PREFACE

The rapidly developing applications of synthetic crystalline materials in science and technology impelled a new upsurge in materials science in particular. To grow better quality crystals for industrial and technological applications in a fascinating research problem; such research would be benefitted by adopting various crystal growth techniques to grow or at least not in the right form with sufficient size and purity. Characterization of grown crystals and studying their various physico-chemical properties in general, especially their mechanical, optical, electrical and dielectric properties, in details, is essential to exploit them in various technological applications.

Ferroelectrics are an important class of electronic materials. They are lesser known and recognised than well established semiconductors and magnetics. Ferroelectrics, in general, are insulators. Ferroelectrics are used for fabrication of a large number of devices ranging from storage capacitor,

transducers to highly sophisticated radiation detectors and electro-optical devices. They are also used in many linear and non-linear mechanical devices. They are apparently suitable for testing the microscopic theory of ferroelectricity.

Rubidium Hydrogen Tartrate (RHT) $RbHC_4H_4O_6$ crystals belong to isomorphic series of hydrogen tartrates such as KH, RbH, NH_4H and CsH tartrates and exhibits ferroelectric properties. It belongs to orthorhombic disphenoidal class. Since this material decomposes before melting and very low solubility in water, high temperature melt growth and low temperature solution growth methods are inapplicable. Therefore the single crystals of RHT are grown by employing the gel technique. A literature survey showed that no investigations are carried out on the growth and characterization of RHT single crystals. It is therefore, decided to carry out a study on the nucleation, growth, characterization, perfection and a few physico-chemical properties of these RHT crystals. The study and results are presented in the form of a thesis.

Since the thesis deals with the growth of RHT single crystals in gels, gel structure, gelling

mechanism, properties and characteristics of silica gels together with various modifications of growth methods are outlined in Chapter 1.

In Chapter 2, various theories of growth and dissolution processes are briefly described. A brief account of existing information regarding RHT single crystals is given in Chapter 3. The experimental techniques used in the present study are described in Chapter 4.

Preliminary experiments on the growth of RHT single crystals in silica gels are described in Chapter 5. A detailed study of nucleation control and growth kinetics, i.e. the variation in the nucleation density and growth of RHT single crystals as a function of the concentration of feed solution, the gel density, the gel pH, the gel ageing time, temperature and concentration programming are presented in Chapter 6.

The habit and morphology modification of RHT crystals grown under different growth conditions are described in Chapter 7.

Chapter 8 inclusive the characterization of gel grown RHT single crystals by X-ray diffraction, chemical analysis, EDAX, pyknometric density, SEM, IR, TGA, DSC and magnetic susceptibility measurement techniques.

Chapter 9 deals with the electrical properties of these crystals. Both single crystals and pelletized samples are studied in the temperature ranges 300 K to 470 K. These samples show distinct conductivity processes and the slope of the ln σ versus 1/T curves are used to calculate the activation energies. The results are discussed and interpreted as extrinsic and intrinsic electrical conductivities in these materials.

The dielectric properties of RHT crystals are described in Chapter 10. The effect of applied frequencies, temperatures, pelletizing pressure, etc., on dielectric constants and losses are investigated. Attempts are made to draw some qualitative conclusions taking in view, the existing theories of various kinds of polarizations contributing to dielectric constants and losses.

Chapter 11 deals with the results of the investigation of mechanical properties studied by indentation and compression testing techniques. The effects of annealing and quenching on Vicker's Hardness Numerals (H_v) are studied. Young modulus of these crystals are determined by using INSTRON ccmpression testing technique and correlated with H_v. The crystals grown at different gel column are found to have different H_v.

The perfection of grown crystals are studied by chemical etching technique using formic acid solutions as etchants and dislocation densities are evaluated during the course of this investigation. These are included in Chapter 12. The kinetic of etching studies with regard to the etching time and temperature are investigated. The activation energy of the dissolution process are also evaluated.

The microtopographical studies on {010} habit faces of RHT crystals show that striations are predominant on these faces for most of the crystals. The growth mechanism is assessed in the light of these observations and results are

discussed in Chapter 13.

Chapter 14 present the general summary and a main conclusions drawn from these studies and the scope for future work in this area of research.

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