ABSTRACT

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Submitted to : Manonmaniam Sundaranar University Tirunelveli

Field of study : Solid State Physics – Crystal Growth and Characterization

Subject : Physics

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Title of the thesis : Growth and Characterization of ADP crystals added with some inorganic materials.

No. of Pages : xvi + 174

Keywords: Ammonium dihydrogen phosphate; Potassium Bromide, Potassium chloride, Calcium Chloride, Slow evaporation solution growth technique; single crystals, X-ray diffraction; FTIR; UV-Visible; Dielectric constant; Dielectric loss; AC conductivity.

In modern technology Single crystals have become a vital necessity. Nonlinear optical crystals with high conversion efficiency for second harmonic generation are desirable in various applications. Hence, the discovery, growth and characterization of novel materials and their design, especially in single crystal form is an urgent need. Ammonium dihydrogen phosphate (ADP) is commercially available material with numerous laser based applications. ADP crystals shows excellent dielectric, piezoelectric, electro-optic, nonlinear optic and anti ferroelectric properties.
ADP crystals are commonly used in frequency conversion applications such as second, third and fourth harmonic generation and in electro-optic modulation. Easy growth of large single crystals, a broad transparency range and relatively low production cost are the qualities that make this crystal attractive for and well suited to a variety of optical applications.

Dopants role is important in improving the properties of a crystal, inorganic nonlinear optical materials have large nonlinear optical susceptibilities, inherent ultrafast response time, and high optical thresholds for laser power. In this context, inorganic materials (KCl, KBr and CaCl₂) are interesting materials, as they contain a proton donor and proton acceptor which provide the ground state charge asymmetry of the molecule required for second order nonlinearity. Hence, inorganic materials (KCl, KBr and CaCl₂) can be used as dopants. With the aim of discovering new useful materials for academic use and industrial applications, inorganic materials (KCl, KBr and CaCl₂) doped ADP single crystals were grown by slow evaporation growth technique at room temperature. The dopants namely, KCl, KBr and CaCl₂ are added separately to ADP salt in 0.1, 0.2, 0.3, 0.4 and 0.5 wt% concentrations. The solubility of the pure ADP salts is determined. Saturated solutions were prepared using the solubility data and the crystals were grown.

Powder X-ray diffraction (PXRD) studies were carried out to characterize the grown crystals structurally.

The Fourier Transform Infrared spectral analysis is performed to identify and assign the bands corresponding to the functional groups associated with the crystals. The UV-Visible absorption spectrum is recorded in the range 200-800 nm for all the grown crystals to study the optical transparency. The AC electrical measurements were performed on the pure, KCl, KBr and CaCl₂ doped ADP crystals at a various frequencies and various temperatures ranging from 40-120 °C in steps of 10 °C along the ‘a’ direction. The dielectric constant, dielectric loss, AC conductivity and activation energy were determined.

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