

Growth and Characterization of Copper Tartrate Crystal by Silica Gel Method

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ABSTRACT

In the present investigation, copper Tartrate crystals were grown in silica gel at ambient temperature. Distilled water used as solvent for copper chloride. Optimum conditions were established by varying various parameters such as pH of the gel solution, gel concentration, gel setting time, concentration of upper reactants, gel density etc. Crystals having different morphology were obtained. Bluish colour, semitransparent, diamond shaped, copper tartrate were obtained. The crystal structure of compound was confirmed by powder X-ray powder diffraction, Chemical analysis. The crystals studied using XRD, FT-IR, and thermal analysis, (TGA & DTA), scanning electron microscope (SEM), Chemical analysis Were studied. Needle shaped and bluish, semitransparent, well shining colour, Diamond crystals were grown. [1-17]

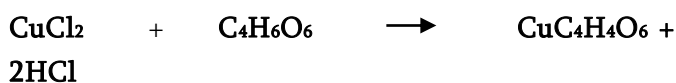
Keywords : Gel technique, Copper tartrate crystals, XRD & Chemical analysis.

I. INTRODUCTION

Every citizen of the nation is enjoying the high standard of living due to recent developments of new materials. Every day pure and mixed crystals are added for practical and industrial purposes. Modern technological revolution was possible because of physical properties like ferroelectric, dielectric non-linear optical, piezoelectric, and semiconductor properties of the material. Therefore, we tried to develop novel materials for the above said applications. Herein, we have developed a methodology to grow the crystals of copper tartrate in silica gel medium in pure form. This chapter reports the complete study made on nucleation and growth of these crystals as a function of gel parameters like the specific gravity of the gel, pH, concentration of supernant solution, and concentration of tartaric acid.

1.1 CHEMICAL REACTION –

The reaction is occurred as follow:



Copper chloride + Tartaric acid \longrightarrow Copper tartrate + waste product

II. CHARACTERIZATION OF GEL GROWN COPPER TARTRATE CRYSTALS

2.1. X-RAY DIFFRACTOMETRY (XRD)

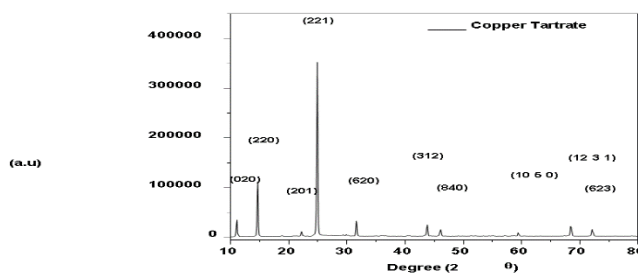


Fig. 1. X-Ray Diffraction of gel grown copper tartrate crystal.

X-ray diffractogram is useful in the analysis of crystal

structure, cell parameters' values, unit cell volume and lattice system, X-ray diffractogram of gel grown copper tartrate was recorded using powder rotation photograph method on 'Minislex Rigaku' X-ray diffractometer at department of Physics, Pratap College, Amalner. $\text{CuK}\alpha$ -radiation (wavelength $\lambda=1.54051 \text{ \AA}$) was used. The scanning speed was kept to $10^\circ \text{ min}^{-1}$. The recorded X-ray diffraction pattern is shown in Fig. 1. XRD pattern shows very sharp peaks having high intensity which leads to extremely good crystalline perfection of the copper tartrate crystals. The lattice parameters of unit cells of copper tartrate is tabulated in the Table 1. From this powder diffraction data (hkl) values were computed. The computer program, POWD, (Integrative powder diffraction and indexing program version 2.2) was used to calculate (hkl) values.

The unit cell parameters, observed and calculated interplanar distance, and orientation of plane corresponding to 2θ obtained from the computer program are summarized in the Table 1 and 2. These parameters fulfill the condition for orthorhombic system i.e. $a \neq b \neq c$ and $\alpha = \beta = \gamma = 90^\circ$. The obtained data is in well agreement with the JCPDS data card no. 01-0158 of copper tartrate material.

Table 1. Lattice parameter for copper tartrate crystals.

C	Copper Tartrate
A	17.9058 \AA
B	16.0728 \AA
C	4.4232 \AA
V	1272.97 (\AA) ³

Table 2 Calculated & observed value of d-spacing and (hkl) indices of copper tartrate crystal.

Peak	d-Spacing (\AA)		Indices hkl	2 θ Degree	
	Obs	Calc.		Obs	Calc.
1	8.0364	8.0364	(0 2 0)	11.00	11.00
2	5.9804	5.9804	(2 2 0)	14.80	14.80
3	3.9656	3.9656	(2 0 1)	22.40	22.40
4	3.5588	3.5562	(2 2 1)	25.00	25.02
5	2.7945	2.7976	(6 2 0)	32.00	31.96
6	2.0562	2.0567	(3 1 2)	44.00	43.99
7	1.9553	1.9553	(8 4 0)	46.40	46.40
8	1.5642	1.5643	(10 5 0)	59.00	59.00
9	1.3668	1.3671	(12 3 1)	68.60	68.59
10	1.3042	1.3043	(6 2 3)	72.40	72.39

III. CHEMICAL ANALYSIS

(INDIVIDUAL ANALYSIS OF COPPER) –

Copper tartrate is separated by routine method i.e. 0.1 gm of copper tartrate was dissolved in dilute acidic solution and the copper was precipitated by passing H_2S gas in the solution. This was filtered by What Mann filter paper no.40. The precipitate was dried and ignited. Weight of copper residue was 0.028 g. The filtrate left after the precipitation of copper was used for analysis.

The filtrate was boiled to expel H_2S gas.

Theoretical percentage of copper (Cu).

Theoretically, in $\text{CuC}_4\text{H}_4\text{O}_6$ having molecular weight 211.62 gm,

The amount of Cu is 63.54 gm.

Percentage of copper = $(63.54 \times 100) \div 211.62 = 30.02\%$

Practical percentage of copper:

Weight of sample = 0.1g

Weight of the precipitate (Cu) = 0.028 g.

Percentage of copper = $(0.028 \times 100) \div 0.1$

Percentage of copper = 28.0 %

Table 3. The result analysis of copper tartrate

Element	Theoretical value %	Practical value%
Copper(Cu)	30.02	28.0

IV. RESULT AND DISCUSSION

The crystals of copper tartrate were characterized by XRD analysis. From the XRD pattern it is noticed that the peaks obtained at 11.00, 14.80, 25.00, 31.95, and 43.35° are corresponds to the (020), (220), (221), (620), and (312) lattice planes of the copper tartrate crystals, respectively. Calculated (hkl) and 'd' values indicate orthorhombic crystals structure of copper tartrate crystals and having lattice parameters of $a = 17.9058 \text{ \AA}$, $b = 16.0728 \text{ \AA}$ and $c = 4.4232 \text{ \AA}$ and volume of unit cell, $V = 1272.97 (\text{\AA})^3$. We have used two different techniques to investigate the elemental composition present in the grown crystals. Specifically, we have used inductively coupled plasma atomic emission spectroscopy for lithium detection in lithium tartrate. We have also used energy dispersive X-ray analysis to identify the presence of copper in the copper tartrate. Theoretical value % of copper is 30 and observed value is 28.74

V. CONCLUSION

1. The gel grown copper tartrate crystals are bluish color.
2. The copper tartrate crystal is grown by simple gel method.
3. It was found that as pH increases, nucleation centers decreases
4. Theoretical value % of copper is 30 and observed value is 28.74

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