CHAPTER-I

GENERAL INTRODUCTION, SCOPE, CONTENTS AND AIM OF THE PRESENT WORK

1.1. Introduction :

Real solids contain a number of lattice defects like impurities, vacancies, interstitials, dislocations etc.; the nature and concentration of such defects may vary from sample to sample depending on its thermal and mechanical history and also on the impurity content. The physical properties of solids are found to be considerably influenced by these defects. The investigation of the changes in the physical properties with controlled variation of lattice defects is of considerable importance from theoretical as well as experimental point of view. Such a study paved the way for applications of some of the materials in technology. Apart from these defects, separation of electric charges leading to local variation in charge density (from that available in normal crystals) may also occur in some cases ; such defects can be easily induced by irradiation with ionising radiations like X-rays. X-ray irradiation generally gives rise to internal photoelectrons, which may get trapped at the special lattice sites having localised potential barriers and does not, in most cases, cause any displacement of the constituent atoms or ions from their natural lattice positions. The imperfections,

produced by X-ray irradiation in a material, are therefore, considered simple in structure and so the physical properties of solids on X-ray irradiation has become the subject matter of many investigations[1-3].

The concepts in defect solid-state are developed from an intensive study of the colouration phenomena in the alkali halides which are in many ways considered ideal solids for experimental and theoretical investigations because they have simple cubic structures, are obtainable in a reasonable degree of chemical purity and are amenable for growth in large single crystals. However, many experimentally observed properties of these materials could not be explained without assuming that the real crystals fall short of the ideal, highly ordered structure. They contain structural imperfections of various types, viz., vacant lattice sites, interstitial ions, impurities and dislocations. Vacant lattice sites and interstitial ions along with a small number of dislocations present in real crystals are generally formed during the growth process itself. Vacancies and/or interstitial ions can also be produced by chemical impurities which are intentionally added to the host material or are intrinsically present in it. For example, foreign atoms of the same or different valency existing in the crystal even in a few parts per million concentration give evidence of their presence by introducing new electronic levels and new absorption bands (Fig. 1.1). Such disturbances in the electronic configuration of a material may bring about