

## Ultra-pure Metals -

In the present age of technological advancement, metals of high purity are required for special purposes. For example - Pure Germanium is needed for semiconductor devices. Uranium of high grade purity is used as fuel in nuclear reactors.

The principal stages in the production of ultrapure metals are the preparation of pure chemical compounds, the reduction of the compounds to the elementary state and further purification. Pure compounds are obtained by sorption, extraction, distillation, rectification, ion exchange, and recrystallization from aqueous solutions. The reduction of compounds is carried out by chemical means, heat treatment or electrodeposition. The additional purification is ensured by electrolytic refining (Cu, Ni, Pb, Al, Ga) distillation or rectification (Zn, Cd, Hg) vacuum smelting (Co, Sn, Al, Ga) or electron beam or plasma smelting (V, Nb, Ta, W, Mo, Ti).

Ultrapure metal exhibit increased ductility, corrosion resistance, electrical conductivity and lower recrystallization temperature. Highly sensitive methods, such as spectral method with enrichment and luminescence are used to analyze the admixtures in ultrapure metals. They are also incorporated

in semiconductor technology.

Purification of Ultrapure metal - Semiconductor -

Zone Refining Method -

This method is a very useful method to get metals with very high purity such as Silicon & Germanium. It is also referred to as zone melting, floating zone process, and traveling melting zone.

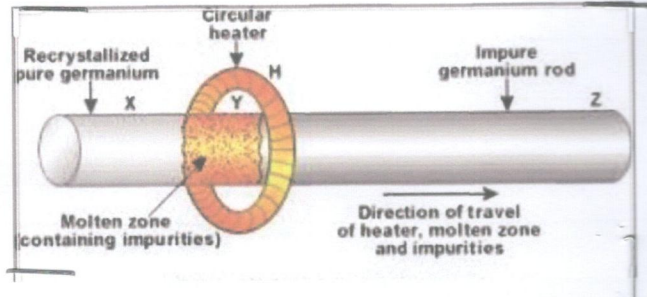
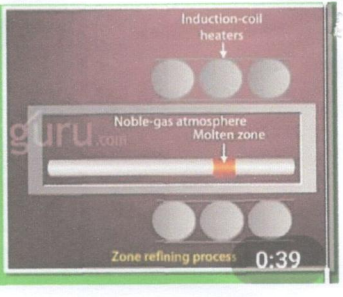
Zone refining refers to the method of purifying a crystal wherein a thin region of the crystal undergoes melting. This molten zone is now moved across the crystal.

The impurities in the metal are melted at the forward edge by the molten zone and move through the block of metal, leaving the solidified pure element behind.

As they move through the block of metal, the impurities in the metal are concentrated in the melt and are transported to one end of the metal block. An illustration for such a process is given below.

It is based on the principle that impurities are more soluble in the melt than in the solid state of the metal.

The impure metal is heated with the help of circular heaters at one end of the rod of impure metal. The molten zone is moved forward along with impurities and reaches the other end and is discarded. Pure metal crystallises out of the melt.



## Principle of zone Refining -

The principle of zone refining is that the impurities in an ingot or wire of metal are more soluble in the melt state when compared to the corresponding solid state of the impurities.

In the zone refining process, the impurities are concentrated at one end of the block of metal so that the rest of the block is purified. It can be noted that the segregation coefficient (which is defined as the ratio of the impurity in the solid state to the impurity in the liquid or melt state) is generally less than 1.