material explain whole sets of properties

METALS	because the free electrons in metals
conduct well	are mobile and so carry electric current
are shiny	oscillate in light, scattering light photons
are stiff	'glue' ions together strongly
are ductile	provide non-directional 'glue', letting ions slip
CERAMICS	because the ionic or covalent bonds holding them together
are insulators	lock electrons to ions or atoms, so none are free t move
are stiff	are strong bonds hard to stretch
are brittle	are directional bonds, so that atoms or ions cannot slip
POLYMERS	because the covalent bonds stringing monomers in long chains
are insulators	lock electrons to atoms, with none free to move
are often flexible	can rotate, letting chains stretch or fold
are often plastic	make chains which can slip past one another
CERAMICS, GLASSES & POLYMERS	because the are no free electrons to scatter light photons
either may be	
transparent	letting light straight through if the material is uniform throughout
opaque/translucent	refracting and reflecting light many times at boundaries between different regions.