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GROWTH AND CHARACTERISATION OF KDP CRYSTAL

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Abstract
Potassium dihydrogen phosphate (KDP) is a well-known nonlinear optical (NLO) material for various optoelectronics applications. The pure and Potassium dihydrogen phosphate (KDP) has been grown by slow evaporation solution growth technique. The good quality has been mowed in the period of 23 days. The lattice parameters of the crystal were confirmed bypowder X-Ray diffraction analysis. The FTIR confirms the presence of functional groups in the grown crystal. The optical absorption was examined by UV-Vis analysis which was carried out for the grown crystal.

Keywords: KDP, Powder X-ray diffraction, FTIR, UV-Visible Analysis.

Introduction

The crystal with advanced properties plays a significant role in the growth of modern scientific world of present technology. Crystal growth is one of the significant fields with controlled phase transformation. The curiosity in crystal growth process has been enlargement particularly in the area of technological application .Materials can be classified as single crystals, poly crystals and amorphous materials depending upon the arrangement of constituent molecules, atoms or ions. In present research is focused on the search for suitable materials displaying excellent second order nonlinear optical properties for potential application in optoelectronics, telecommunication, and optical storage device. Potassium dihydrogen phosphate (KDP) is a well-known inorganic NLO material, having good ferroelectric, piezoelectric and electro optic properties. KDP favors for its crystal growth in a bulk size suitable for device applications. The KDP crystals were grown by slow evaporation method at room temperature [1-3].

Experimental Procedure

The calculated amount of KDP is dissolved in 50ml of double distilled water and stirred continuously for 3 hours using a magnetic stirrer to obtain a homogeneous mixture. The solution was filtered using whattmann filter paper. The resulting solution is kept in a beaker and covered for controlled evaporation. After a period of 5 days, small crystals were obtained, and good quality crystals were grown up by period of 23 days [4]. The photograph of grown KDP crystal is shown in fig. 1.

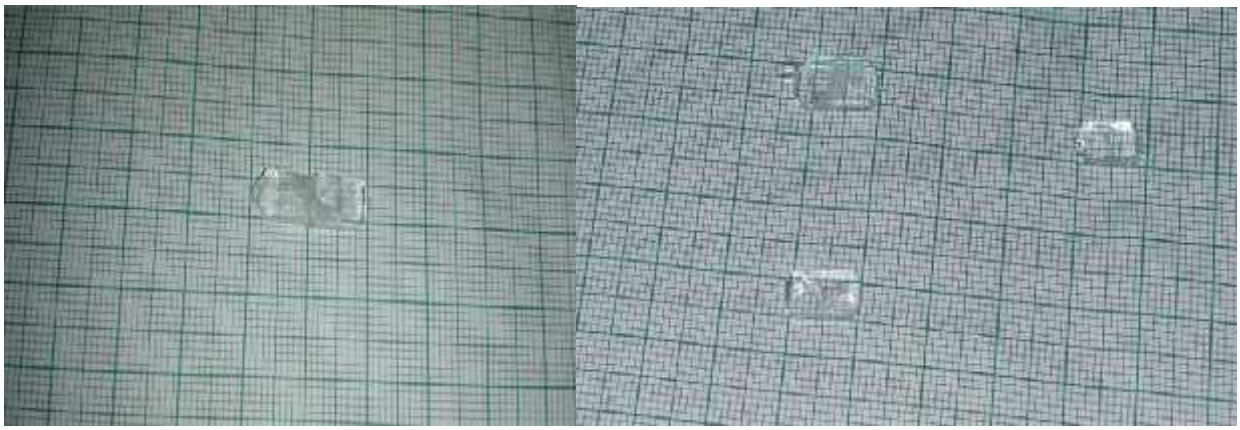


Fig: 1. Grown KDP crystals

Characterization

The grown KDP crystal was subjected to various characterization viz. Powder X-ray diffraction, FTIRanalysis,UV- Visible spectral study.

Results and Discussion

Powder X-Ray Diffraction Analysis

The X-ray powder diffraction analysis was used to confirm the physical phase and structure of the materials. The recorded powder X-ray diffraction patterns of pure KDP crystals are shown in fig. It was confirmed that the incorporation of KDP crystals is tetragonal structure and diffraction patterns.

KDP crystal belongs to the tetragonal scalerohedral symmetry with space group 142d having dimensions a = b = 7.5243A^0 and c = 3.698A^0. The sample was scanned in the range 10-90^0 at a scan rate 2^0 per min [5].
The crystal was identified by comparing the inter planer spacing and intensities of the power pattern with the JCPDS data of KDP crystal value 350807.

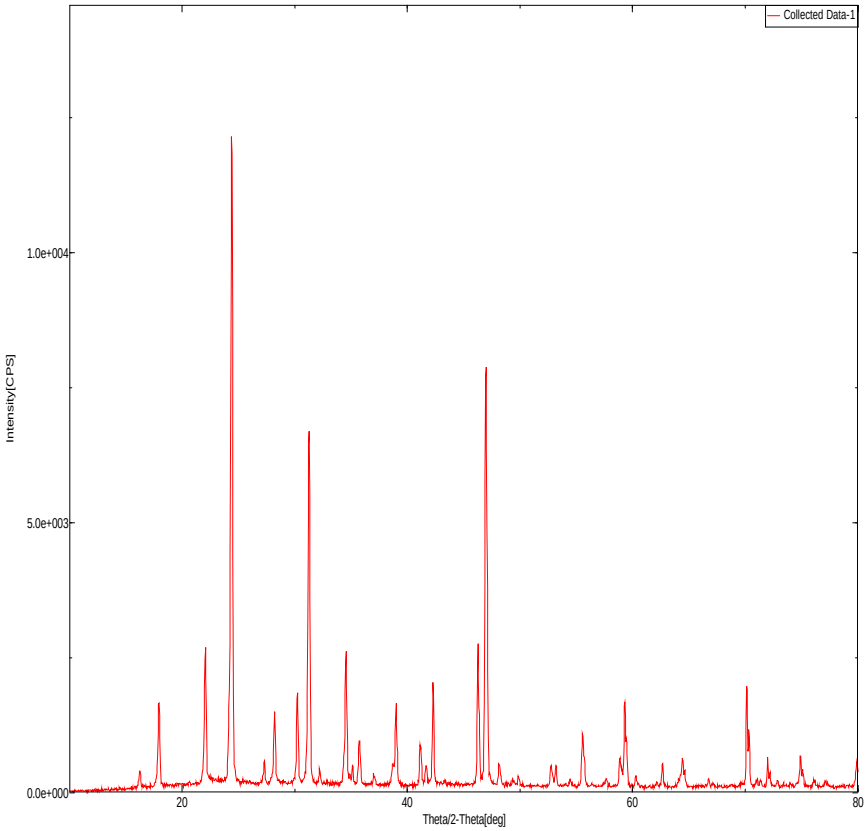


Fig: 2.XRD Spectra of KDP crystal

Table: 1. Lattice Parameter

Lattice parameter	**Values**
a	7.5243 A°
b	7.5243 A°
c	3.698 A°
Volume	381.5 A^3
System	Tetragonal

Ftir Analysis
The KBr pellet method was used to analyze the sample. The grown crystal was subjected to IR spectroscopy to confirm the presenceof functional groups, the frequency range of 400-4000cm^{-1} KDP was shown in fig.

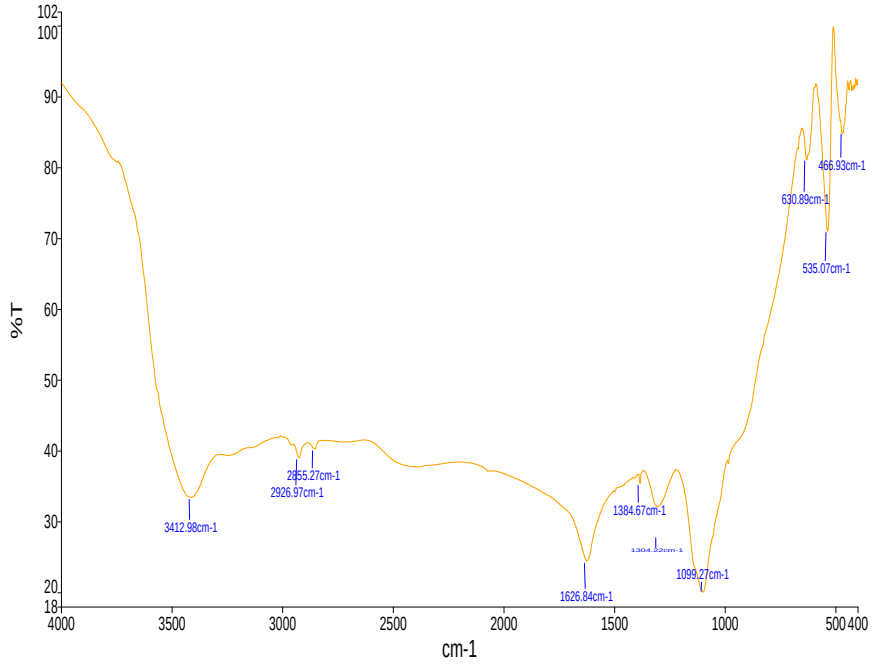


Fig: 3.FTIRspectra of KDP crystals

In the spectrum of KDP, there is a broadband in the higher energy region due to O-H starching vibration KDP and water. Hydrogen bonding with in the crystal is suggested to be the cause for broadening. The broad band at the frequency 3412.98 cm^{-1}represent the O-H stretching. Presence of water is supported by its bending vibrations occurring at the 1626.84 cm^{-1}represent the O= P- OH symmetric stretching(Bandwell et al 1994).The broad band at the frequency 1384.67 cm^{-1}represent the P=O stretching. The observations of 630.89 cm^{-1} confirmed HO-P-OH bending [6-10].

Table: 2. Interpretation of Ftir Datas

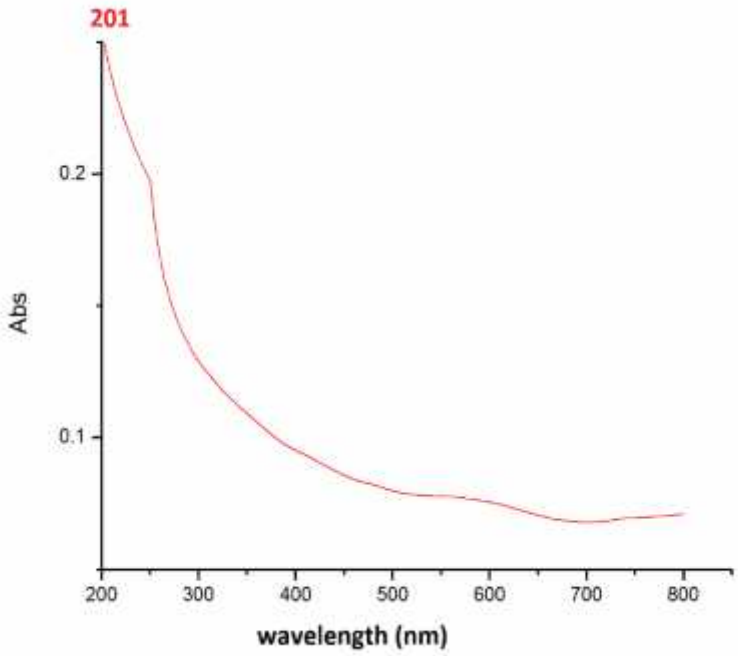
STANDARED FREQUENCY(cm^{-1})	OBSERVED FREQUENCY(cm^{-1})	VIBRATION MODE
3423	3412.98	O-H stretchinghydrogen bonded
2919	2926.97	P-O-H stretching
2839	2855.27	P-O-H stretching
1643	1626.84	O=P-OHsymmetric stretch
1306	1384.67	P=O stretching
	1099.27	P=O stretching
600-700	630.89	HO-P-OH bending
535	535.07	HO-P-OH stretch

3.3uv-Visible Absorption Spectrum

Absorption spectra for KDP crystal spectra covering UV-VISIBLE (200 - 400 nm) region are given in fig.

Fig: 4.UV-VISIBLE spectra of KDP crystals

When absorption is monitored from longer to shorter wavelength, the absorption is found to very less in the entire visible



region of the spectrum. This is most desirable property of the material processing NLO activity.The crystal is highly transparent in the entire visible region. The peak value shows the absorptionat 201nm.

Conclusions

The KDP crystals were grown by a slow evaporation technique. The grown crystal were subjected to various characterization such as FTIR, UV and Powder XRD. The FTIR spectrum confirms the various functional group present in the crystal and vibrational structure of the compound has also been elucidated. The UV-Vis spectral analysis found that the grown crystal is highly transparent and absorption is very low. XRD, the cell parameters are absorbed that the grown crystal belongs to tetragonal structure a = b = 7.5243A$^{\circ}$ and c = 3.698A$^{\circ}$.

Reference

1. R.Raja, D.Vedhavalli, International journal of Materials Science ISSN 0973-4589 Volume 12, Number2 (2017).
2. Baranirag. T, Philominathan. P, "Growth, Thermal, Mechanical and dielectric studies Gliycine doped Pottassium acid phthalate single crystals"(2011), J. Minerals and material characterization and engineering, 10-9, 805 -815.
3. Dillip,R., Madhukar Raddy, C., Deva Prased Raju, B: Growth and characterization of nonlinear optical material, J. J. Minerals and material characterization and engineering, 10-12, 1103- 1110.
4. S.S. Hussaini, K.Datta, ICOP 2009 – International Conference on Optics and Photonics CSIO, Chandigarh, India, Nov,2009. J.W.Mullin, J.Cryst growth, Vol.13-14 (1972)2-3.
5. X. Ren, D. Xu, D. Xue, Crystal growth of KDP, ADP, and KADP, J. Crystal Growth 310 (2008) 2005-2009.
6. G Ravi, A S. Haja Hameed, P. Ramasamy Jr Cryst Growth 207, 319 (1990).
7. P. Koteeswari, S.Suresh and P. Mani, International J.Chemtech Research, 5 (2013) 2010-2014.
8. H.V Alexandru, J. Cryst. Growth 169 (1996) 347.
9. Fundametals of Molecular Spectroscopy, Bandwell et al 1994.
10. R.Raja[1],S.Saravanan, International Journal of Technical Research and Applications e-ISSN:2320-8163,(2016).