

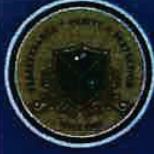


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Habitual growth and its influence on the properties of anilinium perchlorate (AP) single crystal for nonlinear optical device applications

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Abstract

The habit of the semi organic nonlinear optical material anilinium perchlorate (AP) crystallized from different solvents, such as *n*-hexane, acetonitrile, toluene, acetone, ethanol, methanol and water were studied. Solubility of AP in above mentioned solvents at different temperatures was determined by gravimetric method. Crystals were grown by controlled solvent evaporation method. Solution with different solvents having different chemical nature and polarity yielded crystals with different habits, such as needle, platelet, bar, pyramidal cuboid, pyramidal cubic square and cuboid. The AP crystal shows predominant growth behaviour along its (2 0⁻1) direction irrespective of the solvent used. The AP crystal grown from different solvents were found to crystallize in orthorhombic system with space group $P2_12_12_1$. Optical transmittance of the grown crystals was studied using UV–Vis–NIR spectrophotometer. The FWHM of the AP crystal was found to be 65.7 arc s by high resolution X-ray diffraction study. The effective nonlinearity of the AP crystal grown is 2.8 times greater compared to that of the standard KH_2PO_4 crystal. The laser damage threshold of the crystals grown from various solvents were assessed using 1064 nm ND:YAG laser radiation. The relative SHG efficiency of AP is found to increase with the quality of the crystal.

1 Introduction

Nonlinear optical (NLO) materials are capable of producing higher values of the original frequency and find applications in optical modulation, fiber optic communication and optoelectronics [1, 2]. In recent years, laser applications of crystals play a vast role in the technological advancement. Inorganic crystals are widely used in these applications because of their high melting point, high mechanical stability and high degree of chemical inertness. The availability of optical nonlinear inorganic crystals is generally lower than the optical device demand. Organic compounds are often formed by weak van der Waal's bonds, hydrogen bonds and possess a high degree of delocalization [3–7]. A major drawback of organic NLO crystals is the difficulty in growing large size crystal with good optical quality and higher mechanical stability. Nonlinear optical properties of semi-organic materials are currently under intense investigation, triggered by potential applications in NLO due to their incorporated advantages of both organic and inorganic crystals [8]. In this regard, perchloric acid, an inorganic compound with the formula HClO_4 is stronger than sulfuric acid and nitric acid is chosen for the study. Aniline, an aromatic amine and a phase transition dielectric material, attractive for NLO and memory storage applications [9]. Recently, similar structures containing anilinium cations such as anilinium nitrate [10], anilinium picrate [11], anilinium hydrogenphosphite and anilinium hydrogenoxalate hemihydrates [12]. Recently our group has reported the growth, spectral and third order nonlinear optical study of the AP crystal [13]. In this regard the present investigation deals with the habitual growth and its influence on the properties of the grown AP crystal for nonlinear optical device applications.

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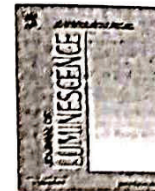
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Photophysical studies on the interaction of PET and non-PET based acridinedione dyes with glycine in water

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ABSTRACT

Photophysical studies of resorcinol based acridinedione (ADDR) dyes with a simple amino acid like glycine were carried out in water. These ADDR dyes are classified into photoinduced electron transfer (PET) and non-PET based on the substitution on the acridinedione ring structure (Scheme 1). Addition of glycine to PET based dye containing a -OCH₃ (ADDR1) moiety resulted in a fluorescence enhancement while that of another PET dye containing (N(CH₃)₂) moiety (ADDR 4) exhibits a fluorescence quenching behaviour. Interestingly, addition of glycine to ADDR 1 dye not only results in a fluorescence enhancement but a significant shift in the emission maximum towards the red region resulted. On the contrary, no significant shift in the emission maximum neither towards blue nor red region results in the presence of ADDR4 dye. The fluorescence enhancement is attributed to the suppression of the PET process through space between the donor and the acceptor moiety of acridinedione dye ring structure. The fluorescence quenching of ADDR4 dye is attributed to change in the excited state properties of N, N-dimethyl moiety such that the local excited state (LE) nature is drastically quenched on the addition of glycine molecules. The fluorescence decay of all ADDR dyes exhibit single exponential decay in water whereas ADDR1 and ADDR4 dyes exhibit a bi-exponential decay in the presence of glycine. Addition of glycine to non-PET based ADDR dyes (ADDR2 and ADDR3) results no significant change in fluorescence emission intensity and fluorescence lifetime. The introduction of glycine implies that there exists two different micro-environment in the aqueous phase around the close vicinity of the ADDR dyes. A large variation in the fluorescence lifetime and their relative distribution of the dye located in different domains are elucidated by time resolved fluorescence spectral techniques. Both hydrogen-bonding along with hydrophobic interactions influences the excited state properties of PET based ADDR dyes in the presence of glycine are elucidated by fluorescence spectral techniques is presented in our study.

1. Introduction

Acridinedione dyes (resorcinol (ADDR) and dimedone (ADD) based) belong to the family of laser dyes [1] and have good lasing efficiency properties. These dyes are significantly important in the field of anion and cation sensors and also in the field of bio medical research [1–3]. ADDR dyes closely mimic NADH analogs and since the reduced form of NADH plays a vital role as the electron source and for the reduction of oxygen in respiratory chain [3]. Acridinedione dyes are considered as a potential dyes not only as sensors, but are widely used as an efficient

probe to determine the interaction of dye with non-fluorescent water soluble solutes containing several hydrogen-bonding and hydrophobic moieties.

Acridinedione is a bifunctional molecule and acts as an electron donor or acceptor, and undergoes various interesting reactions in the excited state. This dye possess several advantages due to the nature of the substituting group in the 9th and 10th positions as shown in (Scheme 1). These dyes are classified into Photoinduced Electron Transfer (PET) and non-PET dyes based on their substitution in the 9th position in the basic acridinedione ring structure. Among the PET based

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