In this thesis, etching technique is used to reveal the nature of dislocations in alkali halide (KCl, NaCl and NaF) crystals by using optical interferometric and electronmicroscopic studies. For convenience, the thesis is divided into three parts. In part one, a brief account of the existing information about KCl, NaCl and NaF is given. The salient features of the various experimental techniques employed in the present work are described. Also a short account of the historical background of etching and dissolution of crystal faces is given in general and of alkali halides (KCl, NaCl and NaF) in particular.

The work done on the alkali halides during the present investigation has been given in part two and three.

In part two, etching of (100) cleavages of KCl is described. Various etchants have been established to study the nature of linear defects present in the body of the crystal. Rotation of etch pits has been produced and explained due to a change in the relative velocities of movement of atomic steps over the surface along <100> and <110> directions. It has been shown that ethanol with PbCl₂ produces
etch pits at the sites of dislocations on (100) cleavages of KCl. By comparing etch pits and their structures on oppositely matched faces, the configuration of dislocation lines (branching and bending of dislocation lines and dislocation half loops) running through the body of the crystal has been investigated. The plasticity of KCl crystals has been studied by applying external stresses using point contact method. Motion of edge and screw dislocations in respective glide bands has been observed.

Depression spirals on (100) cleavages of KCl have been produced by establishing a new etchant. One to one correlation in numbers and position of the spiral etch pits has been observed on matched pairs and it is shown that spiral etch pits reveal the sites of screw dislocations existing in the body of the crystal.

Etch hillocks are produced on (100) cleavages of KCl and are tentatively explained to have been formed due to dissolution process.

Linear arrays of equally spaced etch pits observed on (100) cleavages of KCl, have been shown to consist of edge dislocations in small angle tilt boundaries. One to one correspondence in the densities of pits in three branches of a junction of low angle
grain boundaries and the relation \( n_a = n_b + n_c \) for each junction have been established on matched faces. Cellular structure and complicated structures of grain boundaries are discussed.

Thermal etching of KCl cleavages has been carried out and it is shown that thermal etch pits nucleate at the sites of dislocations. Evaporation spirals and loops have been observed on heated KCl cleavages. Interferometric study has revealed that the spirals are depressions. Formation of evaporation spirals has been attributed to irregular surface evaporation. Spirals along the boundary have also been illustrated. The patterns similar to that developing at Frank-Read sources and complicated patterns originating from a number of sources concentrated in a small region have been observed.

Divalent impurity (Ca\(^{2+}\) from CaCl\(_2\)) doped KCl crystals have been grown from aqueous solution. Etching behaviour of these crystals has been studied and shown that a particular etchant produces pits but is incapable to reveal the sites of dislocations. Pitting on doped crystal cleavages has been attributed to the etching of superficial defects introduced due to the presence of impurities. [110] and [11\(\bar{2}\)] glide
bands have been observed on developed (111) faces of doped KCl crystals and attributed to \{110\} [110] slip system of these crystals.

Structure of dislocation lines has been studied in NaCl single crystals. Complicated structure of low angle grain boundaries is fully observed. Etching behaviour of (100) cleavages and (110) fractured faces of NaCl has been studied in detail. The fracture surfaces have been examined by multiple beam interferometry and it is found that they consist of elevated ridges and depressed valleys. Matched pairs of fractured faces have been etched and one to one correspondence in number and position of the boat shaped etch pits has been established. Low angle grain boundaries are also observed on these fractured faces.

Some fractured faces having complicated nature i.e. having some regions not strictly parallel to (110) planes, are selected and their etching behaviour has been studied. Etch hillocks are produced on these faces. They have been studied by multiple beam interferometry and by electron-microscopy. Formation of etch hillocks is discussed.

In part three, formation of etch pits and
their structures have been studied on (100) cleavages of NaF crystals. It is shown that presence of impurities along dislocation lines gives rise to the formation of etch tails associated with etch pits. A study has been made on the formation of pits in pairs on the matched faces. It is conjectured that they reveal closed loops existing in the body of the crystal. Low angle grain boundaries have been studied on the opposite faces of thin flakes and shown that they may not necessarily run perpendicular to the plane of observation. Etching behaviour of heated crystals has been studied and shown that due to thermal stresses, crystals undergo plastic deformation. Variation in microhardness of the crystals has been studied.

Formation of circularly terraced thermal etch pits on (100) cleavages of NaF has been investigated by heating the cleavages at various temperatures for different periods. It has been shown that the shape of the thermal etch pits depends upon the temperature at which they are produced. Interaction of circular etch fronts from the point of nucleation of two or more dislocations is reported.

Thermal etch patterns have been studied in transmission electronmicroscopy. It has been observed
that the bottoms of the pits are displaced with respect to boundaries along \langle110\rangle directions. This has been explained due to motion of dislocations during the period of thermal etching due to thermal stresses developed in the body of the crystal. It is shown that the presence of impurities on (100) face will interfere with thermal etch front, and retard the etch front locally, thus producing terraces of the pits appearing as if the pits are nucleated at the sites of Frank-Read sources.

Growth of NaF crystals from solution has been discussed. Microstructures on the basal planes and grown faces \(\text{[}(111)\text{]}\) having the preferential growth have been studied. Polygonal structures with four-sided, five-sided and six-sided observed on basal planes of tiny NaF crystals have been attributed to the piling and spreading of growth layers. It is suggested that growth might take place by two dimensional nucleation probably to begin on basal planes and later on, on the faces like \(\text{(111)}\). Etching behaviour of the grown faces and fractured faces have been studied. Evidences of low angle grain boundaries and twin boundaries are illustrated.