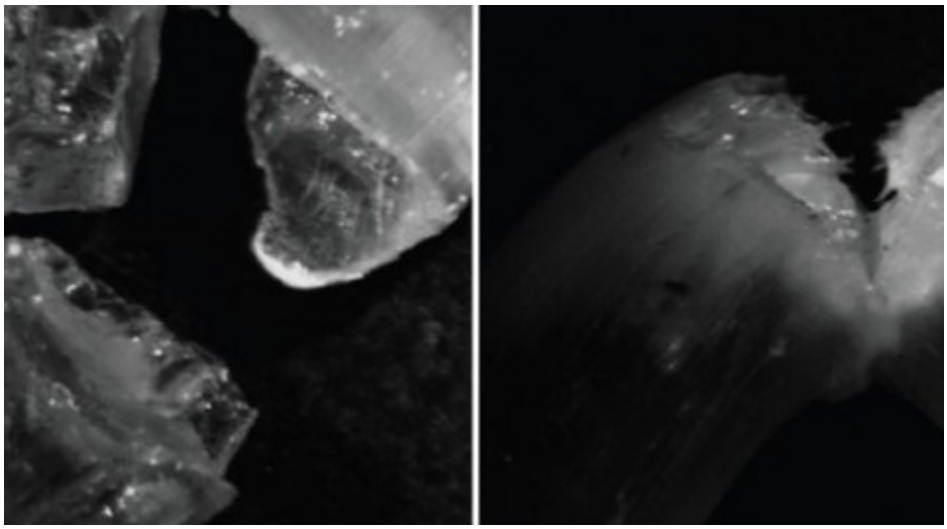
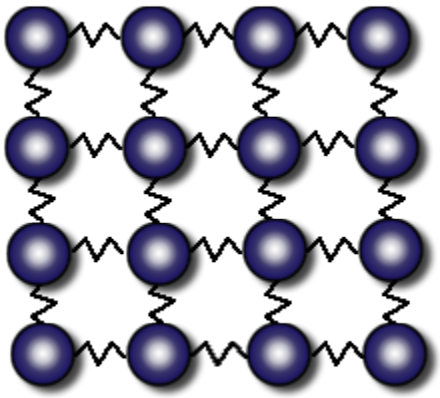
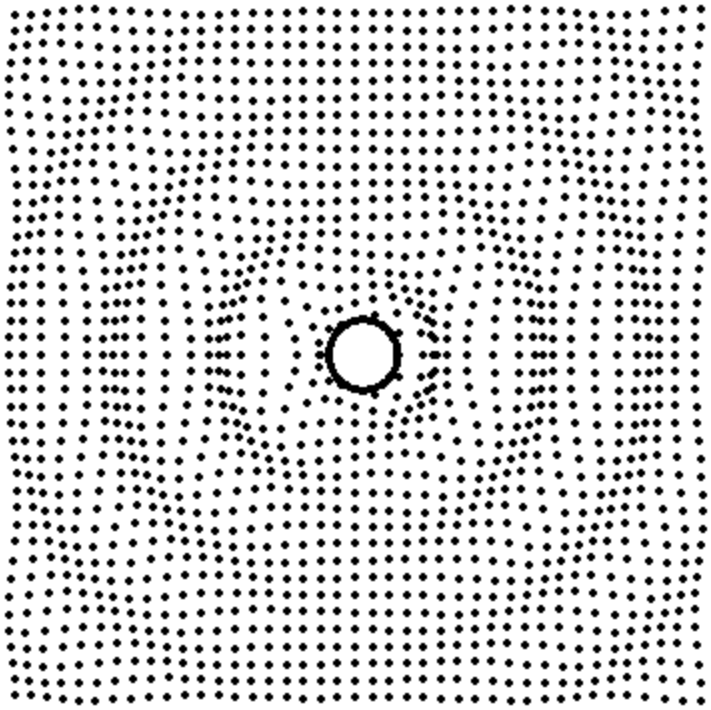
FRACTURING SOLIDS



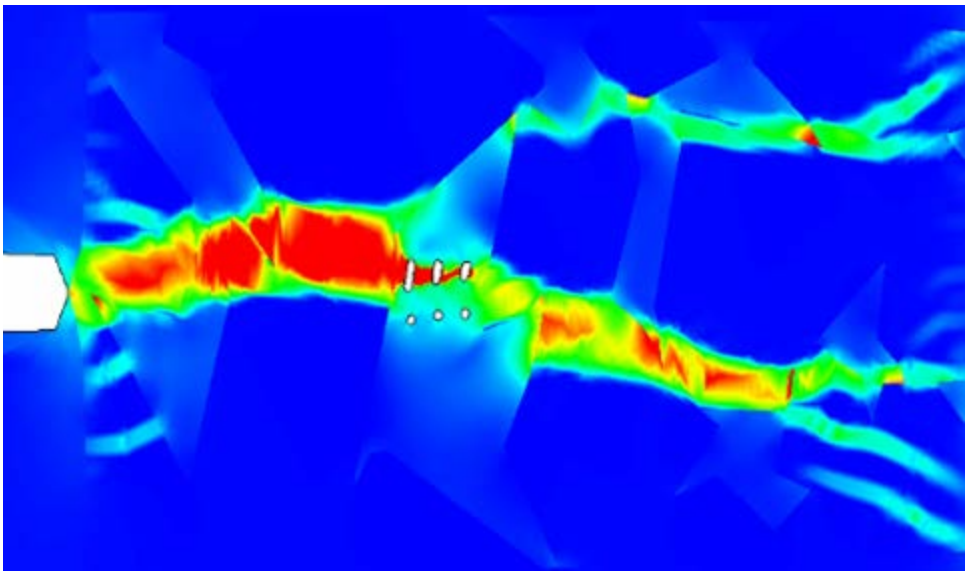
The nature of the conformation of the molecules in a solid and the way they are linked (in their crystal structure) provides electrical transmission properties and resistance to fractures.



When a solid is subject to a point of application of a force with an external kinetic force, it will occur a resistance force or tension between the molecules of the material which act in the opposite direction to stretch the solid.



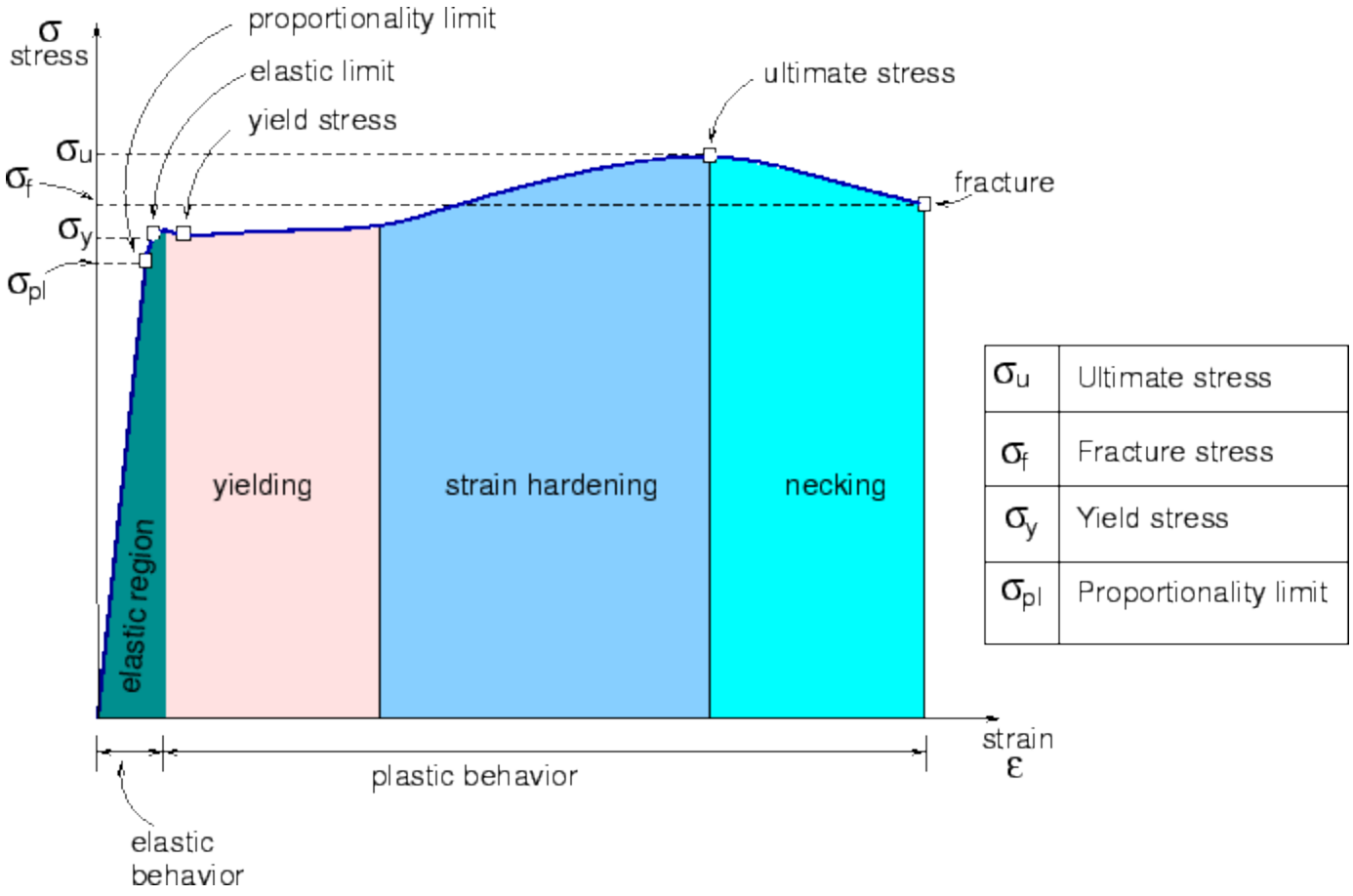
For a crack to occur, it has to be achieved energy levels sufficiently high to break bonds in the molecules of the solid.



Debajo de este límite, la materia se deforma elásticamente ante presiones y regresa a su forma original. Si la materia se somete a tensiones sobre este límite, la materia se deforma elástica y plásticamente, disipando energía.

Corners, flaws and cracks concentrate stresses. All solids have a “yield” which is the maximum stress that a material can withstand without suffering permanent deformations in its structure.

Below this limit, the material deforms elastically to pressure and returns to its original shape. If the material is subjected to tensions over this limit, the material deforms elastically and plastically, dissipating energy.



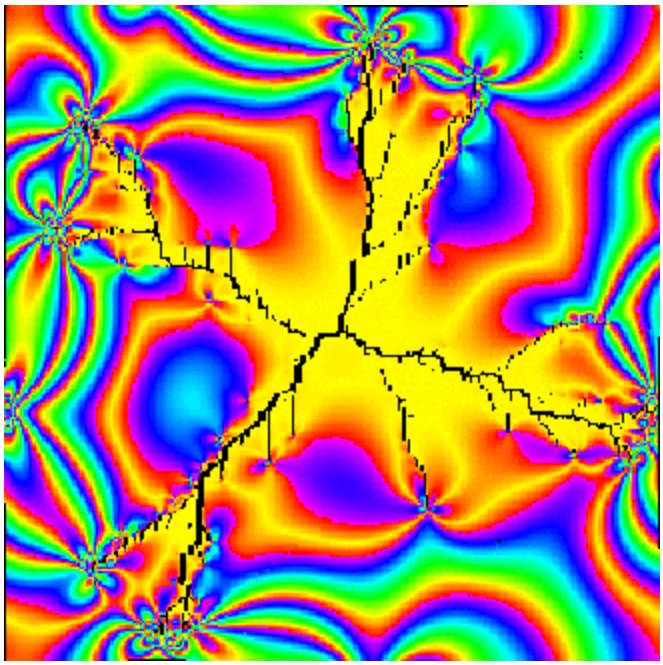
σ_u	Ultimate stress
σ_f	Fracture stress
σ_y	Yield stress
σ_{pl}	Proportionality limit

If energy stresses continue to exceed the “limits of toughness”, the material will reach a breaking point.

The “limit of toughness” of a material depends on the presence of defects and their size in the material.

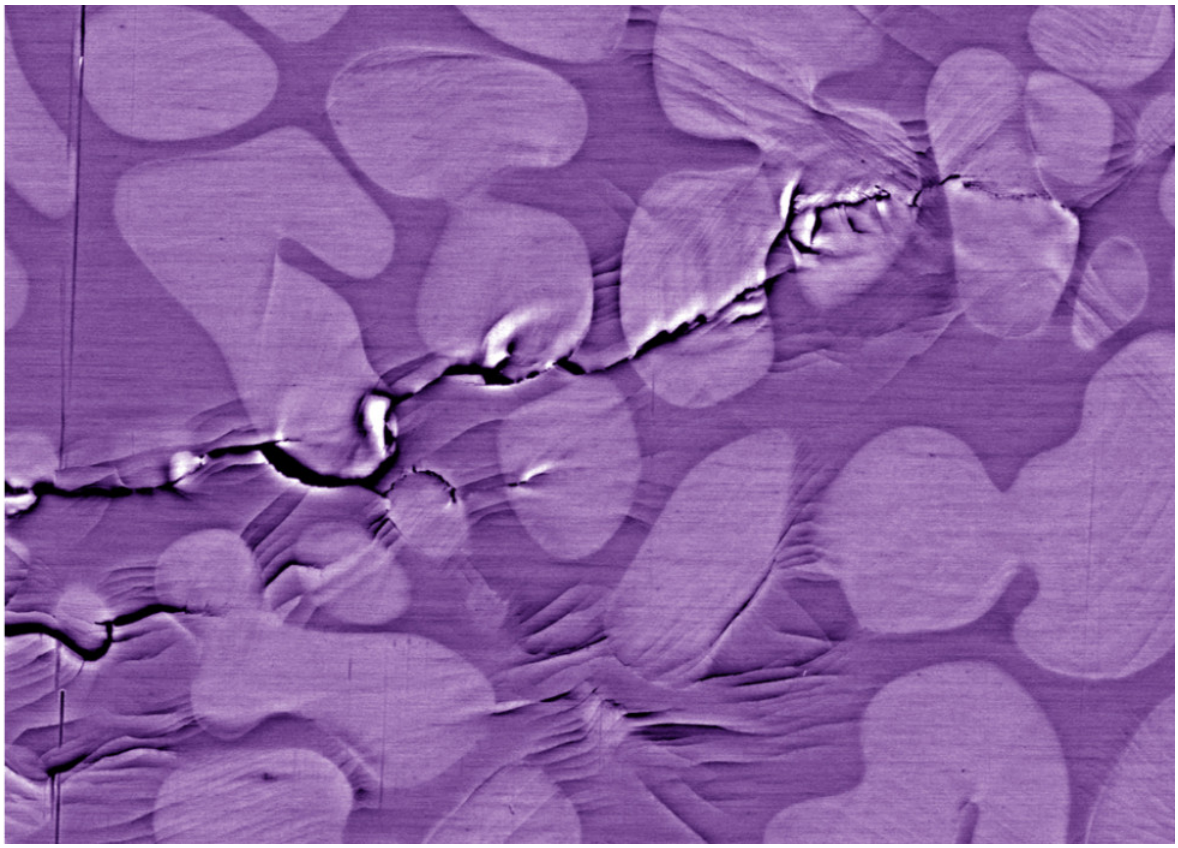
Usually the material will initiate its fracture in existing defects like cracks, propagating and creating new free surfaces through an energy consuming process.

If the material breaks, its internal cohesive forces are separated releasing energy that is dissipated as mechanical waves (sound) to the new surfaces.



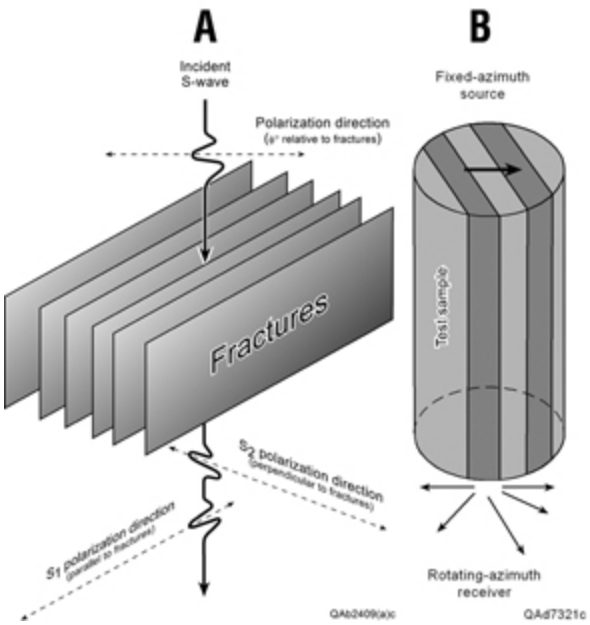
The crack propagation consumes energy as new surfaces are created, the material will deform plastically under stress and elastic mechanical energy is released through the matter.

The crack will propagate when the speed and intensity of the energy supplied to the system is greater than that consumed in the process by the forces of tension and cohesiveness in the material. As the crack grows, the material relaxes, decreasing the elastic energy in the material.



In general terms, the higher the kinetic energy is applied in the material, it will be favored a higher plastic deformationand kinetic energy in the material fractures are favored.

In grain boundaries of the material can inhibit the growth of cracks, while cavities can reduce the tenacity acting as crack initiators.



In ductile materials, at the end of the entire fissure, are developed plasticizing zones, decreasing stresses before their bonds are broken.

Source : http://www.artinaid.com/2013/04/fracturing-solids/