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SPECTRAL AND OPTICAL STUDIES OF L-HISTIDINE (LH) DOPED MALIC ACID CRYSTAL

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Abstract: In present investigation, L-histidine doped malic acid crystal has been grown by slow evaporation technique. The functional groups of grown crystal were identified using the fourier transform infrared (FT-IR) spectral analysis. The UV-visible studies were carried to assess the high optical transparency and wide range of transmission of doped malic acid crystal in the range of 200-900 nm. The photoluminescence spectrum of doped malic acid crystal was analyzed at an emission wavelength of 254 nm using photoluminescence studies.
Keywords: Solution growth; Optical properties; Spectroscopy; UV-visible.

INTRODUCTION

Nonlinear organic materials are widely emphasized due to large application value in optical data storage, optical switching, telecommunication and optoelectronic devices [1-2]. The organic materials possess high and extremely polar nature offering large nonlinearity, high structural stability, fast optical response and lower dielectric properties [3]. The systematic studies of different properties of amino acid crystals with different carboxylic acid have been successfully reported [4-7]. LH is the chiral amino acid with high nonlinear optical response [6]. Till date, no literature is available on synthesis and characterization of LH doped malic acid crystal. Thus, present communication reports the studies on spectroscopic, optical and photoluminescence properties of LH doped malic acid crystal to bring out its vitalized applicability for NLO device fabrication.

Experimental procedure

The AR grade L-histidine and malic acid were used to grow the title compound. 1mole% of L-histidine was gradually added to supersaturated solution of malic acid prepared in double distilled deionized water at room temperature. The doped malic acid mixture was allowed to stir at constant speed for six hours to achieve the homogeneity throughout the aqueous solution. The prepared solution was thus filtered and kept for evaporation at room temperature. The purity of the compound has been achieved by repetitive recrystallisation.

RESULTS AND DISCUSSION

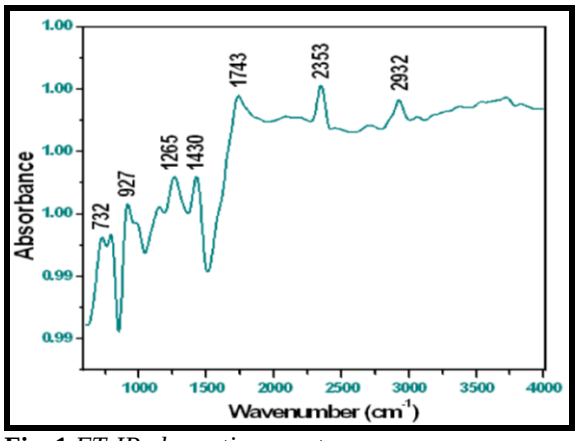

Fig. 1 *FT-IR absorption spectrum*

Fourier transform infrared (FT-IR) spectral analysis

The FT-IR spectrum of grown crystal has been recorded using Bruker α-ATR instrument in the range of 600 cm^{-1} to 4000 cm^{-1} to determine functional groups of the grown crystal. The vibrational absorption spectrum of grown LH doped malic acid crystal is shown in Fig. 1. The absorption peak at 1265 cm^{-1} occurs due to stretching of aryl-N of aromatic ring coming from L-histidine clearly indicates the influence of LH in malic acid. The functional groups of LH doped malic acid crystal are discussed in table 1.

Table 2 ***Functional group assignment of LH doped malic acid crystal***

Wavenumber (cm^{-1})	Assignment
2932	C-H stretching
1743	C=O stretching
1430	$-CH_2$ deformation
1265	Aryl-N stretching
927	C-H wagging
732	In phase CH wagging

UV-visible study

The optical transparency of the grown crystal has been assessed in the range of 200-900 nm using the Shimadzu UV-2450 spectrophotometer shown in Fig. 2.

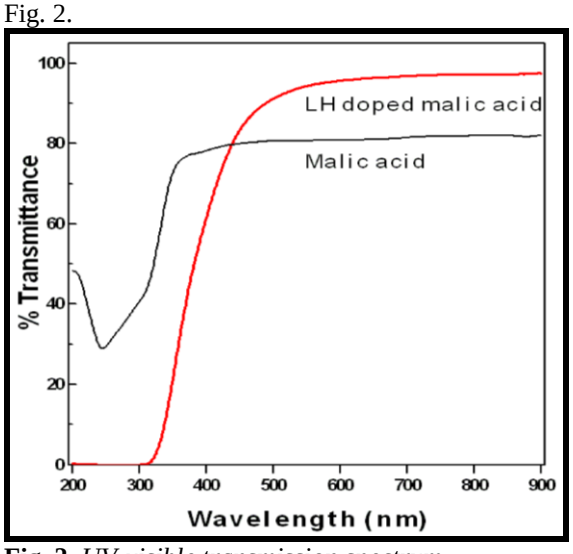

Fig. 2 *UV-visible transmission spectrum*

The crystals suitability for distinct NLO applications can be realized through wide optical transparency window in UV-visible region. The evaluation of optical transmission involves the excitation of electrons from the non-bonding to anti-bonding orbital (n→π*) as a consequence of absorption of incident photon energy. The grown LH doped malic acid crystal possesses optical transparency above 90% which is grater than malic acid. The lower absorption edge at which transmission becomes falls zero is found to be at 317 nm. The occurrence of no absorption peak in the range of 320 to 900 nm, high optical transparency above 90% and lower cut off wavelength of grown crystal suggests its potential candidature for SHG device applications and optical telecommunication systems [8].

Photoluminescence (PL) study

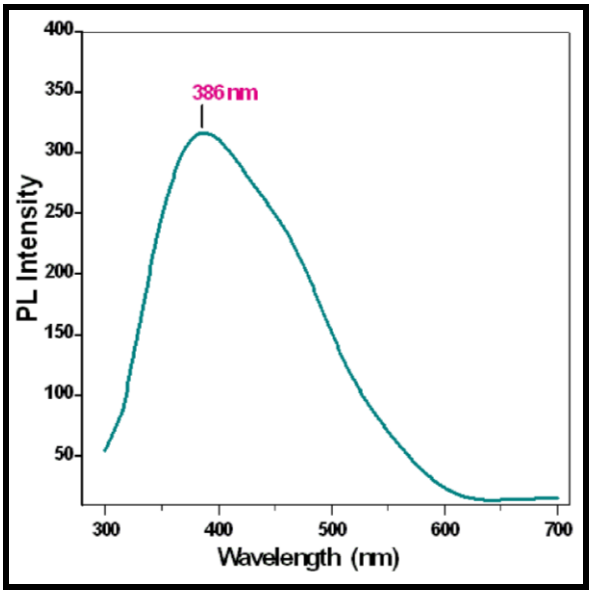

Fig. 3 *PL spectrum of LH doped malic acid*

The spontaneous emission of light from the grown crystal as a consequence of incident photonic absorption is studied undertaking the photoluminescence (PL) study. The PL spectrum uncovers the possible transition electronic band states and impurities of the material at selective photonic energy [15]. The grown crystal has been optically excited with photon energy at 532 nm. The PL spectrum has been recorded at 254 nm, shown in Fig. 3. The intense violet emission peak procured at 386 nm indicated the single transitional band structure and high purity of the grown crystal.

CONCLUSIONS

LH doped malic acid crystal has been grown by slow solution evaporation technique. The presence of Aryl-N stretching in FT-IR spectrum confirmed the incorporation of LH in malic acid. The LH doped malic acid has optical transparency above 90% and lower cut-off wavelength at 317 nm which substantiates its suitability for NLO applications. The PL study confirmed the single violet emission at 386 nm.

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