1.0 Introduction:

Coldworking, quenching and subsequent annealing of a material in solid state have been used for a long time as techniques for changing the physical properties of metals and alloys. Pol Duwez and his collaborators[1] later introduced a new technique of rapid quenching where molten metals and alloys are allowed to impinge on a chill substrate with a high velocity. Crystallinity of a material disappears when it is in molten state i.e. the regularity in the arrangement of atoms in solid crystalline state is no longer present. Slow cooling affords enough time for the atoms to rearrange themselves as they were in crystalline state. Very fast cooling, on the other hand, does not allow sufficient time so that the atoms can arrange themselves in their positions in crystalline state and therefore the random atomic arrangement in the molten state continue to exist in the solid state. Depending upon the rate of cooling and type of materials (metals, alloys), the rapid quenching gives rise to the production of supersaturated solid solution, metastable or intermediate phases and amorphous alloys.

It has been observed that some metals and alloys show abrupt change of their physical properties when quenched from the melt. The alloy of Tellurium, Gold and Copper exhibit unexpected superconducting properties when quenched from the melt[2]. Superconducting alloys are also produced due to rapid quenching from the materials which are not superconductor normally[3]. Enhanced mechanical properties have been observed due to rapid quenching even for pure metals. Kaufmann and Muller[4] reported the improved strength in rapidly quenched hot pressed Be and this is due to the refinement of grain size during quenching. In case of alloys, the improvement of mechanical properties have been observed. Amorphous magnetic alloys produced by rapid quenching have soft magnetic behaviour, and they have been used for many devices[5].

Although a large number of studies using X-ray, electron microscopy and metallography for determining structural defects have been carried out still much remain to be understood, especially the type of defects formed during quenching, interaction with the atoms, and simultaneously their effect on the structure as well as physical properties. The previous workers have laid greater emphasis on more and more rapid method of quenching. The not so rapid method but much more rapid than the conventional method of quenching have been studied very little[6]. It is this region where many other phases are expected to exist. Those phases will contain lattice defects of different types which influence the overall physical properties of the products. Besides, the structural characteristics of some amorphous alloy and the effect of annealing on it, are also the subject of present interest.

1.1 Structure property relation :

It is well known that the physical properties of the materials depend on a great extent on the type of constitute atoms and nature of their arrangement. In solids, materials can be broadly classified into two groups on the basis of their atomic arrangement : Crystalline and non-crystalline. In crystalline solids atoms are arranged in regular manner forming a three dimensional array and the crystal can be obtained by repeating a unit in three dimensions. This repeatation continue to infinity for case of ideal crystals. In fact ideal crystals do not exist in reality since the size of a crystal is finite. This causes irregularity in the atomic arrangement in the neighbourhood of the boundary and the mosaic structure arises. These mosaics are small block of crystal called domains which are mutually oriented each other by small angle.

In non-crystalline solids the atoms are randomly oriented and there is no periodicity in the arrangement. It is also seen that a perfect amorphous material is difficult to produce because of finite size of atoms produces a regularity in the local atomic arrangement.

The imperfections created due to the deviations of atom from their ideal positions influence to great extent the physical properties of solids. In a solid atoms vibrate about their mean positions at all temperatures including the absolute zero. The amplitude of oscillation is more when the temperature is increased and it may happen that atoms are ejected from the lattice forming a defect or lattice vacancy. Interstitial created by vacancy produces strain in the lattice. Again perfect crystallinity can break down by introducing different type of atoms in the lattice. However, atoms may be displaced from the ideal position as a result of the presence of lattice strain, dislocation, stacking faults, vacancies, interstitial etc. Hence it is required to detect the local atomic arrangements of atoms in solids under various physical constraints and then to correlate this with physical properties.

1.2 Lattice defects and their role on the physical properties :

In the above section it is mentioned that the real crystal deviates from the ideal crystal by two factors viz. the finite size of the crystal and the thermal effect due to which atoms vibrate about their mean position. It is also known that real crystal consists of number of mosaic blocks which are called domain misoriented