Fascinating properties, and applications of zeolite crystals are being explored and exploited in several scientific disciplines like geology, mineralogy, inorganic and physical chemistry and physics including crystallography, spectroscopy and solid state physics. The realization that zeolite crystals have potential applications in numerous areas of scientific, industrial and agricultural technology has provided impetus for research and development programmes that have been carried out in several countries. During the last two decades, the status of crystals of zeolite family has changed from that of a museum curiosity to an important mineral commodity. Though the commercial use of natural zeolites is still in its infancy, more than 300,000 tons of zeolite tuffs is currently being mined each year only in USA and Japan.

The successful synthesis of crystalline zeolites has resulted in wide scientific
interest and in a great variety of applications in different fields. Despite heavy demands of zeolites in industries, very little work is reported from India on zeolite crystals. Keeping in view the above described aspects of importance and applications of zeolites, both natural and synthetic, it was thought worthwhile to take up research on zeolites in the present study. Observations and results of this work are compiled to embody this thesis.

The thesis is divided into eleven chapters. Chapter 1 is in the form of introduction to the field of zeolite science and its historical survey. It also describes important industrial applications of natural and synthetic zeolites in a wide variety of fields. The chapter concludes with a brief mention of objectives of the present investigation.

A short account of different experimental techniques used in the present work is given in chapter 2. These include multiple beam interferometry, thin film collodion technique (for interferometry in some special cases), X-ray diffraction, infrared spectroscopy, electron
microprobe analysis etc. Instruments like vacuum coating unit, incident light microscope, electron microscope etc. used in the present work are also briefly described.

Chapter 3 begins with a short account of theories of growth of crystals, both ideal and real. Microtopographical studies of (010) faces of natural scolecite crystals are then described. Striations, rectangular and hexagonal growth pyramids etc are illustrated and explained. Studies on overgrowths of apophyllite crystals on habit faces of scolecite crystals are then presented in chapter 4. That these overgrowths are apophyllites is established. The overgrowths of apophyllite in two different orientations on three different habit faces of host natural scolecite crystals are interpreted in terms of epitaxial bi-crystalline concept.

Etching behaviour of natural scolecite crystals is assessed in chapter 5. Kinetics of etching is briefly dealt with. Suitable etchants to reveal dislocations in the crystals on hand are
worked out. Activation energy of dissolution at the site of dislocation and the pre-exponential factor are computed. Their dependence on the nature and concentration of the etchants is discussed at the end of this chapter.

Chapter 6 includes X-ray diffraction studies on natural zeolite crystals. It is established that our samples of natrolite exists in two systems, whereas the other natural zeolite samples each exists in one system only. Infrared analysis of crystals under study are covered in chapter 7. That they are zeolites is established. Variation in the frequency of the asymmetric stretch in the region 950-1080 cm⁻¹ with Si/Al ratio is explained.

Studies on some physical properties of zeolite crystals are given in chapter 8. These include colour, refractive index, luminescence etc. Profound influence of iron impurity on the luminescent properties of zeolites is assessed. Dehydration behaviour of samples under study is then described.

Hardly any solid state investigation is
made now-a-days without an attempt to use well-developed single crystals. Research would benefit by the availability of crystals which have either not so far been grown at all or at least not in the right form or with suitable size and sufficient impurity. Consequently, a wide variety of methods of crystal growth, each having its own importance and potentiality, has been developed and is in use today. Improvements in the crystals themselves as well as in the methods of assessing and processing would be of tremendous advantage.

Synthesis of fibrous sodium aluminosilicate zeolite crystals in silica gel is briefly described in chapter 9. This is preceded by a general brief review of growth of zeolites from aluminosilicate gels of alkali metals. Influence of some parameters on the quality of these crystals is assessed. That these grown crystals are a kind of zeolite is confirmed. In chapter 10 hydrothermal growth of zeolites is taken up. A short review of the earlier work done in this direction is given. With the help of TEM and SEM particle size, crystallinity and morphology are determined. From their dehydration
behaviour and ion-exchange property, it is established that the hydrothermally grown samples are a type of zeolites.

The thesis ends with chapter 11 giving the summary of the principal findings of the present work. Most recent developments in the study of zeolites are reported. Finally, scope of further work on zeolite family crystals is indicated.

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