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A Study on Mixed Iodate Crystals and Their Properties

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Abstract – Now-a-days crystals have become the pillar of modern technology in all the respects with this aspects in the mind and ever increasing the demand of single crystals in the variety of field in science and technology, the work of the growth and the study of some important crystals have been under taken in the laboratory. In this article, the significance of iodate crystals is described.

Keywords: Crystal, Diffusion, Reactions

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INTRODUCTION

Today with modern technology, with sophisticated instrument many national laboratories and university are growing varieties of crystals, which have the utility in day to day life still the growth of some crystals by using simple equipment by utilizing fundamental properties of material much of the as research work have been carried out and it more less important by considering all aspect and available facilities in laboratories the work of the growth of mixed iodated single crystals by Gel technique which is one of the simplest technique have been undertaken in the present work.

Growth of crystals by gel method is promising techniques for growing single crystals of substances which are sparingly soluble in water and decompose before their melting point, according to thermodynamics consideration since the growth proceeds at near ambient temperature, the grown crystal would contain relatively lesser concentration of non-equilibrium defects.

The growing crystals are held in the gel in a strain free manner, thus limiting effects due to impact of the bottom or the sides of the container. In addition in this method almost complete suppression of large scale movements like convection is achieved which otherwise can be harmful to the crystals perfection. In gel method, the rate of diffusion of reactants can be controlled, since the gels are network of cavities of several tens to several thousand of angstroms in diameter, communicating through slightly smaller orifices.

The gel growth technique appeared quite attractive for growing crystals, on account of its unique advantages in terms of crystals produced and the simplicity of the process moreover the method is inexpensive and within the scope of the Laboratory.

If a suitable solvent is found, crystals can be grown at room temperature below the melting point of the crystal. Growth from solution is the only alternative, if the substance decomposes below its melting point or undergoes a phase change. The choice of solvent is very important, which should have low viscosity and should not react with the container or the atmosphere.

The growth rate by this method is much smaller than the growth rate from the melt. It is extremely difficult to produce spontaneous nucleation in such a manner that only a single or even very few nuclei are formed. If large crystals are to be grown from solution, seeding is essential. Almost 80% of organic and inorganic optical nonlinear crystals are grown by this method.

REVIEW OF RELATED LITERATURE

O'Connor et al 2001 discovered different method of crystal growth in gel and succeeded in growing cuprous chloride crystals. Henisch, Dennis and Hanoka 2009 described the growth of calcium tartrate and calcium tungstate while Dennis et al 2010 have grown lead hydroxy iodide. Optical absorption spectra of gel grown lead hydroxy iodide m. It gives the spectral response of theμwere studied at 430 photoconductivity. Its dielectric constant at 10 KHz is about 10.5 and magnetic susceptibility is –0.256 x 10-6 cgs units.

Bridle and Lomer et al. 2010 worked on the growth of cadmium oxalate and copper tartrate. In 2006, Brenner et al have grown lead sulphide crystals. The electrical resistivity of a gel grown lead sulphide crystals was found to be 8.4 x 10-2 ohm cm and 7.0 x 10-3 cm for synthetcic lead sulphide.

Using silica gel method, 24-layered hexagonal polytype lead iodide was grown by Maheshchand et al 2010 in U-tubes. These crystals have been studied to understand their band structure and polymorphism. In 2007, Dennis and Henisch explained the growth of calcium tartrate, lead iodide and lead hydroxy iodide.

Schwartz et al 2011 have - manganese sulphide crystals. At the same time, E. S. γgrown Halberstadt et al. 2011 reviewed the growth of silver iodide crystals in silica gel by complexing procedure. The complexing procedure was also used by Blank et al 2012 to grow silver iodide and silver bromide crystals.

Armington and O'Connor et al. 2012 used a different method and succeeded in growing cuprous chloride crystals. They used certain complexes, which cause precipitation of the desired material when diluted with water.

Decomplexing sets in with increasing dilution and leads to high super saturation required for crystal growth. They improved the conditions of growth by using constant concentration reservoirs and constant path length over the cross-section of the gel.

In 2008, Kratochvil have grown single crystals of gold having triangular and hexagonal habits. Blank et al 2009 have grown crystals of selenides and tellurides of Cu, Zn and Cd in an organic gel called toluene.

Blank et al 2010 have grown cinnabar crystals using a new gel called polyacrylamide. Dennis and Henisch 2011 reported the enrichment effect of calcium tartrate with iron.

Nickel and Henisch 2012 reported the enrichment effect of calcite with Ni-2 , Co-2 , Cu-2 , Mg-2 , Zn-2 , etc. In 2009, Glocker et al reviewed growth of single crystals of monobasic ammonium phosphate (ADP) in silica gel.

Boulin et al 2004 have written about growth of silver acetate crystals. A single filament of gel grown silver acetate revealed stresses of 1.25 x 10-6 psi in bending without fracture or permanent deformation.

Bloor et al. 2012 has grown rare earth double sulpates in gels. Liaw and Faust et al. 2012 described dendritic growth of lead from gels. Breznia et al 2007 have reported growth of KDP crystals from agar gel.

Wagh 2007 has grown KDP single crystals by gel method and solution method. Crystals have been grown in silica gel by reducing its solubility with the help of ethyl alcohol. Also crystals have been grown in solution method by super saturation and evaporation.

Joshi and Antony et al. 2009 have grown KDP single crystals in silica gel by reducing its solubility with the help of ethyl alcohol. The quality of KDP crystals is judged according to the dielectric properties measured in the vicinity of ferroelectric phase transition.

Patel et al 2010 have reported growth of BaSO4 and SrSO4 while Patel and Arora et al. 2011 have described the growth of barium and strontium tungstates.

Abdul Khadar and Ittyachen et al. 2012 introduced a new method of growing large needles of lead chloride from its colloidal precipitation from silica gel.

George and Vaidyan et al. 2013 have reported significant role played by silica gel medium in the growth of single crystals of silver by electrolytic method.

Van Rosmalen et al 2014 have reported comparative study of gypsum crystals grown in silica and agar gels. Gelatin gel was used by Bank et al 2014 to grow alkaline earth orthophosphate crystals.

Brouwer and Van Rosmalen et al. 2014 compared the growth of Rb2PtCl6 and BaSO4 single crystals in silica and gelatin gels while Cody and Shanks et al. 2014 compared the growth of CaSO4 2H20 in clay and silica gels.

RESEARCH STUDY

In zone melting, molten zone is established at one end of the charge or between the seed and the charge if a seed is used and is advanced slowly by moving either the container or the furnace. As the zone travels, it redistributes impurities along the charge. This method is used for purifying elements and compounds and for preparing materials of desired composition.

Zone refining is the most important zone melting method. In zone refining, number of molten zones are passed along the charge in one direction. Each zone carries a fraction of the impurities to the end of the charge, thereby purifying the remainder.

Crystals can be grown from vapor phase in case of materials which decompose or sublime before the melting at atmospheric pressure and for which a suitable solvent is not available. It is generally more difficult to grow large crystals from vapor than from the melt or from the solution. However, the process has some advantages. In this case, the degree of super-saturation can be more easily controlled than during the growth from melt.

Gel growth in aqueous solution is now a wide spread technique for production of high quality crystals in a large range of solubilities and temperature. A gel acts as a three dimensional crucible which supports the crystals without exerting any constraining forces on it, and encourages orderly growth.

Convection is completely absent and the solute is supplied to the growing crystals by diffusion. Once a solute has been brought to the surface by diffusion, growth takes place by either screw dislocation mechanism or by two dimensional surface nucleation mechanism. One of the distinct features of the gel method is that super saturation is self-adjusting to the needs of the growth process. This leads to the formation of crystals with high degree of perfection.

The principal role of gel appears to be the suppression of nucleation. This nucleation suppression character distinguishes the gel method from ordinary diffusion methods, sometimes used for crystal growth. Suppression of nucleation is achieved by controlling the pore size distribution, which in turn depends on the density of gel.

More gel density reduces the pore size, but the contamination of the crystal by silica increases which negatively affects the shape and perfection of the crystal. This difficulty can be overcome by concentration programming experiments.

In this procedure, the concentration of the diffusion agent is initially adjusted below a certain level on which nucleation is known to occur. It is then increased in series of small steps. During the process, a stage is reached when the concentration of diffusion increases. Once a few nuclei are formed, subsequent increase of concentration leads to faster, but not to new nucleation and thus the existing crystals are able to grow with better quality.

SIGNIFICANCE OF THE STUDY

Increase in aging of gel reduces the number of nucleation centers and growth rate. The reason may be the formation of additional cross-linkages between siloxane chains with increasing gel age, resulting gradually reducing cell size. This in turn, reduces nucleation centers, since many nuclei find themselves in cells of very small size, where further growth is not possible.

Growth rate plays an important role in forming perfect crystals. In all gel growth systems, with increase in distance from the gel interface, the number of crystals growing become less and more perfect in respect of shape and size. Since crystals which grow at substantial depths in the gel grow more slowly than those near the top because of smaller concentration gradient. Slow diffusion should lead to more perfect crystals.

CONCLUSION

Most of the work on crystal growth in gel technique has been done by reaction method. Single crystals of the compounds which are mostly insoluble or sparingly soluble in water and which decompose before their melting point are usually grown by this method.

The basic requirements for chemical reaction are: The reactants employed here must be soluble in the solvent (usually water) and the product crystal must be relatively less soluble or insoluble.

The gel must remain stable in presence of the reacting solution and must not react with these solutions or with the product formed.

Some solubility of the product crystal is desirable in order to grow crystals of considerable size.

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