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A Comparative study of metal replacement on doped L-isoleucine crystals

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Abstract- Single crystals of zinc acetate doped isoleucine and cadmium acetate doped iso leucine crystals have been grown by slow evaporation technique. Good quality crystals were grown in 20 days. The fluorescence of the crystals were analyzed by fluorescence studies. FTIR spectrum reveals the functional groups of the crystals. The crystals have good optical nature in the intact UV-Visible region. SEM analysis reveals the structural morphology of crystals.

Keywords- *LISZA – isoleucine zinc acetate; LISCA – isoleucine cadmium acetate; FTIR - Fourier transform infrared spectrum; UV-VIS region – Ultra Violet-Visible region*

I. INTRODUCTION

A material which satisfies optical transparency is suitable for the opto-electronics device fabrication normally. It is very difficult to identify such a material with all requirements. Amino acid having acentric crystallographic structure with the absence of strong conjugated bonds leads to wide transparency in the entire UV-Visible region[1].

In this paper, the growth and characterization of a new material, L-isoleucine with the replacement of zinc acetate by cadmium acetate(LISCA) is discussed. The grown crystal is effectual in giving good optical, structural and fluorescence behavior which can be utilized for opto-electronic device fabrications.

II. EXPERIMENTAL PROCEDURE

A. Synthesis

High purity salts(99.9%) were used for the crystal growth. Single crystals of zinc acetate doped isoleucine and cadmium acetate doped isoleucine were grown at room temperature by solution growth using slow evaporation method, of an aqueous solution containing pure iso leucine and zinc acetate with isoleucine in equal stoichiometric ratio. The temperature of water in the bath was controlled digitally by using microprocessor. Variation in temperature of the bath can be tuned to an accuracy of ±0.1°C. Transparent good quality crystals of the title compound were harvested in the span of 20 days. The photograph of the LISZA and LISCA crystals are shown in fig.1.

Fig.1(a) Photograph of LISCA

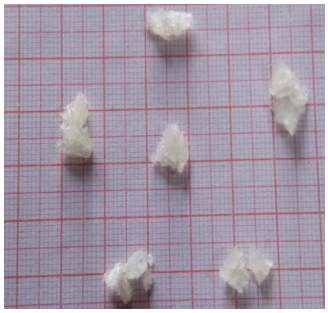

Fig.1(b) Photograph of LISZA

III. CHARACTERIZATION

The fluorescence studies of the grown LISZA and LISCA crystals were carried out using LS45 spectrofluorometer.. FTIR spectrum analysis was recorded in the range of 4000-400 cm^{-1} using Perkin Elmer spectrum RX I. The UV-Visible spectrum was recorded in the range 200nm-1100nm using Perkin Elmer lambda 35 model. The surface morphology of the crystals were compared using Scanning Electron Microscope.

IV. RESULTS AND DISCUSSION

A. Fluorescence studies

Property of fluorescence is used to determine the crystalline quality as well as its exciton and thereby fine structure. The fluorescence spectra of both crystals are observed and given in figure. The fluorescence emission spectra for LISZA and LISCA crystal samples were recorded in the range from 240 – 700nm. The broadband is centered at 454.35 nm with 808.89 for LISZA and 453.52 nm with 878.11for LISCA.

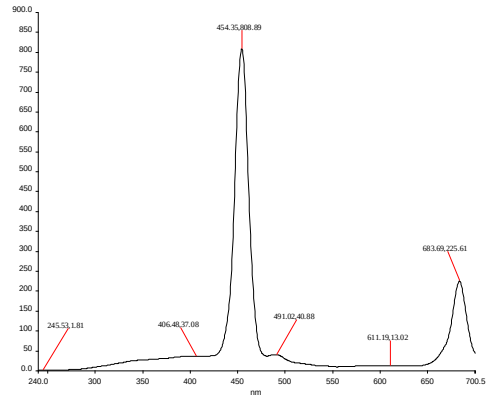

Fig.2(a) Fluorescence peak of zinc acetate with isoleucine

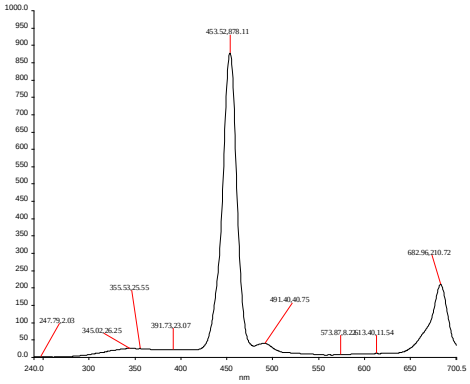

Fig.2(b) Fluorescence peak of cadmium acetate with isoleucine

An intensity peak at 808.89 was observed in the emission spectrum for LISZA and 878.11 for LISCA.

B. Fourier Transform Infrared spectrum studies

The FTIR spectrum was recorded for the sample of the crystals using the KBr pellet technique in the region 4000-400 cm^{-1}. The various functional groups present in the material are identified in this study[2-5]. The FTIR spectrum is shown in fig.3.

Table: Assignment modes from FTIR spectrum

LISZA	LISCA	L-Isoleucine	Assignment mode
3258	-	-	N-H aminoacid stretching
3153	3154	-	NH_{3+} Asymmetric stretching
2966	2967	2967	C-H stretching vibration
2937	2937	-	C-H stretching vibration
2879	2880	2880	Presence of free amino acid with C-H stretching
2621	2620	2618	Presence of aminoacid(weak) ; but not always
-	2347	-	N-H streching
-	2322	-	N-H streching
2112	2114	2114	C-C(triple bond) stretching
-	1580	-	NH_3 deformation
-	1400	-	OH carboxylic acid In plane (bending
1419	1418	1417	CH_3 symmetric bending
1153	-	-	C-C Rocking
-	993	-	C-H out of plane deformation
922	921	921	-O C($CH_{3)}$ skeletal vibration
538	537	537	NO_2 deformation
442	443	-	C-N-C bending

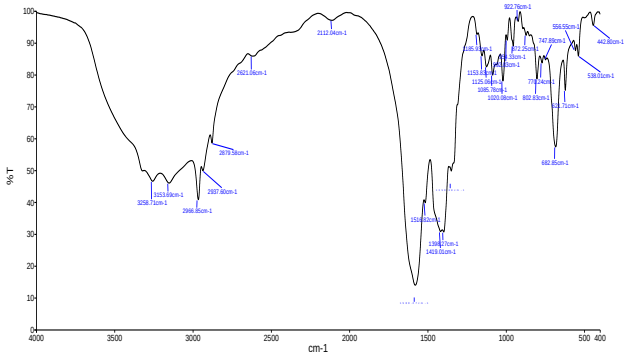

Fig.3(a) FTIR spectrum of LISZA

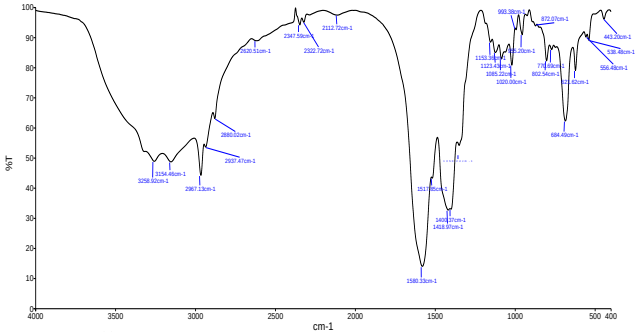

Fig.3(b) FTIR spectrum of LISCA

C. UV-Visible spectral studies

The optical absorption spectra of LISZA and LISCA crystals were recorded in the region 200-1100nm at a scanning speed of 480 nm/min. Fig. 4(a&b) shows the absorbance spectra and transmission spectra which hold good in the entire visible region. The cutoff wavelength of LISCA was found to be 225 nm and 243 nm for LISZA. The optical behavior of this LISCA crystal was suitable for opto-electronic applications when compared to LISZA crystal.

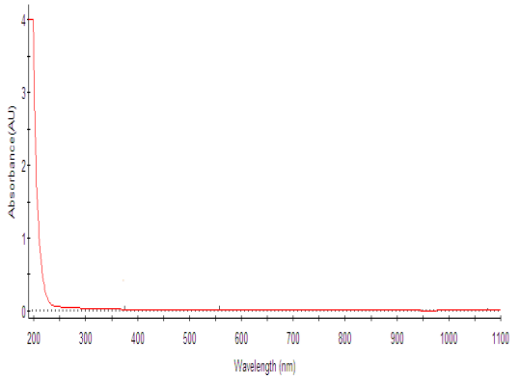

Fig.4(a) Absorption spectrum of LISZA

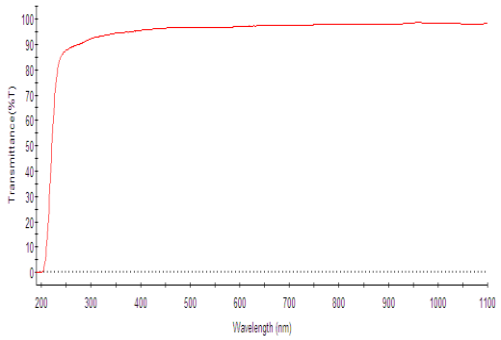

Fig.4(b) Transmission spectrum of LISZA

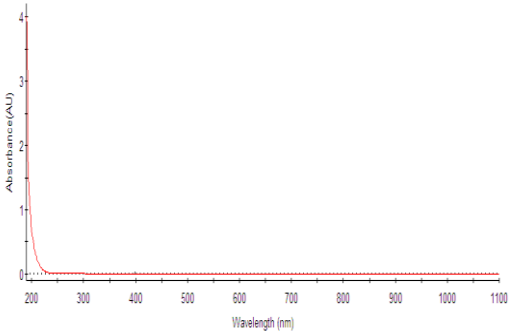

Fig.4(c) Absorption spectrum of LISCA

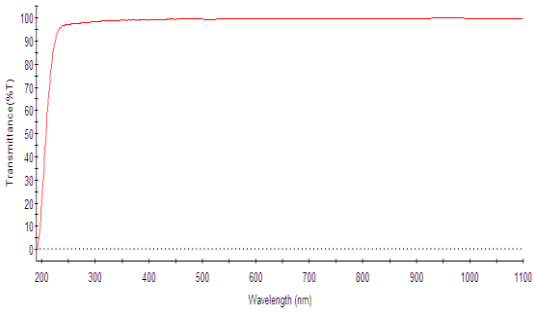

Fig.4(d) Transmission spectrum of LISCA

D. SEM analysis:

Fig.5(a) represents the zinc acetate mixed isoleucine crystal fabric. It has the intergranular fracture in its appearance, whereas fig.5(b) reveals the structural morphology of cadmium acetate mixed isoleucine crystal. This represents the capillary display thin filamentous diaphragmmed fenestral openings.

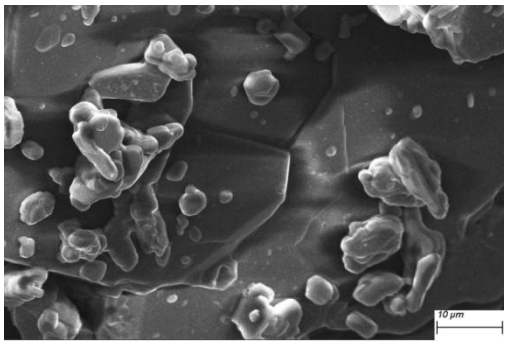

Fig.5(a) SEM image of LISZA

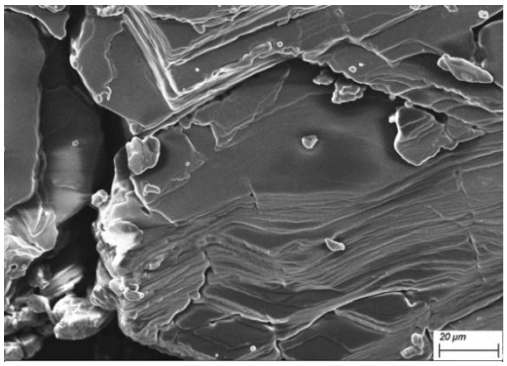

Fig.5(b) SEM image of LISCA

V. CONCLUSION

Single crystals of zinc acetate doped iso leucine and cadmium acetate doped iso leucine have been grown by slow evaporation technique. The fluorescence spectra of both crystals are observed. FTIR spectrum reveals the functional groups of the grown title compound material are upto hope. The crystal has good optical character in the entire UV-Visible region. SEM analysis discloses the structural morphology of LISZA and LISCA crystals. This new crystal material may be considered for opto electronic applications.

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