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Importants and Studies of Surface Topography of Lead Iodide Signle Crystals Grown by Gel Technique

D. S. Bhavsar

Research Department, Department of Electronics, Pratap College, Amalner, India

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ABSTRACT

The single crystals of Lead Iodide grown by simple, inexpensive and accurate technique i.e.gel technique. Gel is formed by mixing Acetic Acid and Sodium Metasilicate. Potassium Iodide is incorporated into the solution of Acetic Acid, Sodium Meatasilicate is then added upto constant pH. After setting the gel, supernatant is added over the set gel. The optimum conditions have been obtained to grow the single crystals of Lead Iodide. Then these crystals were characterized by XRD and Surface Topography. Lattice constants are well matching with ASTM data for the Lead Iodide. Surface Topography useful for the understanding of mechanism of development and growth of habit faces, in particular and crystals in general.

Keywords: Gel technique; XRD; Surface Topography.

INTRODUCTION

Lead iodide has wide spread applications in the field of electronics ranging from phosphors to photovoltaic cells due to its photoconducting nature. Single crystals of photoconductors are preferable because of relative case of defining the case of pertinent variables.

It has already been reported that a variety of single crystals suitable for solid state experimentation can be grown successively in silica gel. The method is used especially for substances, which because of their low solubilities or low dissociation temperature (or both) cannot readily be grown by other methods since the crystals in any one growth systems grows competitively, control of nucleation process is in many cases a key to the practical utility of the method [1].

In the present course of investigation the study of growth parameters have been studied with help of Surface Topgraphy. It is established that the gel grown PbI_2 grow by two-dimensional nucleation mechanism and by spreading and pilling of growth layers.

METERIALS AND METHODS

Good crystals can be grown in gels in a variety of ways by varying the parameters. This method is very simple and cheap. In the present investigation, a solution of sodium silicate (sp.gr.1.04 g cm^{-3}) is mixed with acetic acid (1 N), lead acetate (0.5 N) Cu-acetate (0.1 N, 0.5N and 1N) and allowed to set the gel in constant temperature bath at 30^0 C. After setting the gel potassium iodide (1 N) is then placed on the top of the gel.

The X-ray diffraction patterns (XRD) were obtained by a diffractometer (Philips PW-1730) using CuKα radiation with Ni filter (1.5418Å) at North Maharashtra University, Jalgaon. Surface Topography has been carried by Epignost Microscope at Pratap College, Amalner.

RESULTS AND DISCUSSION

XRD

The result of the XRD are already explained elsevere (2).

Surface Topography

The attachment of crystallites to form the crystals is shown in figure 1 and 2. In the beginning of growth of the crystals near to the interface of the gel, supersaturation is very high, so that the growth rate is very high. Here, the growth mainly takes place by either two-dimensional or by mutual attachment of crystallites formed without the help of screw dislocation. When the crystal reaches to a certain critical size, the surface is strained by internal stresses or by pressure from other crystals forming imperfection of the surface. The triangular spiral (anticlockwise and clockwise) mechanism recently reported (3). Bunching of the crystals is shown in figure 3. Such growth is not observed frequently.

Studies of surface microtopography on habit faces of natural and synthetic crystals and etch patterns on such faces as well as on cleavage go a long way to the understanding of mechanism of development and growth of habit faces, in particular and crystals in general. Such studies also help to understand dissolution of crystal faces. Studies of etch patterns are helpful in delineation of defects in crystals.

Although surface structures on different faces of crystals represent conditions towards the final stage of growth, correlation of such features on different faces helps one to understand history and development of growth of crystals.

For revealing the importance of microtopographaical studies research works of various investigators have been reported here.

Two-dimensional nucleation growth theory proposed by (4, 5), screw dislocation theory (6), information concerning existence and behavior of dislocations in crystals have been verified and

established from studies of surface structures of crystals. It has given comprehensive survey of microstructures on various mineral crystals and discussed growth mechanism of such crystals in general (7).

Overall external shape of a crystal is attributed to different rate of growth of its habit faces. Such a shape is generally accepted as definition of habit of a crystal. Under certain conditions of crystallization, one set of faces may be induced to grow faster than others, or growth on another set may be retarded. Even if substance is the same, its crystal shapes (habits) will be different when grown by different methods. Whisker, needle shaped, acicular needles, rod-like, prismatic, prismatic pyramidal, platy, lamellar, cubic, trapezohedral, octahedral, octahedral, polyhedral, spheroid etc qualitative terms used for convenient description of crystal habit. Vast literature describing habits of crystals grown under different conditions and also by different methods have been published by various investigators in the19th century and 20th century. Surface structures on hematite crystals have been exhaustively investigated (8). He concluded that the growth of these crystals takes place mainly by two-dimensional spreading and piling up of growth layers. Since it is the habit faces through which a crystal grows and develops all phenomena concerning growth and dissolution are almost perfectly pictured on them. Microtopographical studies are helpful to ascertain presence of imperfections, stacking faults, because their behaviors plays significant role in the shaping surface structures which result either from growth or dissolution.

Good deal of information about almost entire history of growth and growth mechanism can, many a times, be also obtained from detailed microtopographical studies. Pattern on crystal surface are generally governed by internal imperfection or disorders of crystals, such as dislocations, stacking faults, inclusions, etc.

Crystals habits are determined by the slowest growing faces. In 1925, it has shown that for equilibrium form of a crystal, these faces have the lowest surface energy, but it is an apparent that a crystal habit is governed by kinetic rather than equilibrium (static) considerations. There are several factors, which have sufficient influence of habit of a crystal. Such factors include the degree of supersaturation, type of solvent, pH of the gel medium, presence of impurities etc.

Figure 1: Anticlockwise spiral mechanism

Figure 2: Attachment of crystallites

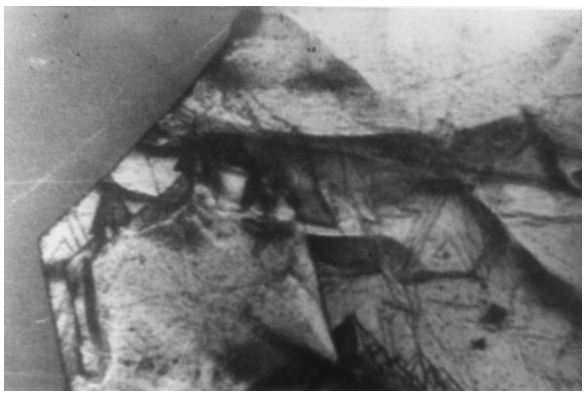

Figure 3: Bunching of crystals

CONCLUSION

Gel growth technique is suitable for growing crystals of Lead Iodide single crystals. Different habits of Lead Iodide crystals can be obtained by changing parameters like gel density, gel aging, pH of gel, concentration of reactants, etc. XRD infers that the grwon crystals is of high quality and lattice parameters are almost matching with the ASTM data.

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