A B S T R A C T

The thesis embodies the results of a systematic study of the growth and etch phenomena in zinc and antimony crystals. It is presented in three parts. Part I contains general information which provides the basic background for the present work and a brief description of the experimental methods used in this work. Part II is devoted to the study of zinc crystals while part III deals with antimony.

The general introduction contained in chapter I surveys the present day situation of the problems of crystal growth and etching. Chapters II and III contain brief reviews on the growth and etch phenomena in crystals, the discussion being limited to metals. The other crystals have been mentioned only when it is necessary to maintain the continuity of discussion. The experimental techniques are presented in Chapter IV, and being well-established are discussed in brief.

The results of a detailed study of the factors controlling the orientation of the unseeded zinc single crystals growing from melt is discussed in chapter V. It has been shown that growth velocity, temperature and the morphology of the interface are the controlling factors. The observed results on the orientation have been successfully explained. The various growth features observed on the surfaces of the crystals have been studied and the results presented in

chapter VI. The free surfaces at the top develop some spirals and closed loop pattern which have been explained in terms of the dislocation theory of crystal growth. The results indicate the influence of the supersaturation on the shape of the growth features. Regularly arranged pits of varying shapes have been observed and these are attributed to the evaporation in a direction perpendicular to the basal plane of the crystals. The features observed on the cleavage surfaces are also discussed in this chapter.

The technique of deep etching has been applied to study the cellular structure of the crystals growing under conditions of constitutional supercooling. The effect of orientation of the crystal, growth rate and temperature gradient on the size, shape and distribution of the cellular structure are investigated into and the results presented in chapter VII. The development of the cellular interface from a planar interface has been demonstrated by sectioning the crystals and the onset of supercooling is evidenced by the appearence of a pox-like structure. The results are in agreement with the theory.

Chapter VIII deals with the detailed study of the etch phenomena in zinc crystals. A large number of etchants have been used for the purpose. The controversy existing on the use of iodine to reveal dislocations in zinc

crystals has been solved. The results also prove that most of the reagents, especially those containing halogens in various solvents are useful to study only the basal planes while there are a few which are useful in prism planes also. Further, no isotropy exists between etch pit density on the basal planes and the prism planes. The effect of temperature and the state of reagents also have profound effect on the pit shape and size. The application of the etch pit technique to study dislocations in crystals deformed in various ways have been investigated into and the results are presented in chapter IX. It has been shown that the screw dislocations associated with the non-basal glide can be revealed without solute decoration.

Part III of the thesis deals with the work on antimony single crystals grown from vapour. The study is restricted to the microcrystals grown from vapour. The various growth features observed are presented in chapter X and it has shown that the growth pyramids observed on the surfaces of the as-grown crystals are the (111) facets grown at sites of dislocations. The results of etching the vapour grown crystals are presented in chapter XI. The density counts along intersecting low angle boundaries have shown that one-to-one correspondence between etch pits and dislocations exist, at least, along these boundaries. The general conclusions arrived at, are presented at the end of the thesis.