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GROWTH OF GAS DOPED COPPER SULPHIDE – IODATE CRYSTALS IN GEL WITH ITS COMPARATIVE TOPOGRAPHICAL AND MORPHOLOGICAL PARAMETERS

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ABSTRACT: The gas doped copper sulphide crystals and copper iodate are grown using single diffusion technique of crystal growth. Effect of supernatants, concentration programming explained and experimentally studied. This report presents the morphological and topographical characteristics of two types of copper compounds Copper Sulphide (CuS) and Copper Iodate $\text{Cu}(\text{IO}_3)_2$. The study compares grown crystals of both compounds with their respective ideal crystalline

Keywords: [Copper sulphide and iodate crystals, Gel, Morphology, Topography, comparison with ideal copper sulphide, Applications.]

1. INTRODUCTION:

Copper iodate crystals are valued for educational, morphological, and redox behavior studies. Copper Sulphide Grown Crystals are valued in material science, electronics, and energy-related research. It is crucial in exploring semiconducting, optical, and catalytic behaviors. Copper sulphide grown crystals are also used in educational labs to study nucleation, lattice growth, and semiconductor behavior. Crystals are analyzed for photo thermal and photoconductive properties. Useful for studying layered or chalcogenide structures via techniques like TEM, SEM, and XRD. Researchers had been studied the growth of copper sulphide crystal in gel and recorded the formations of rings in crystal growth process. Afterwards, mechanism of growth had been discussed extensively by many his coworkers, this work were accelerated by researchers still today. During the last few years, a successful application of gel growth technique has been demonstrated by the preparation of crystals of alkaline earth metal sulphide. The gel growth technique appeared quite attractive for growing crystals of such compounds on account of its unique advantage in terms of crystals produced and the simplicity of the process. The crystals of sulphide exhibit nonlinear properties .A

nonlinear optical phenomenon's are found to be a wide variety of applications in many areas of modern science engineering and technology .The grown crystals of copper sulphide have been characterized.

1.1 Experimentation:

A doped copper sulphide crystal are grown using chemical reaction method. Using this method gel of copper chloride formed and water containing H_2S gas filled with subsequent nucleation and the crystal growth of copper sulphide takes place. Initially different concentration solution of sodium Meta silicate taken for e.g. 11gm,13gm,15 gm., 17 gm., 19 gm., 21gm, 23gm in distilled water to get 250 cc solution. The solution is constantly stirred and filtered. A solution of different molarities prepared by adding proper amount of copper nitrate, copper chloride, hydrogen sulphide gas, acetic acid and sodium Meta silicate solution. A gel formation of mineral or organic acid takes place with a mixing of sodium Meta silicate solution. It forms process of polymerization in the mixture of solution or resultant solution. In the present work, various concentration of acetic acid and those of sodium Meta silicate were tried for optimum condition with different concentrations of Hydrogen Sulphide gas solution.

1.2 Single diffusion methods:

Copper sulphides crystals was synthesized from acetic acid and hydrogen sulphides gas ,Acid taken in the molar ratio of 1:1, by slow gel technique. In actual procedure, 5cc of 2N acetic acid was taken, to which sodium meta silicate solution of density 1.04 gm/cc was added drop wise from burette with constant stirring performed with the help of magnetic stirrer, till pH of the mixture reaches a value 4.4. A 5cc of copper chloride solution of concentration 0.4 M was added with constant stirring in mixture of acetic acid and sodium Meta silicate solution. The pH of the mixture was maintained at 4.4 Number of attempts were tried for optimum condition for

appropriate range of pH values and allowed gel to obtain crystals of copper sulphides.

1.3 Result and Discussions:

The optimum growth conditions for the growth of copper sulphide crystals are represented in figure1. The different parameters such as gel density, gel setting time; concentrations of reactants pH of gel etc have the considerable effect on the growth rate. In the steady state of concentrations gradient, growth rate also becomes steady which favors well developed crystals. However, very slow rate in one particular direction results in the different size of the crystals. In the present investigation, the growth of copper sulphide occurs in three different forms like whisker, dendritic and cubical. Just below the interface the concentration gradient is very high and hence the growth rate is also very high causing the whiskers of copper sulphide to grow in this region. As we go below away from the gel interface, the concentration gradient goes on decreasing. Hence below the whisker growth there is dendrites growth of copper sulphide. Near the bottom of the test tube far away from the gel interface, the rate of diffusion of the feed solution of hydrogen gas reduces and becomes steady causing well developed cubical crystals are obtained.

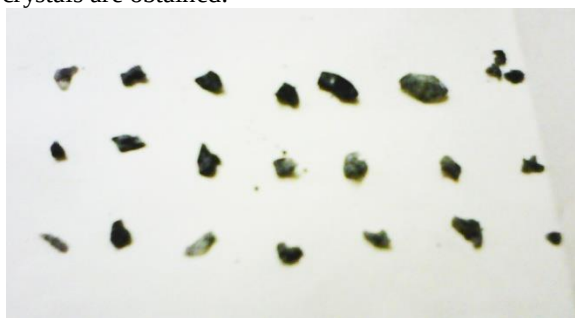


Figure 1: Grown crystals of Copper sulphide doped with gas

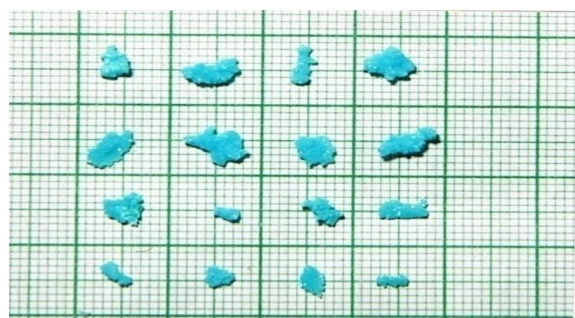


Figure 2 Grown crystals of Copper iodate

1.4 Topographical and Morphological Analysis

Figure 1: The features of Copper Sulphide (CuS) Grown Crystals having topographical features that of irregular shape. These crystals appear dark, angular, and non-uniform in size and shape. Its surface Texture enhances that matter to slightly rough,

indicating uneven nucleation and non-uniform growth rates. and color of these grown crystals observed it is typical dark bluish-black. The morphological Characteristics shows crystallinity the sample lacks well-defined facets, suggesting poor crystallinity or microcrystalline aggregation. Its size Range is small, scattered crystals, with varying dimensions. Its formation is likely grown under at ambient conditions without stringent control over parameters like temperature, but concentration and pH of doping or supernatant matters on growth of copper sulphide crystals.

In Comparison with ideal CuS Crystals it affect on distinguishing features on grown CuS Crystal. Ideal CuS Crystal having Irregular, non-faceted Hexagonal or orthorhombic in shape. its surface is rough, uneven Smooth, well-faceted Crystallinity Poor to moderate high crystallinity color Dark black-blue Consistent black-blue

Figure 2 having Copper Iodate ($\text{Cu}(\text{IO}_3)_2$) Grown Crystals its topographical features shows Uniformity relatively more uniform in shape compared to CuS. The Surface Texture appears grainy or crystalline with bright, bluish coloration. Grid background allows for better size estimation and crystals range from 0.5 mm to a few mm.

1.5 Morphological Characteristics: A color of copper iodate crystal is bright blue a known trait of $\text{Cu}(\text{IO}_3)_2$. Its shape is sub-rounded to granular with rough textures. Its Crystallinity is moderate and several of the crystals show evidence of partial faceting.

Comparison with Ideal $\text{Cu}(\text{IO}_3)_2$ Crystals: ideal $\text{Cu}(\text{IO}_3)_2$ crystal shape is irregular granules Well-formed orthorhombic surface grainy Smooth, sharp edges crystallinity moderate high color bright blue bright blue

1.6 Comparison with Ideal CuS Crystals:

Feature	Grown CuS Crystal	Ideal CuS Crystal
Shape	Irregular	Hexagonal/orthorhombic
Surface	Rough, uneven	Smooth, faceted
Crystallinity	Poor to moderate	High
Color	Dark black-blue	Consistent black-blue

1.7 Copper Iodate ($\text{Cu}(\text{IO}_3)_2$) Grown Crystals

Topographical Features:

Uniformity: Better than CuS; relatively consistent shapes.

Surface Texture: Crystalline with bright hue.

Color: Bright blue, typical of copper iodate.

Morphological Characteristics:

Shape: Sub-rounded to granular with occasional faceting.

Crystallinity: Moderate; visually more refined.

Size: Crystals range from 0.5 mm to a few mm (as seen on grid background).

1.8 Comparison with Ideal $\text{Cu}(\text{IO}_3)_2$ Crystals:

Feature	Grown $\text{Cu}(\text{IO}_3)_2$ Crystal	Ideal $\text{Cu}(\text{IO}_3)_2$ Crystal
Shape	Irregular granules	Well-formed orthorhombic
Surface	Grainy	Smooth, sharp edges
Crystallinity	Moderate	High
Color	Bright blue	Bright blue

1.9 Comparative Study: CuS vs. $\text{Cu}(\text{IO}_3)_2$ Crystals

Parameter	Copper Sulphide (CuS)	Copper Iodate ($\text{Cu}(\text{IO}_3)_2$)
Color	Dark black-blue	Bright blue
Shape Uniformity	Low	Moderate
Surface Texture	Rough, dull	Grainy, crystalline
Crystal Growth	Random, uncontrolled	Partially controlled
Crystallinity	Poor	Moderate
Similarity to Ideal	Low	Moderate

CONCLUSION

The analysis indicates that copper iodate crystals were grown under more favorable and controlled conditions, resulting in better morphology and topography than copper sulphide.

Doped and non doped copper crystals having different characteristic feature with same type of acidified solution.

While neither of the samples matches the ideal crystalline forms perfectly, $\text{Cu}(\text{IO}_3)_2$ shows greater resemblance in terms of shape, surface structure, and color consistency.

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