INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN: 2278 – 0211 (Online)

Electro Kinetic Studies Of Potassium Ferro Cyanide Single Crystal

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Abstract:
In this present study, unidirectional growth at room temperature and 100% solute crystal has been achieved for the first time from the solution growth method using "uniaxially solution – crystalline method". The nonlinear single crystals of Potassium Ferro cyanide were grown by slow evaporation solution growth technique. The chemical reactions were studied both, in the Ultraviolet – Visible (UV – VIS) and Fourier Transform Infrared Region (FTIR) of the spectrum. Along with these dielectric constant and viscosity measurements were performed for better investigation. It is increasingly recognized that, in order to understand the kinetics and mechanism of ionic crystal, dissolution at the microscopic level is required. When the single crystal of the material of interest is available, these techniques allow kinetic and structural information on dissolution from single crystals. Crystallographic data of monoclinic and integrated single crystal were measured.

Key words: *Crystal growth, slow evaporation technique, Ultraviolet – Visible (UV – VIS), Fourier Transform Infrared Region (FTIR).*

1.Introduction

The necessity of recrystallization as a method of purification is well known but the method by which Fourier Transform Infrared Region (FTIR) and Ultraviolet – Visible (UV – VIS) quality the crystal is not well known. The purpose of this monograph is to briefly and informally outline some of the methods which can be used to obtain single crystal suitable for FTIR and UV – VIS studies. This monograph means to be neither rigorous nor exhaustive, but rather, a sort of practical, good general reference which covers similar material and can be found in crystal growth [1 – 6]. The main aim in growing single crystal of FTIR experiment is to grow single crystal of suitable size. For practical size, the crystal should be 0.2 – 0.4 mm in at least two or three dimensions. Most potential structure determination is thwarted by a lack of suitable crystal. Crystal growing is an art and there are many variations to the basic crystal growing recipes as there is crystallographer. The recipes given below are ones which we have developed. The technique chosen for crystal growth largely depends on the chemical properties of the compound of interest. A slow evaporation technique used to grow crystals work best for those compounds which are not sensitive to ambient condition in the laboratory by using the Sankanarayanan Ramasamy method.

The action of crystal growth yields a crystalline solid, whose atoms or molecule are typically closed packed with a fixed position in a space relative to each other. The crystalline state of matter is characterized by a distinct structure of rigidity and virtual resistance to deformation (change of shape and volume). Perfect crystal would only grow exceedingly slowly whereas real crystal grows comparatively rapidly because they contain dislocation, which provide a necessary catalyst for structural transformation and long range order form [7 – 10]. In this work, we have experimentally investigated the hysteresis behaviour of Potassium Ferro cyanide crystal. Our aim is to develop an analytical description of the most important forces that do not necessarily compound to the slow growing faces.

2.Experimental Studies

A crystal is a solid material whose constituent atoms, molecules or ions are arranged in an orderly repeating pattern extending in all three spatial dimensions. Crystal growth is a major stage of a crystallization process and consists of addition of new atoms, ions or polymer string in the characteristics arrangement of a crystalline bravices lattice. The growth typically follows an initial stage of either homogeneous or heterogeneous (surface catalysed) nucleation unless a "seed" crystal, purposely added to start the growth which is already present. Most crystalline solid has high values both of young modulus and shear modulus of elasticity. This is in contrast with most fluids, which has a low shear modulus and typically exhibits the capacity for microscopic viscous flow [9].

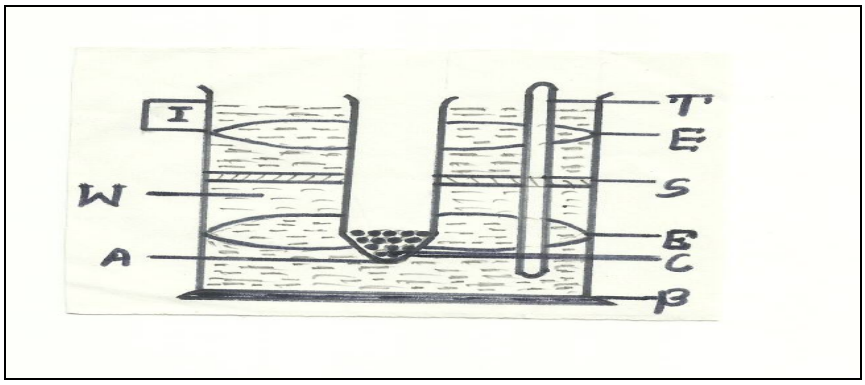

Figure 1: Experimental Set Up For S.R. Method

T… Thermometer E… Electrical heating Element
S… Stand C… Seed crystal
B… Tough bath W... Water
A… Ampoule

The process of crystal growth is not an example of crystals that grow rapidly in skeletal or dendrites forms.

Figure 2: Crystal Of Potassium Ferro Cyanide

Potassium Ferro cyanide is purely soluble in water at a particular temperature and kept over five to ten days to avoid the dust particle for preparing seed crystal by using S.R. method as shown in figure 1.

3.Characterization Techniques

3.1.Ultraviolet – Visible (UV – VIS) Studies

The UV – VIS transmission spectrum of the recorded crystal is shown in figure 3.

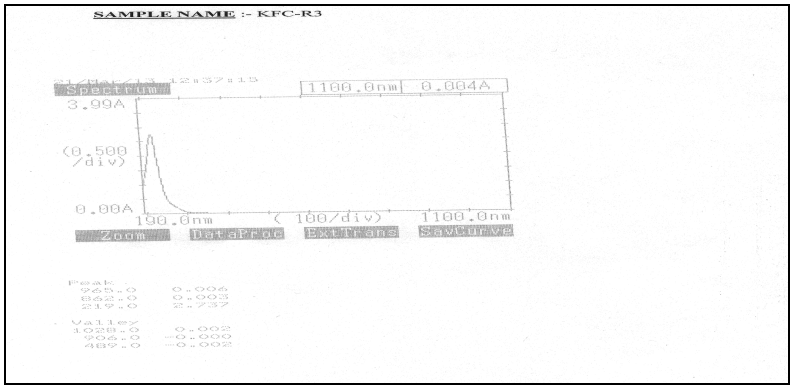

Figure 3: UV – VIS Of Potassium Ferro Cyanide Crystal

It is seen that in UV – VIS transform, there is remarkable absorption in the entire region of the spectra, which is an important requirement for Non Linear Optical materials for possible application.

3.2.Fourier Transform Infrared (FTIR) Studies

The FTIR spectra of the crystal were recorded in the phase in the frequency region of 3909.93 cm^{-1} to 586.67 cm^{-1} with a scanning speed of 2 mm/sec.

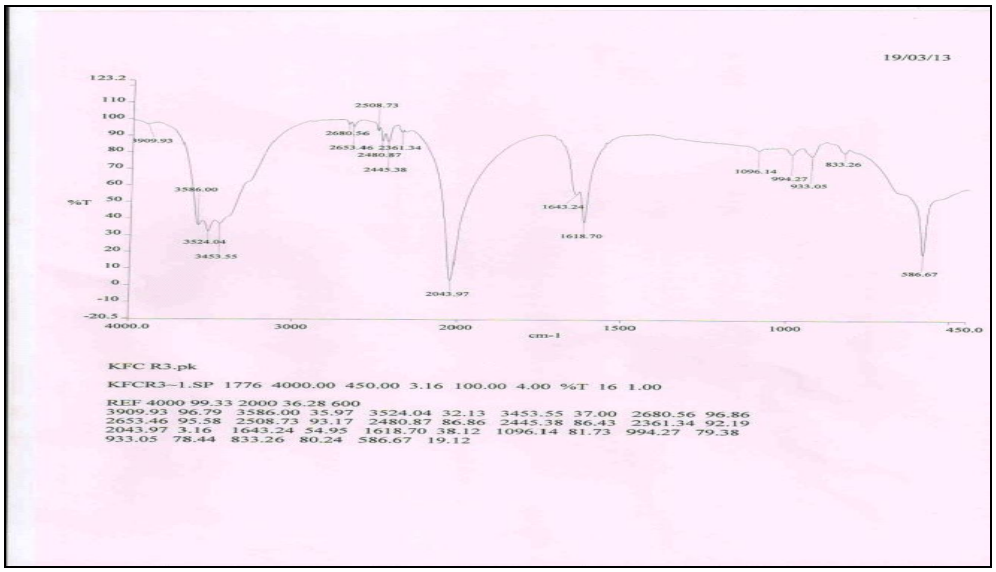

Figure 4: FTIR Of Potassium Ferro Cyanide Crystal

The recorded FTIR spectra as shown in figure 4 were compared with the standard spectra of the functional group. The strong but broad peak at 1618.70 cm^{-1} is due to the presence of stretching in the carboxyl group.
The very strong peak observed at 2043.97 cm^{-1} is due to the combination of stretching and deformation.

3.3Dielectric Constant

The single crystal of Potassium Ferro cyanide was crushed into powder form. Such type of material filled in the assembly of dielectric constant instruments and the capacitance was measured with the help of multi meter.
In this study, the applied electric field is opposite to the internal electric field in a dielectric crystal. The dielectric constant at optical frequencies arises almost entirely from the electronic polarizability. The capacity of the condenser is directly proportional to area of plates, dielectric of medium between two plates and inversely proportional to the distance of two plates. The dielectric constant of Potassium Ferro cyanide material were found to be 2.101 $x10^{-3}$.

3.4.Viscosity

Ostwald Viscometer is used to determine the viscosity of Potassium Ferro cyanide. The viscosity of the material depends upon the nature of the material, solvent, temperature and molecular weight. The viscosity of this sample is found to be 1.673 Ns/m^2. We also found that, the viscosity of liquid generally decreases with rise in temperature. This is due to the continuous movement of liquid molecules into these vacancies as a consequence, the vacancies also keep on moving around as otherwise the liquid will not be able to

flow. In this crystal as activation energy becomes increasingly available at increasing temperature, a liquid can flow easily at higher temperature.

4.Result And Discussion

Potassium Ferro cyanide unidirectional seeded single crystal was successfully grown by slow evaporation solution grown technique and investigation were performed by UV – VIS, FTIR. The Dielectric constant and viscosity of the sample were also determined. The crystal of Potassium Ferro cyanide extremely resembles a monoclinic structure. This type of Potassium Ferro cyanide materials is used in the dry colours, tempering steel, dying, explosive process, engraving, lithography and laboratory reagent. It is also used in preparation of the potassium cyanide.

5.Acknowledgement

We are very much thankful to Dr. D. C. Kothari, Head of the Department of Physics, University of Mumbai. We are also grateful to Darshan, Archana, B. Warude, Babuji, Madhubhai and all staff members of Formokem India Corporation Bhayandar, Thane for their help and support.

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