# ABSTRACT

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Title of the thesis : **GROWTH AND CHARACTERIZATION OF POTASSIUM HYDROGEN PHTHALATE CRYSTALS DOPED WITH SOME ORGANIC AND INORGANIC COMPOUNDS**

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Keywords : Crystal growth; solution growth; KHP Crystals; XRD analysis; CHN analysis; AAS studies; SEM with EDAX studies; FTIR analysis; UV-Vis spectral studies; SHG measurements; Thermal studies; microhardness measurements; Dielectric measurements; AC Conductivities; piezoelectric studies.
Crystal growth has prominent role to play in the era of immense technological excellence attributing to the usefulness of many crystals in important areas of service to humanity namely science, medicine, engineering, technology and also strategic areas of defence and space science. In addition, many crystals be as useful as elements in piezo-electric, accousto-optic, photo-refractive, photo-elastic applications and also as radiation detectors, parametric amplifiers, transducers, harmonic generators, bragg cells etc. Now a days, crystals grown also find applications in microelectronics, optoelectronics, medical instruments, radar systems, communication systems, defence and laser.

Nonlinear optic (NLO) is a new frontier of science and technology playing a major role in the emerging era of photonics including optical information processing, sensor protector applications, data storage etc. Semi-organic NLO crystals have also attracted attention because they have been proposed as a new approach for materials with fascinating NLO properties which have the combined properties of both inorganic and organic crystals like high damage threshold, wide transparency range, less deliquescence and high non-linear coefficients which make them sui for device fabrication. Most of these crystals have been grown by slow evaporation solution growth technique (SEST). Hence in the present work, more focus is given to the studies on the non-linear optical properties of semiorganic single crystals and how their properties improved by the effects of organic and inorganic materials as dopants.

Potassium Hydrogen Phthalate (KHP) with the chemical unit formule \( \text{K}(C_6H_4\text{COOH-COO}) \) is a semi-organic salt that belongs to the alkali acid phthalate series has an orthorhombic symmetry with the space group Pca2\(_1\) and shows a perfect cleavage along (010) plane. KHP crystal presents long term stability and is used in
devices due to its electro optical properties. KHP is chosen as model compound because of its well developed surface pattern on the (010) face consisting of very high and low growth steps which can be relatively easily observed by means of optical microscopy. KHP crystal plays an important role in the field of NLO and is used in quantitative X-ray Analysis. Its higher chemical stability and economic viability with good kinetic growth properties have made to pay attention on them in past decades. The addition of some organic and inorganic materials is expected to influence the growth kinetics, habit modification, its chemical properties and the large size single crystal. So attempt has been made grow optically transparent, good quality KHP crystal by doping some organic and inorganic materials and to explain the influence of dopants on structural, mechanical, thermal, optical and electrical properties of KHP.

In the present work, the slow solvent evaporation technique is used for the growth of pure and doped KHP crystals. The inorganic dopants are SrCl$_2$, BaCl$_2$, CdCl$_2$ and the organic dopants are Thiourea, L-Histidine, and L-Glutamine. The study of solubility curves for pure KHP solutions are presented. The grown crystals of this work were characterized by various studies.

The crystal structure of grown crystals was confirmed by Single crystal and powder XRD. All the grown crystals belong to orthorhombic system. In CHN analysis, the presence of C and H are detected for all doped organic samples. Atomic absorption studies and EDS analysis revealed the presence of Sr$^{2+}$, Ba$^{2+}$ and Cd$^{2+}$ metal ions in the doped KHP crystals. Surface morphological features were studied by SEM. The density of the pure and doped KHP crystals was determined by floatation method.
All the crystals were mechanically characterised by Vickers micro hardness studies to confirm that the category of the material.

The existence of functional groups and bonding nature of all the grown crystals were studied by FTIR spectral analysis. SHG describes the nonlinear optical properties of grown pure and doped KHP crystals. The optical behaviour of the grown KHP crystals was studied by UV-Visible spectral analysis.

Thermal stability of the grown crystals were studied by Thermogravimetric (TG) and Differential thermal Analysis (DTA).

The dielectric study and AC conductivity have been carried out on pure and doped KHP crystals at room temperature by varying the frequency of applied field in the range from 100 Hz to 100 kHz. The piezoelectric behaviour of all grown samples were also studied and the results are discussed.

A detailed report of the research work is presented in this thesis.