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GROWTH AND CHARACTERISATION OF PURE AND METHYL ORANGE DOPED POTASSIUM DIHYDROGEN PHOSPHATE (KDP) CRYSTAL

R. Kayalvizhi[*1], G. Meenakshi[2], S. Thiyagaraj[*], V. J. Priyadharshini[*], M. Indhumathi[*]

*Karpagam University, Coimbatore.
[1]Department of Physics, St.Joseph's College of Arts & Science, Cuddalore.
[2]Department of physics K.M.C.P.G.S, Puducherry.
[1]Corresponding author mail: ramvizhi@yahoo.co.in

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ABSTRACT:

Potassium dihydrogen phosphate is a well known inorganic crystal [1]. It has an interesting property such as NLO, wide frequency conversion, high damage threshold against power laser and good UV transmission. Methyl orange dye has been desired to dope in KDP. In present study single crystal of pure and methyl orange doped KDP has been grown by slow evaporation solution growth technique. The grown crystal has been studied by X-ray diffraction analysis. The enhancement in transmittance of grown KDP crystal with addition of methyl orange was determined by UV-Visible spectral analysis. The grown crystal was subjected to conductivity and capacitance analysis to observe its electrical property [2-4].

Keywords: Potassium dihydrogen phosphate, nonlinear optical material, methyl orange, slow evaporation technique, UV transmission, X-ray diffraction.

1. INTRODUCTION

In this modern world crystal plays a vital role in scientific advancements. An increasing demand of crystal in scientific media is because of high nonlinear transparence property. KDP dominates all other inorganic crystal by having this kind of properties. In the present investigation the organic methyl orange were doped with KDP in 0.1 % ratio and grow by slow evaporation technique. The grown pure and methyl orange dye doped KDP crystal has been subjected to X-ray diffraction, UV transmittance, conductivity and capacitance analysis [5-8].

2. EXPERIMENTAL

The KDP salt was purified by repeated recrystallization using the method of dissolving in distilled water. Then the solution of KDP salt was prepared in a slightly under saturation

condition. The solution was stirred well for five hours constantly using magnetic stirrer still the salt has been dissolved in water. Then the prepared solution were transferred into two clean Petri dishes and kept for crystallization at room temperature in a quiet place. Within four days the nucleation takes place and seed crystals in all Petri dish were obtained as show in figure.1

Fig.1 Shows the KDP seed

A supersaturated solution of pure KDP and 0.1% of methyl orange doped KDP at room temperature was obtained by constant stirring up to five hours and then filter into beakers. The good quality seeds were suspended in respective beakers using the nylon thread. Slow evaporation method was employed for the growth. After completion of growth run, the crystal was harvested. The photograph of grown methyl orange doped KDP crystal is shown in figure 2.

Fig.2 Shows the 0.01% of M.O doped KDP grown crystal

2.2. Characterization

The X-ray Diffractometer analysis has been carried out for the rapid identification and quantification of grown crystal by using Diffractometer system of XPERT-PRO at 2 theta position of 10.088 to 79.9381 2 with CuKα. The obtained results have been shown in figure 3 (a) and 3 (b).

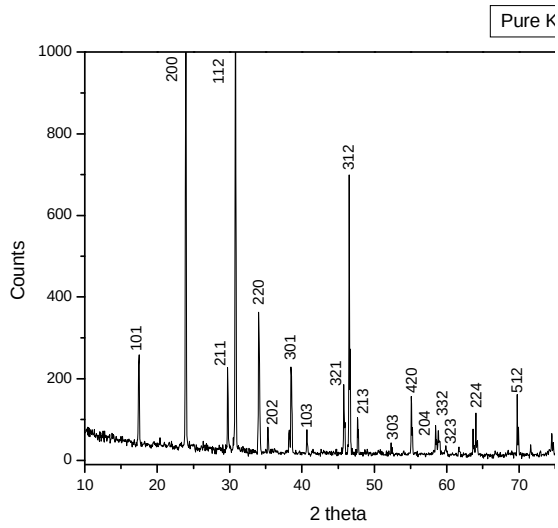

Fig 3 (a) shows the powder XRD pattern of pure KDP

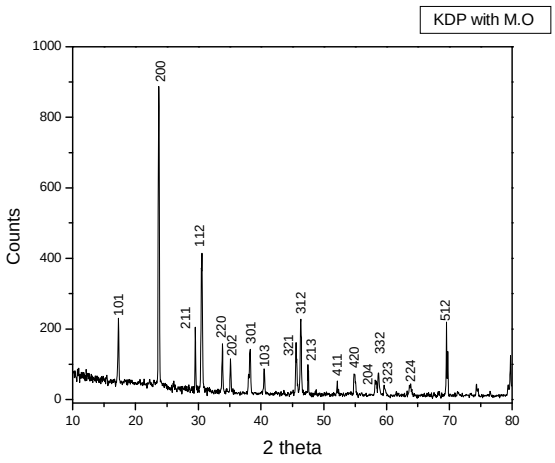

Fig 3 (b) shows the powder XRD pattern of methyl orage dopped KDP

The optical absorption and transmission spectra have been recorded by using UV-VIS_NIR spectrometer in the range of 100-1100nm as shown in the figure 4(a) and 4(b).

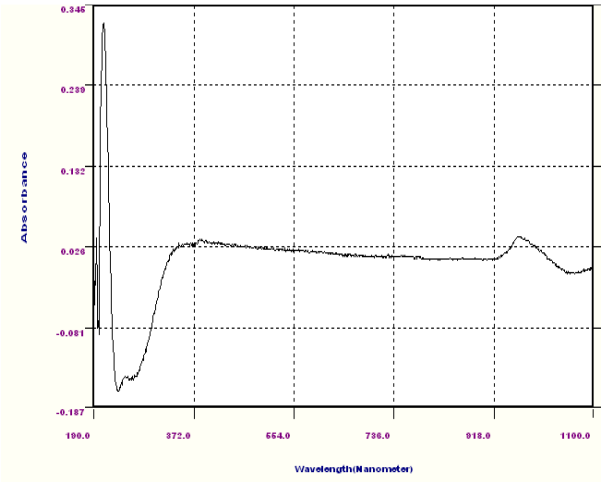

Fig.4 (a) shows the KDP UV analysis

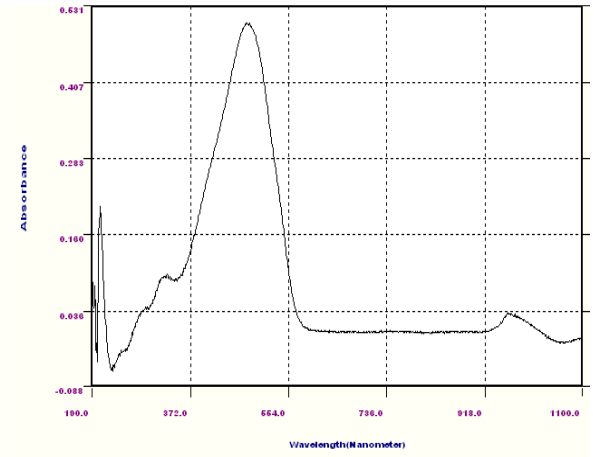

Fig.4 (b) shows the 0.1% methyl orange doped KDP UV analysis

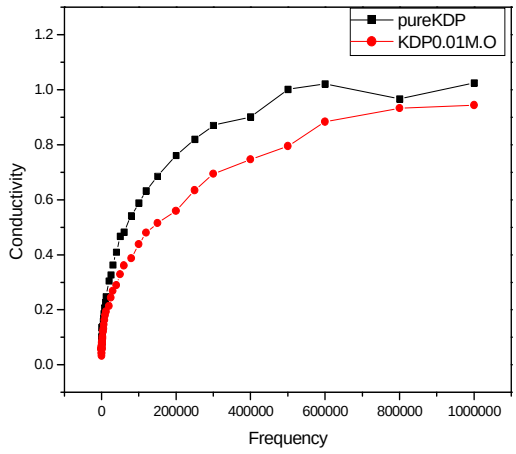

Fig.5 (a) shows the Conductivity result for KDP and 0.1% methyl orange doped KDP

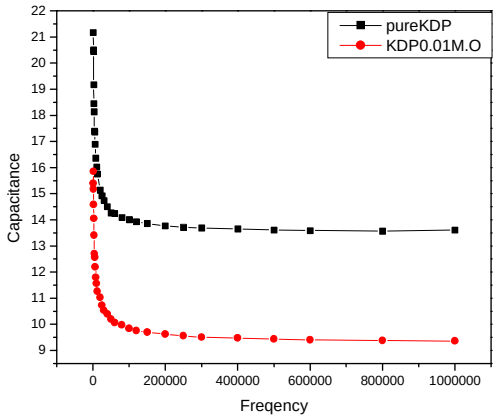

Fig.5 (b) shows the Capacitance result for KDP and 0.1% methyl orange doped KDP

The dielectric properties such as conductivity and capacitance has been measured and shown in the figure 5(a) and 5(b)

3. RESULT AND DISCUSSION

KDP crystal is a queen of all crystal because of its high transparency and best NLO property. When methyl orange dye has been doped in KDP crystal it has some changes in its character. By comparing pure KDP crystal the characteristic changes in methyl orange dye doped KDP crystal has been studied by using XRD, UV and dielectric test analysis.[9-12]

The excitation of X-ray in KDP and methyl orange dye doped KDP crystal has been found and shown in Fig 3(a) & 3(b). While comparing the XRD pattern of methyl orange dye doped KDP crystal with pure KDP crystal structure the 2 theta values slightly shifted towards left i.e. the 2 theta values decreased in fraction and hence the d-spacing range increased in fraction. The pyramidal plane (112 and (312) has been dominated heavily whereas the basal plane (200) is unaffected. This is due to the incorporation of methyl orange dye in KDP crystal. The methyl orange dye trying to dominates the KDP and increases its transparency.

From UV absorption pattern (Fig4a & 4b) it is found that a strong absorption peak near the

wavelength of 280nm in pure KDP crystal. Whereas in methyl orange dye doped KDP crystal the absorbance range is shifted towards the higher wavelength side around 480nm. This implies that methyl orange dye finely incorporated inKDP crystal.

From the figure 5(a) and 5(b) the conductivity and capacitance of pure KDP and methyl orange doped KDP crystal has been analysis by varying frequency. The results shows that the KDP crystal having a good conductivity and capacitance. When methyl orange added with KDP its dielectric properties has been reducing.

4. CONCLUSIONS

Using XRD analysis, the data methyl orange dye doped KDP crystal has some changes in its structure. The shift of absorption and excellent transmission in entire visible region makes this crystal a good candidate for electronic applications. The conductivity and capacitance study of grown methyl orange dye doped KDP crystal indicated that this crystal can be a high NLO crystal than a pure KDP crystal.

5. ACKNOWLEDGEMENT

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