

Solubility and Laser damage threshold properties of L-Histidinium 2-nitrobenzoate single crystal

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Abstract : L-Histidinium 2-nitrobenzoate single crystal was grown by solvent evaporation technique using water and methanol solvents. Solubility study was carried out using two different solvents and solubility of the crystal was found out. Laser Damage threshold study was carried out to find the withstand ability of the crystal for high intense laser light.

IndexTerms –LDT, Histidine, Solubility.

I. INTRODUCTION

Organic Nonlinear Optical crystals with wide range of application have been searched by many researchers in the recent past [1,2]. Organic materials having very interesting nonlinear optical property, which is the key factor for selecting them into the optoelectronics and photonics devices [3,4]. In the recent years researchers are more interested in rapid growth of optical quality single crystals [5,6]. Optically good quality crystals are very often used in frequency doubling and optical switching, and fiber optics communication systems [7].

Organic amino acids show second harmonic nonlinear optical conversion efficiency. Due to the acentric crystallography structures and the weak van der Waals and hydrogen bond make them to have high transparency in the ultra violet region [8]. They have zwitter ionic nature which is essential for non linear optical materials. L-Histidine is very effective NLO materials due to the hydrogen bonds present in the material. L-Histidine is reported by many scientists due to its high nonlinearity and laser field applications [9-11]. L-Histidine 2-nitrobenzoate is one among the other Histidine based compound famous for its promising non linear property was reported by Zamara et al [12]. In that report a detailed study of optical, mechanical and thermal was carried out and reported. But no work have been carried out for finding the ability to withstand the material against high laser

In our present work we now focusing on various laser based characterization of the crystal L-Histidinium 2-nitrobenzoate. Solubility of the crystal in water and methanol was carried out. Laser damage threshold study was done to find the laser withstand ability of the crystal.

II. Crystal growth and Solubility

L-Histidine (99% purity) and 2-nitrobenzoic acid was taken in stoichiometric ratio and dissolved in aqueous and methanol solvents. Solubility of L-Histidinium 2-nitrobenzoate in two different solvents was carried out in three different temperatures. Solubility curve of L-Histidinium 2-nitrobenzoate crystal was shown in figure 1. From the plot it evident that solubility of L-Histidinium 2-nitrobenzoate was high in methanol solvents than aqueous solvent. Crystal grown in aqueous solvent is mentioned in the figure 2. The crystal was grown in monoclinic crystal system with P21 space group.

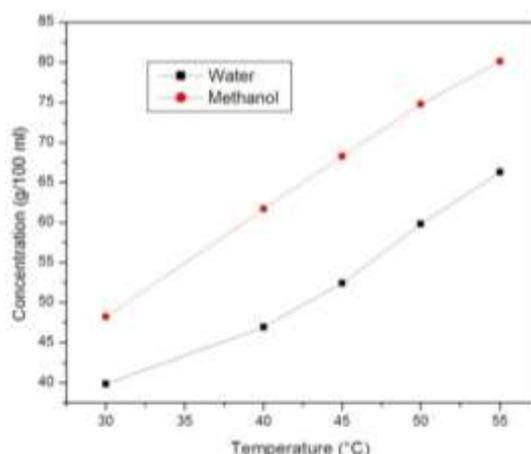


Figure 1. Solubility cure of LH2NB(I) crystal

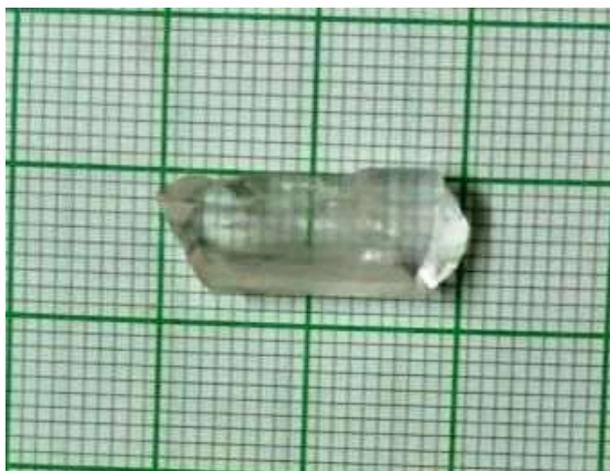


Figure 2: Grown crystal of LH2NB(I) from methanol

III. Laser Damage threshold study

An Q-switched Nd:YAG laser beam with wavelength of 1064 nm is used to find the surface damage threshold values of L-Histidine 2-nitrobenzoate single crystal. The pulse width of the laser beam is 10 ns with the repetition rate of 10 Hz. The laser beam is focused on the crystal on focusing area of 1.2 mm, while the focusing length of the beam is 1 m.

The laser beam was focused on the crystal to find the surface damage threshold value. The surface damage threshold value ($P_{(d)}$) is calculated using the relation

$$P_{(d)} = E/\tau A,$$

Where, E is the Energy of the laser beam, A is area of the crystal which exposed on laser and τ is the pulse width of the laser beam in ns. The LDT value of the crystal was calculated as 5.82 GW/cm². The LDT of 2-nitrobenzoate crystal is comparatively high with the same kind of other crystals [13,14]. High LDT values of LH2NB(I) suggest that the crystal can be used in high power laser applications [15].

IV. Conclusion

L-Histidinium 2-nitrobenzoate (LH2NB(I)) crystal was grown from aqueous and methanol solvent, methanol is found to be a better solvent for LH2NB(I) crystal than the water solvent. Laser Damage threshold of the LH2NB(I) crystal was calculated using a high power laser, and it is found that the LDT value of the crystals is high than that of the other Histidine based crystal. Calculated surface damage threshold values of LH2NB(I) is 5.82 GW/cm². From the LDT and results we conclude the crystal L-Histidinium 2-nitrobenzoate can be a better candidate in opto electronics, low power laser and as well as high laser device applications and it can be a perfect replacement of same kind of organic crystals.

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