# C H A P T E R I

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

# CHAPTER I

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### 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 applications 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 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. However X-ray irradiation generally produces electrons and holes in solids like alkali halide crystals which get trapped at special lattice positions (like negative ion and positive ion vacancies) forming colour centres which give new absorption bands in the normally transparent spectral region (Fig. 1.1) ; colour centres thus formed are an important class of point defects in ionic crystals.

The concepts in defect solid state are developed from an intensive study of the colour centre 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. These studies on colour centres and electronic properties of alkali halide crystals have become an established line of research for understanding in general the influence of lattice defects on the physical properties of solids. The importance of this is indicated by the phenomenal growth of experimental and theoretical investigations on colour centres.

The colouration of pure crystals is generally characteristic not only of the process of colouration but is also strongly influenced by the nature of the impurities and the previous history regarding thermal, mechanical etc. treatment the sample may have undergone. These colour centres are