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Research Paper

Fused State in Chemistry

Education

KEYWORDS :

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The continuous effect of heat on the solid, liquid or gaseous state resulting in atoms, nuclei, ions collase to form the fused state. In many of the instances, the fused state is very transitory, and the ions separate immediately, the atoms also separate however, they tend to be in combined state in a cloud. The ions, atoms in the fused state are thermally active and behave as one unit with charge remaining the same. The enthalpy remains constant. Fused State (Molten state, transitory state, Nano solid state, a state wherein boundaries of individual atoms or nuclei are not clear, Fusion of ions, layered structures in fused state. Fibers in fused state- example, asbestos, hemp, molasses.

Metals in pure form when charged by an electric current passes from cell to cell to make each of the cell behave as though it is independent and carries the charge and transfers effectively to slide the charge on the layer to make the entire layer conduct as though it is one unit. It has clear direction. The vector force acting upon the body could be estimated and measured to study the impact. The act or procedure of liquefying or melting by the application of heat.

2. The liquid or melted state induced by heat. **a.** The merging of different elements into a union: *the fusion of copper and zinc to form brass;*

The joining together of light atomic nuclei, especially hydrogen nuclei, to form a heavier nucleus, especially a helium nucleus. Fusion occurs when light nuclei are heated to extremely high temperatures, forcing them to collide at great speed. The collision releases one or more neutrons and energy in the form of radiation. Fusion reactions power the sun and other stars. See more at **fission**.

2. A mixture or blend formed by fusing two or more things: *An alloy is a fusion of two or more metals.*

A gaseous mixture that is easy to identify but difficult to separate by physical methods in to its pure forms- e.g. Halogens, gases such as Argon, Neon, a mixture of oxygen and ozone, allotropes of Carbon, Sulfur, CO_2 and Carbon mono oxide.

The intercalation may or may not be a fused state. The caged structures found in the complex may not be fused state for example; Xenon hexafluoride is a cage structure embedding the Xenon with no interaction with the fluoride. It is not a fused structure.

The highly electronegative fluoride ions form a cage around the Xenon and embed it in it. Diamond in a gold ring. Whether fused state is a surface phenomenon?

Generally, fused state is appearing more in the surface due to the extreme heat exposure of around 100 degree Celsius or more. However, fused state tend to occur in the different parts of the fluid in semi solid forms interacting with each other for example, solid particulate matter blocking the blood flow in varicose veins. The blocks are the semi solid nano structures fused to increase the thickness of the veins or partially block them. The generally supporting matter that becomes amenable for such a partial blockage is fat. Heart is the structure in the body that gets usually affected by such irregular depositions. The fused state is a phenomenon of the contraction of the surface of the substance to form folds, pores, overlapping layer, or vesicles. The continuous pressure exerted upon the body with a gradient acting together results in a contraction for example, a polymer bag contracts when pressure is applied on it. When it is in a gradient it shows flow properties. A laminar property of flow of liquid is exhibited by the fused state matter in semi solid. Forms for example two thin layer metal sheets are heated to higher temperatures, and apply castor oil (viscous fluid), on one of the metal sheet and place the heated another metal sheet on it.

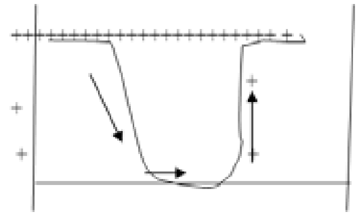
It does not show fused state. But, it slides one over the other easily. A temporary fused state of phase conversion is observed as a physical phenomenon for example, ice getting converted into water. A Vapor state of water

gets cooled and forms droplets of water. The two immiscible liquids show a temporary equi existence on surface in proportion to their density for example, Pour some kerosene of 100 ml into a beaker containing water of 100 ml. Mix it thoroughly. Allow it to settle. The droplets of oil go into water and come back to oil to form a layer of its own. As the density of kerosene is less than water, kerosene forms the top layer and water the bottom layer. The two layers show a clear separation. The organic substances having two separate densities when mixed show a temporary state of fused state for example, oil and petrol in an internal combustion engine. Initially, oil is separate from petrol and on continuous mixing due to mechanical and heat supplied one may observe the oil going into the petrol as a mixture. Similar mixtures could be obtained from kerosene with petrol, petrol with gasohol or diesel with gasohol. Petrol, diesel has low ignition points and they go into gaseous state on continued pressure and heat on it. Milk on continuous heating forms a thin layer on the surface covering almost the entire surface. It is a fused state of matter (in the common language: Malai). It facilitates equi temperature being supplied in downward direction to heat the entire matter and form the entire liquid as a one unit.

The charge obtained on the entire surface is unitary. The continuum of the charge that traverses the surface is in linear form but showing a bend towards the lower surface of

the liquid. (As shown in the figure no. 1)

Figure no. 1 showing the charge moving in liquid with unit charge



Application: 1.The nano or micro fused state is used for the effective application of fertilizers, insecticides, herbicides.2. Drugs as they are formed (manufactured) in the factory gives a bitter or gives other taste other than sweet. In order to make it palatable to man a sugar coating is given as a thin layer on the surface.

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The class II permissible colors are also added to the eatables and drugs to make it more attractive and palatable.3. Sugar or Common salt (Sodium chloride) could be made into their amorphous form that gives the same taste as that of sugar or salt. Salt could be iodized. Sugar could be coated with any flavor or color (for example, candy).

4. The liquid gel gives as much foam as that of the form generated by the application of solid substance such as soap.5. Herbal face wash, application of malai on face or lips, application of Mehendi on the hands.

Micro Alloys in fused state: Heat the iron to 1500degree Celsius and the iron becomes molten iron at this stage, add 0.5 gm of Vanadium or Titanium heat further for some time and allow it to cool. The metal could be hammered to get the required shape. This iron is fire resistant steel that is quite stronger than the ordinary steel. It is used for building scaffolding of the rocket, hanger of aero plane and preparing girders for the building. The other modern application is drawing of co-axial cables that are equally strong as that of the girders. It is used in building malls, bridges, hangers, and rope ways. The regular wear and tear is going to cause removing of the upper layer and softening of the steel. Sometimes, in certain places the steel may become weak due to various reasons. In such cases, the portion that is affected could be replaced by new one. The other solution for developing micro pores in the pipes or the iron bars is the coating of the polymer over the iron structure that prevents corrosion and more safety in the carriage and alignment.

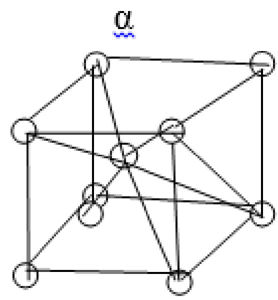
It may be recounted here that a mixture or blend formed by fusing two or more things: *An alloy is a fusion of two or more metals.* The merging of different elements into a union: *the fusion of copper and zinc to form brass.* The brass better properties. It is quite hard than copper or zinc. It does react easily with dilute acid or react to the elements in air. It does conduct electricity as good as that of copper.

Brass is used for various purposes of preparing vessels, utensils in the kitchen to boiler for heating water. There is more resistance. There is very less likelihood of developing a micro pore in brass. It is used as burners in the laboratories. The heavy containers are made out of iron or steel or the brass. The brass does not show any corrosion. The cannons in the earlier years were made out of either iron or brass. When the cannon need to be small but powerful, brass cannon is used. When the thrust needed is more and more maneuverability is sought iron cannon was used. Lamps in temples (Hindu) are generally made out of brass. It can withstand more heat, easy to clean, maintain and durable. It lasts for several years. In recent days, brass is also added to the making of coins. This gives the shine, weight and more support for the hold. It does not show much of magnetic properties. It is used in the manufacture of heavy coils in the place of steel to hold more weight .Brass is used as weight for the measure. Sometimes, alloys exhibit more resistance to deformation due to the presence of the small atoms in the interstices of Iron atom. For example, impurities in semiconducting ferromagnetic alloys lead to different properties, as first predicted by White, Hogan, Suhl, Tian Arrie and Nakamura.The alloys in general do not have a single melting point but a melting range in which the material shows a mixture of solid and liquid phases. The temperature at which melting begins is called the Solidus, and the temperature when melting is just complete is called the liquidus. The proportion of constituents either results in a eutectic mixture or a peritectice composition that gives the unique melting point to the alloy.

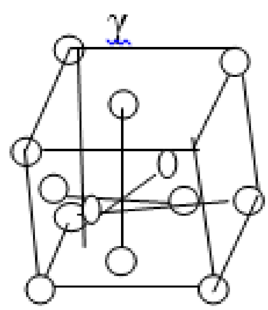
In order that the defects are overcome in the crystal structure, general application is the plastic deformation such as hammering or bending and further crystallization due to heating at higher temperature. The softening of metal alloy by heating is called annealing which recrystallizes the alloy and repairs the defects. Many alloys of aluminium, copper, magnesium, titanium, and nickel can be strengthened to some degree by some method of heat treatment, a few respond to this as much as steel does in the smelting process.

At higher temperatures (usually between $1,500^{0}$F (820^{0}C) and $1,600^{0}$F (870^{0}C), depending on the carbon content), the base metal of steel undergoes a change in the arrangement of the atoms in its crystal matrix, called allotropy. This allows the small carbon atoms to enter the interstices of the iron crystal, diffusing into the iron matrix. When this feature occurs the carbon atoms are said to be in solution, or mixed with the iron, forming a single, homogeneous, crystalline phase called austenite. The crystal structure when the iron is cooled slowly or fast could be discerned properly. However, in other elements the alloys show different phases showing properties of brittleness.

The iron shows ferroalloys that have characteristic magnetic properties such as paramagnetic properties. However, it may not be seen in other elements in equal measure.



Allotropes of Iron,α iron



Allotropes of Iron,γ iron
Figure No.2 showing differences in atomic arrangement in α and γ iron

If the steel is cooled slowly, the iron will gradually change into its low temperature allotrope. When this happens the carbon will not be in the interstitial spaces of iron but precipitate out of the solution, nucleating into the spaces between the crystals. This steel is heterogeneous for the reason that the spread may not be uniform and it results into two phases one of carbon (carbide) phase cementite, and ferrite. This type of steel is due

to heat treatment results in soft and malleable iron. When the iron is cooled rapidly the carbon does not get time to precipitate the atoms get trapped into the iron forming martensite. This results in the iron crystals getting deformed and forms very hard and brittle.

In the process of alloy formation there are three possibilities depending on the conditions obtained such as heat, atmospheric pressure and the space available for atomic movement. They are:

1. pure alloy formation, 2. one element is in the superposition allowing for the laminar structure of the iron. And 3. The carbon may get caged into the iron interstices.

When the molten metal is mixed with another substance there are two mechanisms possible i.e. atom exchange and the interstitial mechanism. When the atoms are of similar size usually the atom exchange takes place. Some the atomic crystals of metal of similar size are substituted with the other constituent. This is called as a substitutional alloy, the examples being bronze and brass, in which the some of the copper atoms are substituted with either tin or zinc atoms.

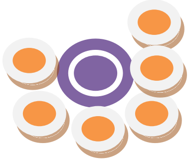


Figure No.3 showing the substitutional alloy of bronze and brass.

With the interstitial mechanism, one atom is usually smaller than the other, thus the smaller atom is embedded in the atoms of the crystal matrix, called the interstices. The alloy formed of this kind is called interstitial alloy example, being steel. The very small carbon atoms fit into interstices of the iron matrix. In the molten stage of iron, at around 1500^{0}C

0.5 to 1 or 1.5 percent of carbon is added considering the type of steel needed.

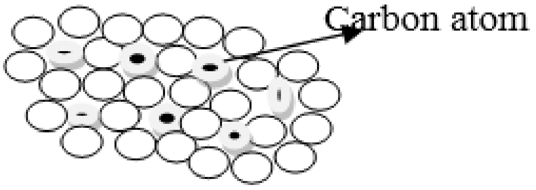


Figure No.4 Showing the interstitial alloy of steel. The small carbon atom is embedded in iron matrix.

Stainless steel is an example of a combination of interstitial and substitutional alloys, because the carbon atoms fit into the interstices, but some of the iron atoms are replaced with nickel and chromium atoms. This atomic organization at the nano level is taking place more with self organization. This means the organization is following the bottom-up approach. As the crystal size in few Armstrong's it becomes rather difficult to identify the intermediary phases. However, the phases could be discovered as soon as the metal cools down and forms the laminar structures. The photomicrographs of steel show that annealed (slowly cooled) steel forms a heterogeneous,lamellar microstructure called pearlite, consisting of the phases cementite (light) and ferrite(dark).Whereas the quenched (quickly cooled) steel forms a single phase called martensite, in which the carbon remains trapped within the crystals, creating internal stresses.

Another example may illustrate the problem more clearly, in a winter early morning in Kashmir, when the airplane is landed if the person keeps his hand on the air plane there is every likelihood that his skin on the hand gets fixed to the alluminium exterior of the airplane. It may necessitate in the removing of the skin by cutting to come off the plane. This happens because of the fused state getting created in the very low temperature.The cells in the outer layer of the skin gets permanently get stuck to the alluminium exterior of airplane due to the extreme cold conditions obtained in the surrounding. The human body shows a differential resulting in the fused state occurring on the surface of the airplane.

Sometimes, a question arises that to what extent a metal alloy could reduce the Frenkel defects. It could be observed that the metal alloys show more uniformity in atomic structure for example, iron (Fe), gold (Au) or Silver (Ag). The interstitial arrangement on disturbance of the laminar structure due to continuous heat generally becomes uniform and when the catalyst is added to molten iron Such as titanium or Vanadium in small quantities of around 0.5 % to 1.5% different grades of steel is obtained with varying carbon percentage. Sometimes, the addition of titanium is reduced to around 0.2 %. The titanium and carbon occupy different interstitial spaces in the iron forming more uniform structure that is showing a layer formation. The defects are largely reduced showing more strength.

In comparison, one may observe schottky and Frenkel defects in other fused state of substances.Stoichiometric crystals may display two types of lattice defects vacancies of equal number of anions and cations are termed Schottky defects for example, single layer of sodium chloride shows schottky defects. It is represented in Figure No.5

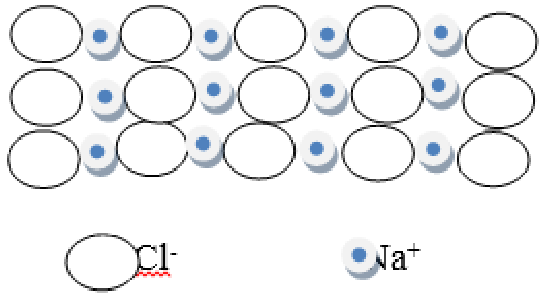


Figure No.5 Showing Schottky defects in Sodium chloride

These schottky defects are uniform and on ionization they collase to form ions very easily thus creating a good electrolyte. The monolayer structures allow for clear study of the structure of the substance.

Frenkel defects occur when an ion occupies an interstitial site, leaving its normal site vacant. These defects occur when the size of anion and cation differ greatly and the smaller ion occupies the vacant site easily to form a laminar structure. Frenkel defects in Silver Bromide AgBr are illustrated in Figure No.6.

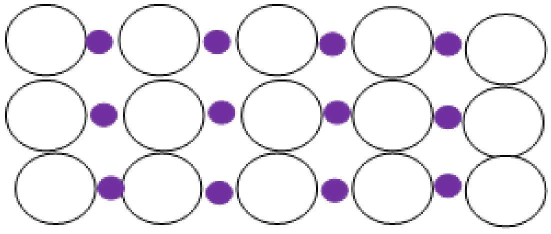


Figure NO.6 Showing Frenkel defects in AgBr

Crystal formation from gaseous ions: Douglas,B, Mc Daniel,D and Alexander,J (2006) have observed a relation between the enthalpy and the defects in crystals. The large amount of heat released while the crystal lattice are formed from gaseous ions accompanied by a large unfavourable entropy change, resulting from formation of the rigid well ordered crystal lattice. The formation of crystal lattice takes place through a process of self organization following a bottom-up approach. Introduction of vacancies or dislocations in the crystal lattice certainly decreases a crystals heat of formation, but, the increase in entropy accompanying the decrease in order favours the process. A balance is achieved between entropy and enthalpy and defects are more

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abundant in Crystals where the enthalpy needed to create a defect is low. Defects are less for more ionic type for example Sodium chloride NaCl, Rutile where the balance of coulombic forces is critical.Frenkel defects are observed more in partially co-valent substances , where polarization helps decrease the effect of charge dislocations.Pure stoichiometric crystals can exhibit both Frenkel and Schottky defects with a balance in enthalpy and entropy terms. Stoichiometric CrO has 8% vacancies in the anion and cation sites.

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