CHAPTER - 6

GENERAL CONCLUSIONS & SCOPE FOR FUTURE WORK IN GEL GROWTH

As mentioned in the preface the present study includes the gel growth & the characterization of potassium dihydrogen phosphate (KDP) crystals. A systematic investigations carriec out in these directions have been described and discussed in the preceeding chapter (chapter 3 to 5). A brief review of the present work and some general conclusions along with the scope for future work in gel growth are presented in this chapter.

6.1 GENERAL CONCLUSIONS:

From the present study it reveals that the gel method is important for growing a variety of single crystals useful for ferroelectric, pyroelectric, piezoelectric studies.

For the growth of single crystals of KDP upto the 20 x 8 x 5mm^3 in size, test tubes of 20 cm length and 2.5 cm outside diameter have been used, which have been found to be advantageous, convenient and suitable. Test Tube method requires less quantities of gels as well as feed solutions. It has been found that the crystals grown at greater depths from the gel solution interphase are bigger in size, less in number and more perfect than those near the interface. This is due to lower concentration gradients.

From the study of the effect of gel parameters on nucleation and growth of undoped KDP and KDP doped (with nickel and

cobalt) crystals, it has been observed that high pH and hence high density gels produce opaque crystals where as good quality single crystals have been obtained at medium (5 wt%) density and medium pH (5.5) gels. Increase in gel density reduced the nucleation centres considerably but the quality of the crystals was not good.

The study of growth of undoped KDP, KDP : Ni, KDP : Co crystals in silica gels revealed that doped crystals can also be grown from gels having pH 5.5 and density 5 by weight percent.

From the X-ray diffraction pattern it is clear that the grown crystals are good quality single crystals. Chemical analysis of doped crystals shows that impurities are present.

From the observations and calculations for dielectric constant it has been observed that dielectric constant for doped crystals are greater than that for undoped crystals.

The gel technique described in this thesis appears quite promising for the production of highly perfect single crystals of a variety of materials for various ferroelectric properties which have been so for resisted orthodox usual growth technique.

6.2 SCOPE FOR FUTURE WORK:

A general assessment of the gel method and its potentialities is not yet possible, but recent experiments have yielded results

which should prove useful to other workers in this field. A great deal of work remains to be done to document and explain the detailed nature of the gel structure which will be displaced by the growing crystals or incorporation of gel interstices as in the case of potassium dihydrogen phosphate. Many important crystals viz., ZnS, CdS, PbS, ZnTe, CdSe, $CaWO_4$, CaF_2, etc. can be grown in various types of gels, with various acid set gels and by adding impurities in order to decrease the nucleation density and to grow various shapes of highly perfect single crystals. An attempt of comparative studies on the growth of crystals like AgI, PbI_2, HgI_2 etc. by reaction method and complex dilution method is to be made. Growth of various metal crystals are to be tried by using suitable chemical reducing agents. Only a few water soluble crystals (ADP,TGS) have been grown in gels. So crystal growth of many other water soluble materials is to be tried. With the gel method, it is also possible to produce the naturally occuring habits of the crystals by controlling the experimental parameters in the laboratory and hence gel method can be used as a tool in understanding geological conditions.

Out of a large number of gel grown single crystals properties of only a few have been studied. It is worthwhile to make an attempt on comparative studies of gel grown single crystals with those grown by other methods in order to probe into and take advantage of the characteristics and peculiarities of gel grown

crystals. The further development of the gel method will certainly depend on the extent to which its mechanism can be understood and controlled.