CHAPTER I

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

1.1 Introduction : A study of the defects in solids is of considerable importance because of the insight it gives into the fundamental processes taking place in the solids. Such a study paved the way for application of some of these materials in technology. In fact, the physical properties of solids are — to a large extent — controlled by the nature and concentration of these defects. The investigation of the changes in the physical properties with controlled variation of lattice defects is of considerable interest from theoretical as well as experimental point of view. The lattice defects may be due to many causes, namely impurities, vacancies, interstitials, dislocations etc., and these may vary from sample to sample depending on its thermal and mechanical history and also on the impurity content. Apart from these, 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. Irradiation by ionising particles, like neutrons and protons, produces charge separation and also displacement of the constituent atoms or ions; as such, lattice defects of both kinds are produced in this process. 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 of their easy availability in comparatively pure form, simple cubic structure as well as their amenability 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 concentration of dislocations present in real crystals are generally formed during the growth process itself for thermodynamic reasons. 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