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Studies on etching and dissolution of Lead Iodide crystals grown by gel method

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ABSTRACT

Crystals have studied because of their potentials in all the fields. In the crystals etching and dissolution are phenomenon, having their own characteristics. Dissolution means uniform two-dimensional removal of layers from the crystal faces by suitable physical or chemical means and this phenomenon is very useful in the study of the growth history of crystals. In the present paper it has been decided to study on etching and dissolution phenomenon.

Keywords: Gel, etching, dissolution.

INTRODUCTION

Etching and dissolution are phenomenon, having their own characteristics. Dissolution means uniform two-dimensional removal of layers from the crystal faces by suitable physical or chemical means and, this phenomenon is very useful in the study of the growth history of crystals. Many workers in this investigation state, “there is a strict reciprocity between growth and dissolution”.

Etch figures represent the very early stage of crystal dissolution. When the crystal is dipped into a suitable etchant, dissolution is not uniform; it is being only at certain points and, proceeds more rapidly in some directions than in others. If the action is stopped at the right moment, the uniform solid surface is found usually covered with tiny geometrical figures often referred as etch pits. That the shapes of etch figures varies with the nature and concentration of solvent, time and temperature, but is strictly related to the molecular configuration of the crystal face, is well established.

In the present course of investigation, it has been decided to work on the etching and dissolution of Lead Iodide crystals grown by gel method. Both, etching and dissolution, helps to understand the growth of the crystals.

MATERIALS AND METHODS

Lead Iodide crystals have been grown by gel method. The details of experimental procedure already given elsewhere [1,2]. Various were tried for chemical etching, but only concentrated HCl, distilled water and acetone in the ratio of (2:20:20 ml) respectively, was found to be most suitable etchant.

RESULTS AND DISCUSSION

Historical review
The first through study on etching was carried by Wollaston [3]. Daniell [4] was the pioneer, who tried to correlate the nature of the etch pits with molecular structure of the crystalline solids. Notable contributions on the theory and applications of etch methods were made by Baumhauer [5], Nairan [6], Honess [7], Miers [8], Traube [9], Gold Schmidt [10].

Early views on etching.
The first attempt to explain the process of etching is due to Gold Schmidt [10]. According to him, both etch pits and etch hillocks are a result of movements developed in the solvent. Chemical action between the corrosive and the substance upon which it acting gives rise to currents some of which are directed towards and some away from the surface which is being etched and interference of the ascending currents with the descending ones tends to form eddies each of which is a starting point of a pit.

Further he suggested that,
1. The etch pits are located at the places where the currents starts in the corrosive.
2. Small particles of dust on the substance provide the corrosive with the points of first attack.
3. Preferential etching takes place along fine scratches.
4. Bunching of the etch pits takes place on the strained parts of the crystal.
5. The presence of the inclusions or impurities is likely to be the starting point of etching.

According to Nairan [6] the lines of selective pitting are also the lines of weak cohesion, as for example; cleavages planes are corroded much more slowly than those of the lower degree. One of the main drawback of this theory was its failure to explain satisfactorily the distribution of the etch figures on the surface.

Modern theories on the mechanism of etch pit formation.
According to Burton [9], when a perfect crystal face is exposed to a solvent, dissolution probably begins by the nucleation of unit pit of one molecular depth. These unit pits grow as steps retreat across the crystal through the action of the kinks.

Strained regions on the surface enhance the dissolution of that part. Hence, all structural defects, which are storehouses of energy, are the sites for the attack of the etchant. If this is the case on a real crystal, the dissolutions which are lines of defects may be preferential sites for the nucleation of unit pits and, repeated nucleation at a dislocation leads to the formation of an etch pit due to screw dislocation is quite different than this.

Etch pits can be formed where a dislocation meets a crystallographic surface, has demonstrated by Horn [12], Amelinckx [13], Dekeyser [14], Gilman [15], Cabrera [16], considered the formation of dislocation pits by evaporation.

Addition of poison can inhabit or enhance the motions of steps from the sites of the nucleation center as shown by Gilman [15], Frank [17] has inferred that all etchants that produce well marked etch pits contain a poison either by chance or design. He drew this conclusion in the development of topographical theory of crystal growth and dissolution.

Various were tried for chemical etching, but only concentrated HCl along with distilled water and acetone in the ratio of 2:20:20, ml respectively was found to be most suitable etchant. No perfect etch pits rows resembling tilt or twist boundaries were observed. The general dissolution was observed on the face of the crystals. On careful observations some triangular etch along with the general dissolution was observed as shown in Fig. 1.

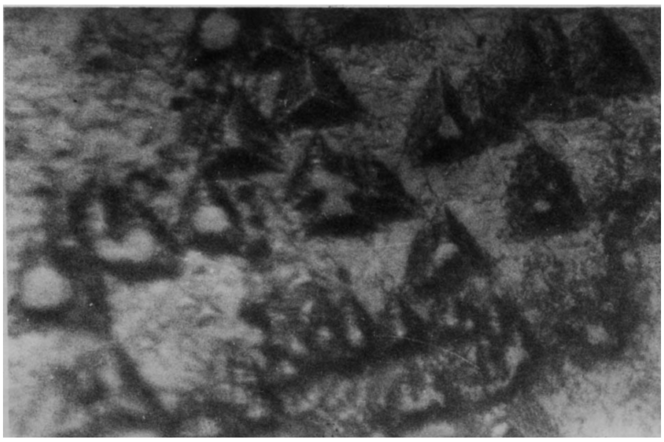

Fig.1 Etch pits are seen due to etching

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