SYNOPSIS

The development and the technical improvement in lasers started an intense activity in the synthesis and characterization of nonlinear optical materials, materials with radiation intensity dependent propagation characteristics or can generate radiation that propagates at new frequencies or in new directions. Non-linear optical materials include both single crystals as well as polycrystalline inorganic and organic materials, polymers, composites, liquids and liquid crystals. Among these materials the non-linear organic optical materials (NLOOM) have attracted much attention recently because of their large nonlinear optical figure of merit, high optical damage thresholds, ultrafast optical responses, architectural flexibility, and ease of fabrication. NLOOM include liquids, dyes, fullerenes, charge-transfer complexes, \( \pi \)-conjugated polymers, dye-grafted polymers, and organic-metallic compounds. One of promising semi-organic NLOOM is L-arginine phosphate (LAP) which has potential of replacing KDP being used presently for SHG at optical frequencies commercially. Despite large amount of research on this material, no commercial application has been reported till date. This could be due to non-availability of the proper crystal-growth technique to grow crystals of required size and quality for commercial application. The inherent slow growth rate of the solution growth technique used exclusively presently not only makes it difficult to grow large size crystals but also limits the optical quality due to solvent inclusion. On the other hand, melt growth by conventional techniques is difficult because of its thermal properties; the melting point of LAP is 141°C while its decomposition temperature is \( \sim150°C \). Laser heated pedestal growth setup assembled around a well-stabilized (power) laser has potential of preparing crystalline fibers (rod shaped crystals of \( \sim1\)mm diameter) of required size and quality for
commercial application. Assembling of laser heated pedestal growth setup around a home-built 50W CW CO₂ laser, preparation of transparent LAP and Rd6G/KDP doped crystalline fibers and characterization of these fibers by XRD, FTIR, SEM, EDX, TG/DTA, SGH and fluorescence techniques have been attempted in this study.

The theoretical framework relevant to the nonlinear organic molecules is reviewed briefly in CHAPTER I. Also various techniques used to grow crystalline fibers along with the advantages of laser heated pedestal growth also have been discussed in this chapter.

The details of the home-built 50W CO₂ laser along with those of laser heated pedestal growth setup and other facilities developed in the laboratory are discussed in CHAPTER II. Also, the specifications of the commercial equipment used for the characterization of the crystalline fibers are included in this chapter.

CHAPTER III discusses the preparation and characterization of L-arginine phosphate monohydrate (LAP) crystalline fibers. Results obtained from XRD (powder and SC), FTIR and TG/DTA measurements on crystalline fibers agree well with those of LAP crystal grown by solution growth. Also, crystalline LAP fibers showed SHG with 30mJ laser pulses from a Q-switched Nd: YAG laser.

Modifications in the thermal properties of LAP on doping with Rd6G and KDP are discussed in CHAPTER IV. Doping increased the decomposition temperature of LAP. This increase is significant enough to make the melt growth easier. Also, the increase in the resistance to environmental degradation of LAP on doping with Rd6G is discussed in this chapter.