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RESEARCH ARTICLE

Structural, optical and dielectric properties of organometallic L-alanine cadmium chloride single crystals doped with strontium chloride

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Abstract

The single crystals of pure and strontium chloride doped L-alanine cadmium chloride (LACC), an organometallic nonlinear optical material is grown by a slow evaporation technique. The grown crystals were subjected to XRD, FT-IR, SEM, EDAX and TG/DT analyses. Second harmonic generation was confirmed by the Kurtz and Perry powder technique. The dielectric measurements were carried out for different frequencies at different temperatures. The grown crystals are thermally stable about 110^0C and dielectric constant increases slightly in the doped crystal than that of pure due to introduction of Sr^{2+} ion into the lattice of pure LACC crystal. So that the strontium chloride doped LACC crystals are found to be potential material for microelectronic applications.

Keywords

Crystal growth

XRD

LACC

Nonlinear optic materials

TG/DT analyses

Introduction

Materials possess optical nonlinearities find applications in the area of optical signal processing, information technology, optical computing and data storage. Much of the work on new materials has been aimed at producing stable materials with large nonlinear susceptibilities, which efficiently double the low peak power sources such as diode lasers. Metal complexes of polarizable organic ligands are currently being explored for their nonlinear optical (NLO) properties. These have been commonly referred as organometallics, because they share the advantages of both organic and inorganic materials, which include the extended transparency in the entire UV-Vis. region, high optical nonlinearity, low angular sensitivity and good mechanical hardness. Metals with d^{10} configuration like zinc, cadmium readily combine with thiourea and resulting organometallic NLO materials like bisthiourea cadmium chloride [1], zinc thiourea sulphate [2], with high optical nonlinearity. In recent years organic thiourea is replaced by amino acid and amino acid based organometallic crystals are grown and have been studied. The title compound L-alanine cadmium chloride (LACC) was investigated by many authors [3-5]. Again the effect of K^+ ion on the dielectric properties of LACC was studied by Bright [6] *et, al*.

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Experimental

Crystal growth

The LACC doped with strontium chloride was synthesized by reacting equimolar quantities of

L-alanine and cadmium chloride. The calculated amounts of the reactants were thoroughly dissolved in double distilled water and stirred well for about 2 h using a magnetic stirrer. Then one mole percentage of strontium chloride was added to the initial solution as the dopant and again the mixture was stirred well for about 1 h to obtain a homogeneous mixture. The saturated solution was allowed to crystallize by slow evaporation of solvent at room temperature of about 303 K for about three weeks. Well defined single crystals of good transparency were harvested in three weeks.

Results and discussion

The powdered crystals of one mole percentage strontium chloride doped LACC were subjected to powder XRD by Philips X'pert Pro with Cu Kα1 radiation (λ = 1.54056 Å) for the phase analysis. The grown crystals belongs to the monoclinic system with space group C2 and the number of molecules per unit cell is Z = 4. The unit cell dimensions calculated from the powder XRD data the obtained values agree with the reported values [3].

The surface morphological features of all the samples have been observed using a SEM JEOL-JSM 5600 LV model, in back scattered mode. An elemental analysis is carried out for all the grown crystals by employing EDAX in order to confirm the composition of elements. The presence of Sr^{2+} ions in LACC doped with strontium chloride was confirmed by EDAX. The composition of elements presents in the strontium chloride doped LACC crystals. The EDAX shows the presence of Sr^{2+} ions. Second harmonic generation was confirmed by the Kurtz and Perry powder technique.

The thermal stability is one of the important properties for the NLO for device applications. The thermal stability of the grown crystals was analyzed by thermo gravimetric analysis and differential thermal analysis. These analyses were carried out using Perkin Elmer thermal analyzer in the nitrogen atmosphere at a heating rate of 283 K/minute for the temperature range of 303–1093 K. It was observed that there is endothermic and exothermic peaks were confirmed by the DTA curve. Here these peaks are shifted towards the high temperature region compared to pure LACC [6].

The grown crystals are thermally stable about 110^0C and dielectric constant increases slightly in the doped crystal than that of pure due to introduction of Sr^{2+} ion into the lattice of pure LACC crystal. So that the strontium chloride doped LACC crystals are found to be potential material for microelectronic applications.

Conclusions

Organometallic NLO single crystals of strontium chloride doped L-alanine cadmium chloride are grown by a slow evaporation technique. SEM study shows the alignments of grains are improved in doped crystals The presence Sr^{2+} ion in the doped crystals are confirmed by energy dispersive analysis by X-ray. The increase in thermal stability and the low dielectric values enhances the utility of the material for microelectronic applications.

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