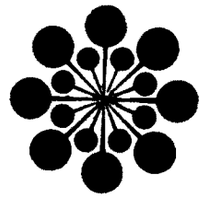

CHAPTER - VI

GENERAL CONCLUSIONS AND SCOPE FOR FUTURE WORK IN GEL GROWTH OF SINGLE CRYSTALS

CHAPTER 6

GENERAL CONCLUSIONS AND SCOPE FOR FUTURE WORK IN GEL GROWTH OF SINGLE CRYSTALS

As mentioned in the preface, the present work deals with the growth of calcium sulfite single crystals in silica gels. The detailed systematic investigations carried out in these directions have been described and discussed in the preceding chapters (Chapters 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 work it reveals that transparent single crystals of calcium sulfite can be grown by diffusing $CaCl_2$ and Na_2SO_3 through silica gel. The morphology of these crystals depends on the places where they are formed. It has been found that the incorporation of Na_2SO_3 with the gel gives rise to spherulites whereas good quality single crystals have been obtained using $CaCl_2$ incorporated gels. In the case of $CaCl_2$ incorporated gels, precipitation started as soon as the feed solution of Na_2SO_3 was added over the set gel. Depending on the concentration of Na_2SO_3, the precipitation depth from the gel solution interface varied from 1 mm to 2 cm distance. Below precipitation, spherulites and dendrites followed by single crystals have been obtained. After 2 months of growth period, all the dendrites and spherulites got converted into needles (at the top portion of

the gel) and single crystals (below the needles).

Growth of $CaSO_3$ crystals using 250 ml. beakers, test tubes and U-tubes reveals that test tubes are more suitable to grow good quality single crystals in terms of intercrystalline separation and crystal size. In the test tubes it is observed that the crystals at greater depths from the gel-solution interface grow more slowly, less in number and are more transparent because of the smaller concentration gradients than those near the top. The lattice parameters and interplanner spacing values of these crystals are in well agreement with the values reported in the literature and confirm that the water of crystallization is 0.5.

From the study of the effect of gel parameters on nucleation and growth of $CaSO_3$ crystals, it has been observed that while high pH (greater than 7) and high density (greater than 1.03 sp. gr.) gels have been found to produce opaque crystals whereas good quality single crystals have been obtained at low density (between sp. gr. of 1.02 and 1.03) and low pH (between 3 and 6). Increase in gel ageing and the height of the intermediate neutral gel reduced the nucleation centres considerably. Further, a study of the effect of concentration programming on the growth of $CaSO_3$ crystals indicates that the size and quality of the crystals can be improved by using concentration programming.

Microtopographical studies on the gel grown $CaSO_3$ reveal various

types of microstructures such as growth layers, growth spirals, liquid inclusions and overgrowths on the crystal surfaces. It has been found that the two dimensional growth layers have been observed only at higher concentration (greater than 0.5M) whereas at lower (less than 0.2M) concentration of feed solutions, spiral growth, over growths of square and spinal cord structures have been observed.

6.2 Scope for Future Work

A general assessment of the 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 crystal as in case of calcium sulfite or incorporation of gel into new solid by crystal growth in the gel interstices as in the case of calcite. Many industrially important crystals such as ZnS, CdS, PbS, ZnTe, PbSe, CdSe, $CaSO_3$, $CaSO_4$ 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. It is worth while to make an attempt of comparative studies on the growth of crystals like AgI, PbI_2, HgI_2 etc. by reaction method and complex dilution method. Growth of various metal crystals is to be tried by using suitable chemical reducing agents. Only a few water soluble crystals (KDP, ADP, TGS) have been grown in gels. So crystal growth of

other water soluble materials is to be tried. With the gel method, it is also possible to produce naturally occurring habits of the crystals by controlling the experimental parameters in the laboratory and hence gel growth can be used as a tool in understanding geologic conditions.

Out of a large number of gel grown single crystals, properties of only a few have been studied. Comparative studies of gel grown single crystals with those grown by other methods are worth attempting in order to probe into and take the advantage of 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.

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