PHASE TRANSITION

The term ***phase transition*** (or **phase change**) is most commonly used to describe transitions between solid, liquid, and gaseous states of matter, as well as plasma in rare cases. A phase of a thermodynamic system and the states of matter has uniform physical properties. During a phase transition of a given medium, certain properties of the medium change, often discontinuously, as a result of the change of external conditions, such as temperature, pressure, or others. For example, a liquid may become gas upon heating to the boiling point, resulting in an abrupt change in volume. The measurement of the external conditions at which the transformation occurs is termed the phase transition. Phase transitions commonly occur in nature and are used today in many technologies.

- ***A metastable to equilibrium phase transformation. A metastable polymorph which forms rapidly due to lower surface energy will transform to an equilibrium phase given sufficient thermal input to overcome an energetic barrier.***
- ***A peritectic transformation, in which a two-component single-phase solid is heated and transforms into a solid phase and a liquid phase.***

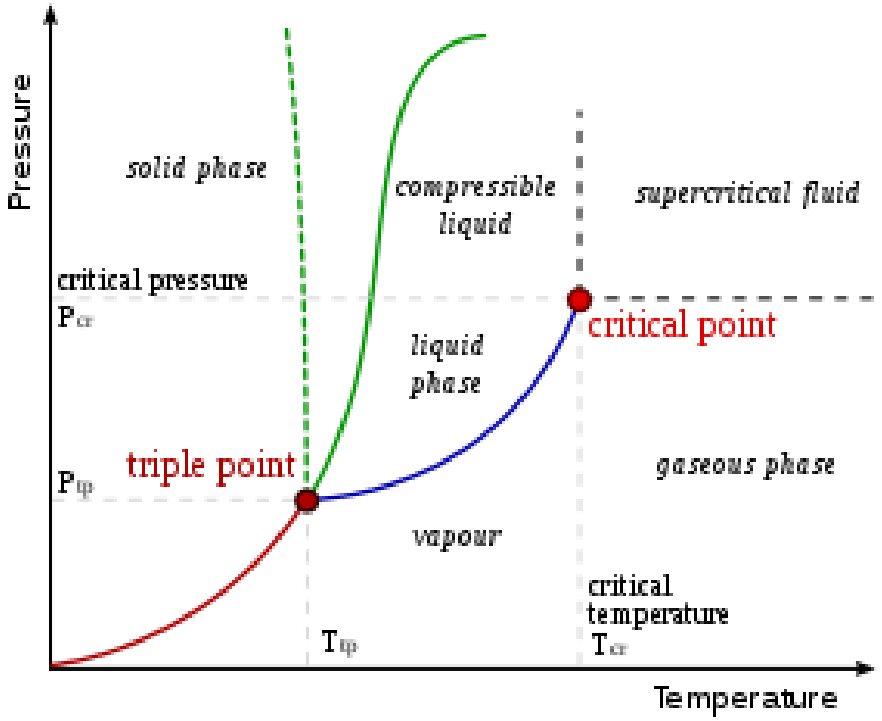
- *A spinodal decomposition, in which a single phase is cooled and separates into two different compositions of that same phase.*
- *Transition to a mesophase between solid and liquid, such as one of the "liquid crystal" phases.*
- *The transition between the ferromagnetic and paramagnetic phases of magnetic materials at the Curie point.*
- *The martensitic transformation which occurs as one of the many phase transformations in carbon steel and stands as a model for displacive phase transformations.*
- *Changes in the crystallographic structure such as between ferrite and austenite of iron.*
- *Order-disorder transitions such as in alpha-titanium aluminides.*
- *The dependence of the adsorption geometry on coverage and temperature, such as for hydrogen on iron.*
- *The emergence of superconductivity in certain metals and ceramics when cooled below a critical temperature.*
- *The transition between different molecular structures (polymorphs, allotropes or polyamorphs), especially of solids, such as between an amorphous structure and a crystal structure,*

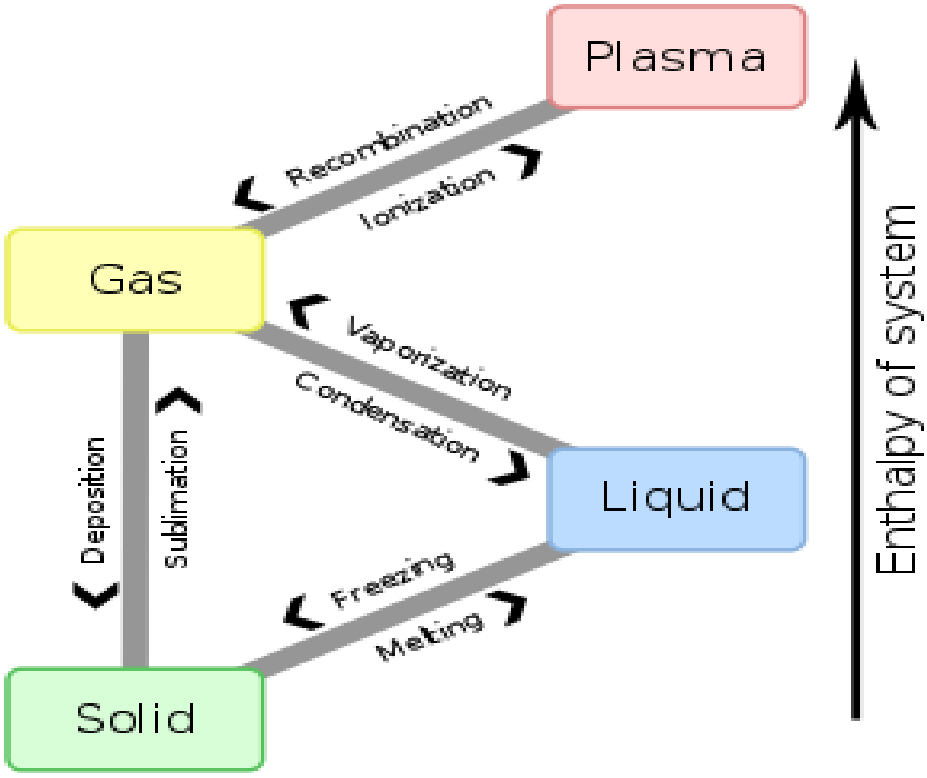
between two different crystal structures, or between two amorphous structures.

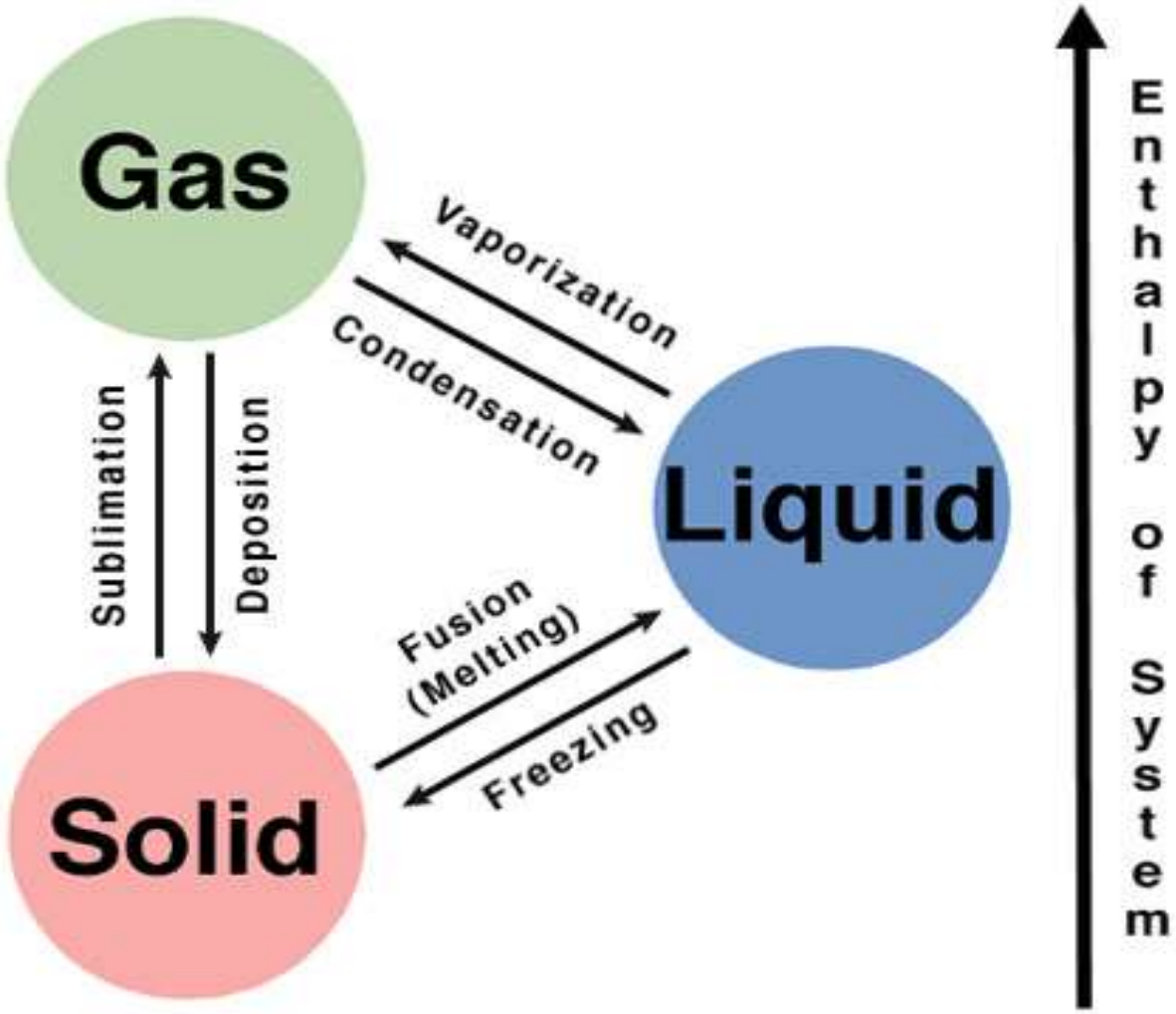
- ***Quantum condensation of bosonic fluids (Bose–Einstein condensation). The superfluid transition in liquid helium is an example of this.***
- ***The breaking of symmetries in the laws of physics during the early history of the universe as its temperature cooled.***

Phase transitions occur when the thermodynamic free energy of a system is non-analytic for some choice of thermodynamic variables. This condition generally stems from the interactions of a large number of particles in a system, and does not appear in systems that are too small. It is important to note that phase transitions can occur and are defined for non-thermodynamic systems, where temperature is not a parameter. Examples include: quantum phase transitions, dynamic phase transitions, and topological (structural) phase transitions.

At the phase transition point (for instance, boiling point) the two phases of a substance, liquid and vapor, have identical free energies and therefore are equally likely to exist. Below the boiling point, the liquid is the more stable state of the two, whereas above the gaseous form is preferred.


Pressure
solid phase
compressible liquid
supercritical fluid
critical pressure
P_{cr}
liquid phase
critical point
triple point
P_{tp}
gaseous phase
vapour
critical temperature
T_{cr}
T_{tp}
Temperature


Plasma
Recombination
Ionization
Gas
Vaporization
Condensation
Deposition
Sublimation
Liquid
Freezing
Melting
Solid
Enthalpy of system


Gas
Liquid
Solid
Vaporization
Condensation
Sublimation
Deposition
Fusion
(Melting)
Freezing
Enthalpy of System