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# The Static Magnetic Field Effect on Crystal growth of Uric Acid

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## ABSTRACT

In the present work, Uric Acid crystal one of the crystalline components of urinary stone were grown by single diffusion gel method in the presence of static magnetic field for different strengths such as 0, 0.1, 0.2 Tesla for constant pH, density and concentration of the solution at room temperature. Yields and morphology of grown crystals were studied. These crystals were characterized by using XRD and FTIR method.
**Keywords:** Uric Acid Crystal, Single Diffusion Gel Method, XRD, FTIR.

## I. INTRODUCTION

The systematic study of growth of crystal is very significant to understand the process of stone formation in human body. Uric acid is one of the constituent of renal stone. It has formula ($C_5H_4N_4O_3$) is a heterocyclic compound of carbon, nitrogen, oxygen, and hydrogen. It has molecular mass 168.11gm. It appears white solid. It has melting point 300 °C (572 °F; 573 K). Uric Acid is one of the crystalline components of urinary stone which occurs in human. It is insoluble 0.0006g/100 mL (at 20 °C) in Water but easily soluble in HCl. The renal calculi; which are major health problem found in all habitats around the globe. Hence various crystals were grown by researchers using gel media [1]. Exposure of growth [2, 3]. The Struvite and Whewellite crystallization in gel media studied [4,5]. In in-vitro gel; the environment is similar to physiological environment of living human and animal body so in this present research paper In-Vitro gel method used. The origin of this research work is to explore findings on crystallization of Uric Acid by studying effects of time varying electro-magnetic field as promotes or inhibits; Also crystal size, morphology and yields with and without microwave exposure are studied. After that grown Uric Acid crystals were characterized by using XRD and FTIR method.

## II. METHODS AND MATERIAL

AR grade chemicals used for study of Uric Acid crystal growth, Sodium Meta Silicate (SMS), Acetic Acid (glacial), Dilute Hydrochloric Acid, Na OH, Distilled water. Borosilicate Glass Test tubes of diameter (25x15) cm with stand, pH meter, Dropper, filter papers, graph papers, Mask, Hand Gloves.

**Gel Setting for Uric Acid crystal**

The Uric Acid crystals were grown in silica gel media using chemical reaction in gel method by two ways 1. Without Static Magnetic Field setup and 2. With Static Magnetic Field set up. Crystal growth parameters are shown in Table 1 and the steps 1 to 7 are same and step 9 used for step II.

**Table 1. Uric Acid Crystal Growth Parameters.**

| Sr. No. | Uric Acid Crystal Growth | Parameters |
|---|---|---|
| 1 | Specific Gravity of stock solution | 1.045 g/cc |
| 2 | Acid used for pH setting | Acetic acid |
| 3 | Stock solution at pH | 6.5 Temp. |
| 4 | Concentration of Reactant I | Dilute Hydrochloric Acid |
| 5 | Concentration of Reactant II | 1.0M |
| 6 | Uric Acid in Na OH | 2.5M |
| 7 | Gel Aging | 48hrs |
| 8 | Time variation of Static Magnetic Field | 30-120mins. |
| 9 | Duration Growth Period 120hours | |

**Step I:** The gel was prepared by dissolving Sodium Meta Silicate powder in double distilled water and shaking this solution well. This solution is filtered and kept in clean flask. This solution was mixed with glacial acetic acid at pH 6.5 and with specific gravity1.04 g/cc. This solution were mixed in 1M concentration of Dilute Hydrochloric Acid solution in the ratio 1:1 and allowed to set for 48 hours at room temperature. After setting the gel, concentrations 2.5M of Uric Acid in Na OH solution is poured slowly and gently around edges of test tubes over set gel. The test tubes were tighten using cork and kept in a quiet and vibration free condition. The following reaction takes place **$(C_5H_4N_4O_3+NaOH)+H\ Cl= C_5H_4N_4O_3+NaCl+H_2O$.** After 120 hours; Fine Uric Acid crystals were observed in test tube at the centre of gel region and some at surface of test tube. Then crystals were collected from test tubes on filter paper for weighing.

**Study of Effect of Exposure of Static Magnetic Field on Uric Acid Crystal Growth:**

An Electromagnets (EMU-50) of 7.5 kg placed at 10mm air gap with flat pole pieces (50 mm diameter) is used to apply magnetic field strength as shown in figure 1.The magnetic field strengths were varied by using appropriate current to the coils and it is measured by Gauss meter. The study of effect of static magnetic field on crystal growth of uric acid is carried out by applying static magnetic field at nucleation state in Silica Gel media. The experimental setup and various components and their arrangements are as in figure 1and 2.

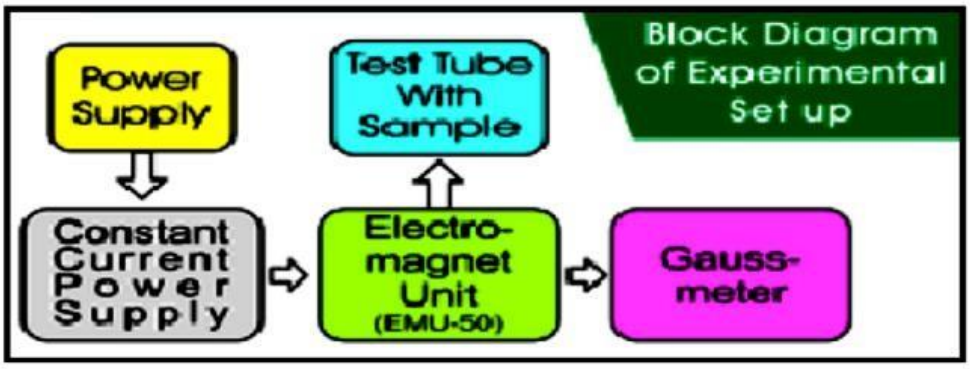


**Figure1 Block diagram of Static Magnetic Field Experimental Set up.**

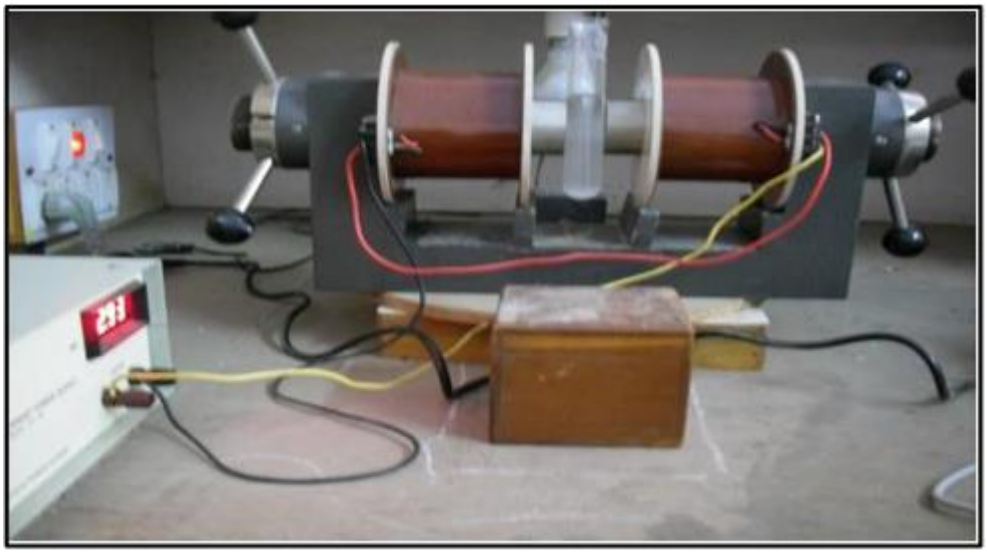

**Figure.2. Experimental Set up for Uric Acid Crystal growth at 0.1 and 0.2 Tesla magnetic field strengths.**

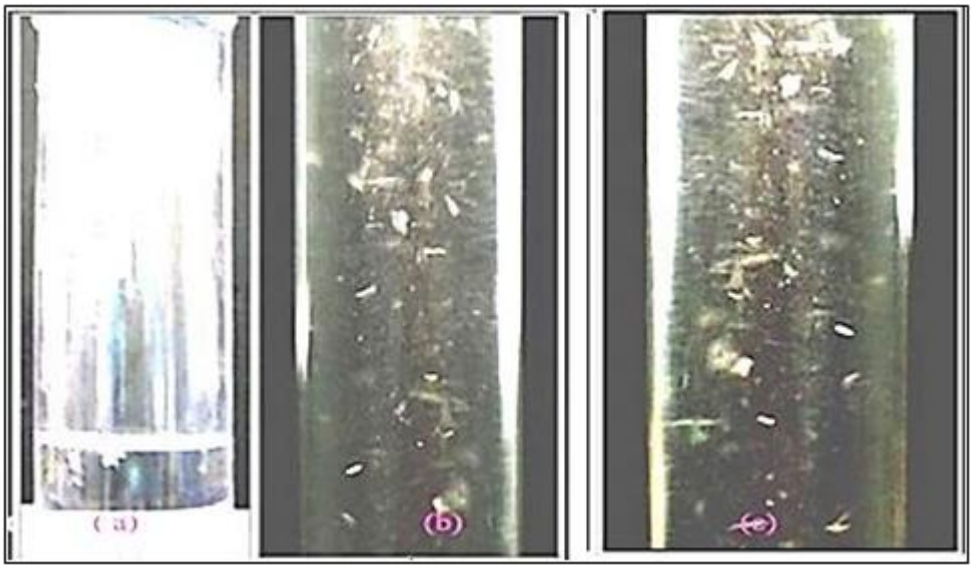


**Figure.3. Crystallization of Uric acid (a) At Nucleation State (b) & (c) After 120 Hours for Static Magnetic fields 0,0.1 Tesla & 0.2 Tesla**

The study of crystal growth of Uric Acid is carried out[6] by applying the growth process at nucleation state with static magnetic field strengths 0.1 T and 0.2 T for the periods of 30min., 60min., 90min. and 120min.as given in figure1.The crystal growth parameters used for Uric Acid are as in table 1. Using the procedure discussed in above; the gel for crystal growth is prepared in a set of eight test tubes using 2M concentration of reactant one. Then gently add the second reactant of 2.5 M concentration in the first test tube. Now the nucleation of crystals will start this state is called the nucleation state of crystal growth. At this state of nucleation the test tube is kept in between the poles of electromagnet for exposure of static magnetic field strength 0.1 Tesla (Core coil current 1.46 Ampere) for the period of 30 min. After addition of reactant two of 2 M concentration the second test tube is kept at the nucleation state for exposure of same magnetic field strength for the period of one hour (60 min.). Similarly the third and fourth test tubes after addition of second reactant of 2.5 M concentration are exposed for same magnetic field strength for the period of 90 min. and 120 min. respectively. And then allow to grow for the defined period (total 120 hours from the nucleation state) in vibration free steady environment.

Similar procedure is followed for exposing the test tube for magnetic field strength 0.2 Tesla for the period of 30 min, 60 min, 90 min and 120 min. at nucleation state. Then the exposed test tubes are kept in vibration free steady environment for the defined period of 120 hours from the nucleation state.

**Crystal Yield Analysis:**

Yield of Uric Acid crystals grown are given in table no.1 plotted in figure 3.

**Table.2. Yields of Uric Acid Crystal after 120 hours in gm. at pH 6.5**

| Magnetic field in Tesla | Time in Minutes | Yield of Uric Acid Crystal |
|---|---|---|
| 0 | 0 | 1.4 |
| 0.1 | 30 | 0.8 |
| 0.1 | 60 | 1.1 |
| 0.1 | 90 | 1.18 |
| 0.1 | 120 | 1.25 |
| 0.2 | 30 | 0.9 |
| 0.2 | 60 | 1.05 |
| 0.2 | 90 | 1.18 |
| 0.2 | 120 | 1.32 |

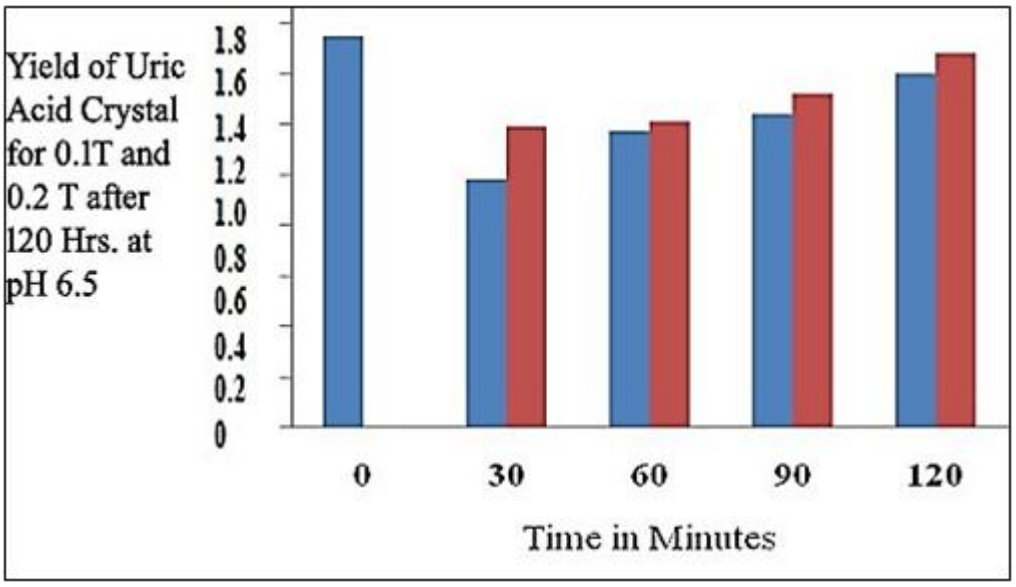


**Figure.4. Plot of Yields of Uric Acid Crystals**

**Crystal Characterization Analysis:**

XRD and FTIR Studies were conducted to characterize the crystals grown in silica gel media.

**Powder X Ray Diffraction Analysis:**

A Philips X-ray Diffract meter model PW/1840 with Ni filter, Cu-Kα radiation from Department of Physics, Savitribai Phule University Pune is used to identify the crystal structure of Uric Acid crystal as given in figure5.It is found that Uric Acid crystallized in the monoclinic with unit cell parameters [7,8] as P21/a space group with unit cell parameters as;

a =14.465Å, b =7.403Å, c=6.208Å and

β =65.20 Z =4, V= 602.9A03

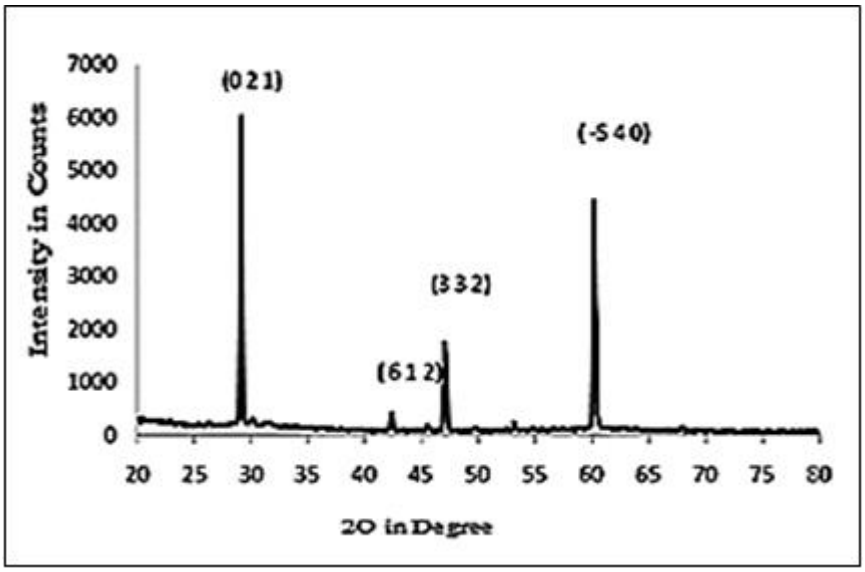


**Figure.5.Powder XRD pattern of Uric Acid crystal**

**FTIR Analysis:**

The FTIR spectrum of Uric acid Crystal is recorded using FTIR-BUSY-6100A JASCO spectrometer in a scan range (4000-400cm-1) from Department of Physics Savitribai Phule University of Pune. It is found that FTIR spectra revealed functional group for Uric acid crystal.

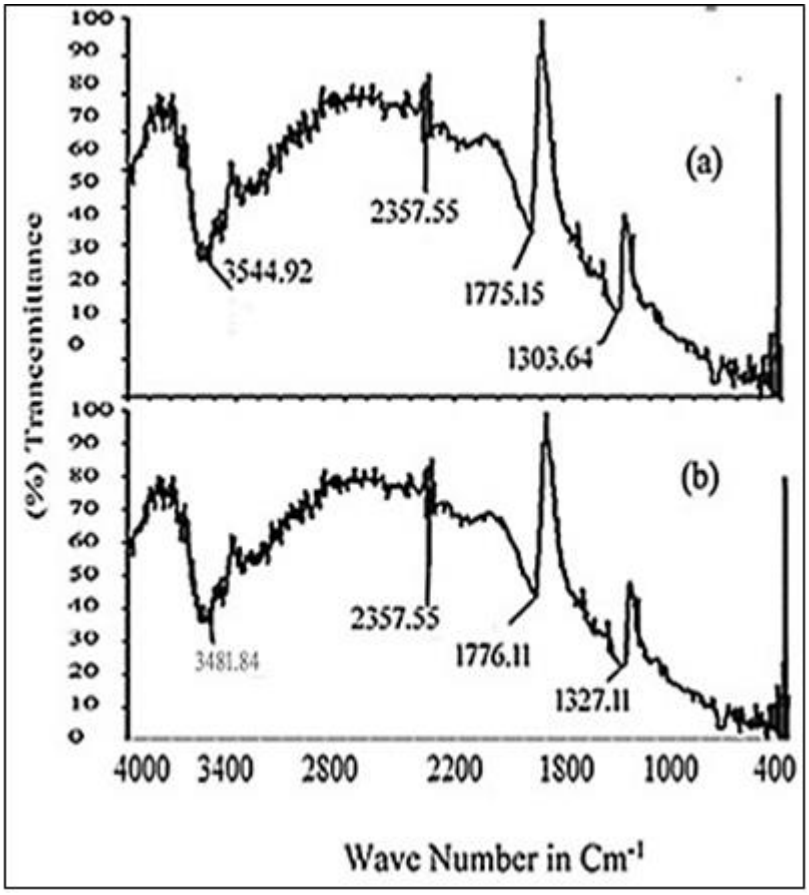


**Figure.6. (A) FTIR of UN Exposed Uric Acid crystal (B) FTIR of Static Magnetic field Exposed Uric Acid crystal.**

The compared FTIR spectra of Uric acid with and without exposure reveals the presence of water and O- H stretching absorbed at 3481.84 cm-1. C-C, C-O and C- N stretching absorbed at 2357.55cm-1. The C=O

stretching absorbed at 1776.11cm-1. O-H deformation absorbed at 1327.11cm-1. which varies and indicates as presence of water and O-H stretching absorbed at 3544.92 cm-1. C-C, C-O and C-N stretching absorbed at 2357.55cm-1. The C=O stretching absorbed at 1775.15cm-1. O-H deformation absorbed at 1306cm-1.

## III.RESULTS AND DISCUSSION

The photographs of Uric Acid crystals grown are shown in figure3. The morphology of Uric Acid crystals observed as elongated rod like morphology and is in good agreement with result published. The powder XRD pattern shown in figure no. 4 of Uric Acid crystal confirmed and results are in good agreement with results reported in literatures.

Also FTIR analysis pattern shown in figure no.5 (A,B) of Uric Acid crystal confirmed and results are in good agreement with results reported in literatures.

FTIR pattern obtained for crystal for crystal grown under exposure of magnetic field at the nucleation time exhibits more % transmittance for magnetic field strength 0.1 T than 0.2 T. The difference of % transmittance found decreased and depth of %transmittance dip at frequency is found increased as exposure time is increased.

Rate of nucleation observed reduced and size of crystals decreased with increasing strength of magnetic field but number of crystals found increased.

Yields of Uric Acid crystals grown are given in table no.1 and plotted in figure 3 is found slightly increased as influence of increasing magnetic field. Overall yield found less as compared to without exposure of magnetic field.

## IV.CONCLUSION

1. Platy Rectangular Type Morphology of Uric acid crystal remains same without and with increasing strength of magnetic field.
2. Yield of Uric acid crystals grown are found slightly increased as influence of increasing magnetic field. Overall yield found less as compared to without exposure of magnetic field.

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