

A MINOR RESEARCH PROJECT CARRIED OUT UNDER THE FINANCIAL ASSISTANCE OF UNIVERSITY GRANT COMMISSION WRO, PUNE.

Submitted by

Dr. Narendra.S.Patil

Principal investigator and Associate Professor

Bhusawal Arts Science & P.O. Nahata Commerce College Bhusawal, Dist-Jalgaon, (MS).

(UGC sanction No.47-723/13(WRO), date:09 JAN 2015)

Executive summary of the project

“Studies and Characterization of doped Cadmium tartrate Crystal by gel method”

INTRODUCTION AND ORIGIN OF THE RESEARCH PROJECT:

Crystal's growth plays a key role in science and technology. Large numbers of national and international laboratories are busy with growth and characterization of crystal. Some especially busy put them for specific use. Growth of the single and mixed crystals has been the heart of research and development. The development of new and better methods of growing large crystal and to control nucleation remains a field open to research[1]. A lot of work remains to be done to explain the detailed nature of the gel structure, which is broadly, displaced by the growing crystals and also the incorporation of gel particles into growing matrix as in the case of calcite. This will help to understand why gel inclusion occurs and how it can be prevented to get proper products.

This symposium will cover the field of growth and application of single crystals of considerable scientific and technological interest. Availability of high quality single crystals continuously determines the pace of progress in many areas of condensed matter physics like for example in semiconductors, ferroelectrics, magnetics, optoelectronics, organic microelectronics or superconductivity. Crystal growth from its very beginning has included experts from different disciplines carrying on interdisciplinary research focused on samples for basic research, technology or commercial interest. This symposium should encompass single crystal growers with single crystal users. Should help crystal growers to define current needs for samples leading to breakthrough enabling materials as well as allows crystal users to formulate the critical parameters achievable in crystal growth laboratories. This symposium will focus on interactions between growth, purity, quality or structure and physical properties. This symposium will provide a forum for exploring current results inspired by availability of single crystals [2].

Abstracts are solicited on all aspects of properties and characterization of single crystals emerging from perfection of crystal growth technology.

Symposium Topics.

OBJECTIVES OF THE STUDY:

To prepare solution of the crystal at room temperature by using silica gel method. To analyse particle size of grown crystal .To find optimum condition for growth of defect less free larger crystals and observed the effect on the crystal of growth parameter like pH value of gel solution, Gel concentration, setting time, Gel ageing time, Concentrations of reactants of solution, Gel density. To study growth and characterization of grown crystals by using XRD, UV-VIS Spectroscopy, Scanning Electron Microscope (SEM and EDAX), Thermal analysis(TGA/DTG/DSC), FTIR, Chemical analysis. To evaluate Activation energy and frequency factor of grown crystals. After performing all this above mention, the final result will compare with the standard value of the crystal and final conclusion will be drawn.XRD Analysis of the grown crystals to find out dimension of unit cell i.e. a, b c, and α , β , γ for exact determination of the structure. Thermal analysis suggests thermal stability and thermal behavior. FTIR shows the presence of different functional group and bonds. The chemical analysis confirms the chemical formula of the grown crystal. UV-VIS spectroscopy shows band gap in eV.SEM analysis confirms the shape and boundaries of the grown crystals [3, 4].

HYPOTHESIS AND METHODOLOGY:

The job of the crystal grower is to prepare large specimen of crystalline material such that there is complete crystallographic continuity across a given specimen in all direction. There are two principal reasons for the deliberate growth of the crystal. Many physical properties of solid are observed by the effect of grain boundaries [5].The full range of tensor relationship between applied physical causes and observed effect can be obtained only full internal symmetry of the crystal structure is maintain throughout the specimen [10]. There are several method for growing the crystals. The crystal can be grown by

Solution method

Growth from melt

Growth from evaporation method

Gel method is one of the solution method for growth of crystals and it is promising technique for growing crystals of substance which are sparingly soluble in water and decompose before their melting point. The grown crystals have wide application in electro and acoustooptical device, in

synthesis of superconducting compound. The gel medium can be used to synthesize chloride with the help of tartrate. The tartaric acid can be used for setting of gel as well as one of reacting components. Growth of crystals has become the heart of the research due to various applications of the crystals. The development of newer and better techniques of growing large crystals and control of nucleation remain as open field to research, a lot of work remains to be done to explain detailed nature of the gel structure. The tartrate crystals have wide applications. Doping of different metals in the growth of cadmium tartrate is also the one area to study the changing properties of grown crystals compared to undoped grown crystals. Also to study the other properties of grown crystals, this will be helpful for fulfilling the industrial requirements [6].

UTILITY OF THE STUDY:

Cadmium tartrate have many application that are, it is used in the medical transducer application and chemical industrial for bulk production. They are relatively cheaper their nitrate and alkoxide salt therefore which are required for chemical rout. It is used in the mechanism of pyro techniques composition, fireworks, tanning agents [7,8].

LIMITATIONS OF THE STUDY:

Growth period of the crystals in gel medium is very long. Nucleation control can be made up to certain limit. During growth of some crystal gel trapping occurs specially with silica gel. Also the crystal size is generally small. The period of gel setting depends on atmospheric condition i.e. at winter season the gel setting period is small while at summer season it is very long. When the tube for setting gel are disturb then no proper gel setting is possible and also no proper nucleation takes place and no production of crystals.

ii) Work done so far and result achieved and publication, if any, resulting from the work.

The first theoretical prediction of crystal growth came from in the case of natural mineral crystals [1]. It has been appreciated that advances in solid-state science depend critically on the availability of single crystal specimens. As a result, an enormous amount of labor and care has been lavished on the development of growth technique. In terms of crystal size, purity and perfection; the achievements of the modern crystal grower are remarkable indeed, and vast sections of industry now depend on his products. No matter, whether these are under investigation for particle reasons or because knowledge of their properties might throw new lights on our understanding of solids in general [9].

ACHIEVEMENTS FROM THE PROJECT:

In order to predict the stability of the crystal structure. The first theoretical prediction of crystal growth came from [1] in the case of natural mineral crystals. It has been appreciated that advances in solid-state science depend critically on the availability of single crystal specimens. As a result, an enormous amount of labor and care has been lavished on the development of growth technique. In terms of crystal size, purity and perfection; the achievements of the modern crystal grower are remarkable indeed, and vast sections of industry now depend on his products. No matter, whether these are under investigation for particle reasons or because knowledge of their properties might throw new lights on our understanding of solids in general.

In another way a large number of new materials have been grown as a single crystal in recent years, which have defied the whole array of modern techniques and have never been seen in single crystal form even though grown by conventional methods, have never been obtained in the required size or degree perfection. All these constitute a challenge and an opportunity, for the professional crystal grower. New and unusual methods of growing crystals are therefore of wide interest; and if the crystal are themselves beautiful, as they so often are, there is no reason why this interest should be confined to professional scientist. It has been mention that, sometime growing of crystal is more of art than science. .

CONTRIBUTION TO THE SOCIETY:

- 1) Society will get the work done based on this topic and may helpful in technical aspect either the one way or other.
- 2) Same study may be used by researcher to develop some new Compound of the future which is serve the society in their development.

NO. OF PUBLICATIONS OUT OF THE ROJECT:

- 1) "Kinetic and Thermodynamic Study of Mixed crystal of cadmium barium Levo-tartrate dehydration grown in silica gel. Published by 3rdInternational conference on KATHMANDU SYMPOSIA ON ADVANCED MATERIAL,OCT-2016 POKHARA NEPAL
- 2) "kinetic and thermodynamic study of mixed crystal of cadmium-calcium levo-tartrate dehydrate grown in silica gel" by International Conference on Advanced Technologies for Societal Application DCE- 2016,held at SVERI College of Engineering Pandharpur.

CONCLUSION:

The sample is polycrystalline in nature having hexagonal structure. The IR Spectrum revealed the presence of water molecules, O-H band, C-O and carbonyl C=O bands. The C-OH in plane bending and out of plane bending is identified. The band around 958.50cm^{-1} is assigned to C-C stretching and band around 814.75^{-1} is assigned to C-OH out of plane bending. The presence of metal calcium and barium identified to C-OH out of plane bending. The presence of metal cadmium and barium identified was confirmed by chemical analysis and the presence of water molecules was confirmed by TGA and DTA analysis. The DSC recorded the peak at $386.45\text{ }^{\circ}\text{C}$ and found to be endothermic. The EDAX confirm the presence of Cd and Ba. SEM reveals the flower type structure. The UV-VIS determines the band gap of BCT crystal is 5.16 eV.

REFERENCE

- [1] Dharmaprakash S M & Mohan Rao P, J. Mater. Sci. Lett., 4 (1985) 787.
- [2] Warriar G M & K Shreedharan Pillai, Indian J. Pure & Appl. Phys., 32(1994) 25.
- [3] Dalal P V & Saraf K B, Bull. Mater. Sci. 29 (2006) 421.
- [4] Bangera K V & Mohan Rao P, Indian J. Pure & Appl. Phys. 32 (1994) 871.
- [5] Bangera K V & Mohan Rao P, Bull. Mater. Sci., 15 (1992) 339.
- [6] Raju K S, Krishna K N, Jayakumari Issac & Ittyachen M A, Bull. Mater. Sci, 17 (1994) 1447.
- [7] Bisailon S & Tawashi R, J. Pharmaceutical Sci. 64 (2006) 458.
- [8] I Korah, Joseph C & Ittyachen M A, Cryst. Res. Technol. 42 (2007) 458.
- [9] Arora S K & Tomy Abraham, Indian J. Pure & Appl. Phys. 19 (1981) 199.
- [10] Arora S K, Patel V, Kothari A & Amin B, Crystal Growth and Design, 4 (2004a) 343.

ACKNOWLEDGEMENT:

Principal investigator is thankful for availing the financially supported to this project by UGC, New Delhi, India through MRP FILE NO. 47-723/13(WRO), date: 09/01/2015. Also thankful to Management, Tpti Education Society Bhusawal and Principal Bhusawal Arts Science & P.O. Nahata Commerce College Bhusawal, for valuable assistance in completing the project and giving constant motivation and encouragement for research activities in the college.

(PRINCIPAL INVESTIGATOR)

DR. NARENDRA S. PATIL