The optical response is due to a transition of the dipole moment from the ground state to the excited state due to the transition of an electron between frontier orbitals, from the highest occupied molecular orbital to the lowest unoccupied molecular orbital (LUMO). Furthermore, the polymers represent one of the most used classes of substances in pulsed laser deposition, but also in the other methods for preparing thin films. Organic semiconductors as active materials in thin-film electronic devices such as alkynes, heterocycles, dyes, ferrocenes, spiranes, or porphyrins, with special geometries and certain electronic molecular parameters, which possess nonlinear optical properties and offer several major advantages over their inorganic counterparts. Molecular crystals of organic molecules are also interesting from the biological and biochemical perspective. An understanding of the hydrogen bond is essential to comprehend many important biological processes and molecules such as proteins and peptides.

Dr. Manoj K. Malik completed his M.Sc. (Physics) degree from Institute of Chemical Technology, Matunga, Mumbai in 2008. Later on he was awarded Ph.D. by same institute. His research paper published in several National and International journals. He has participated in various conferences and seminars. He has more than ten years teaching experience. Currently he is working as an Assistant Professor of Physics in Lingaya's Vidyapeeth, Faridabad.

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Nonlinear Optical Properties of Organic Molecules and Crystals

Dr. Manoj Kr. Malik

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Preface

Organic materials are expected to have relatively strong nonlinear optical properties due to delocalized electrons at π–π^* orbitals. This expectation explains extensive search for better NLO materials among organic crystals. Nonlinear optics (NLO) is the branch of optics that describes the behaviour of light in nonlinear media, that is, media in which the polarization density P responds non-linearly to the electric field E of the light. Above the Schwinger limit, the vacuum itself is expected to become nonlinear. In nonlinear optics, the superposition principle no longer holds. Nonlinear optics is related to the analysis of the nonlinear interaction between light and matter when the light-induced changes of the medium optical properties occur. The nonlinear optical effects are weak, and their observation became possible only after the invention of lasers which provide a highly coherent and intense radiation. A typical nonlinear optical process consists of two stages. First, the intense coherent light induces a nonlinear response of the medium, and then the modified medium influences the optical radiation in a nonlinear way.

Second-order nonlinear optics (NLO) is the foundation of frequency conversion for the generation of coherent light at frequencies where lasers have no emissions or operate poorly. The prerequisite for NLO materials is noncentrosymmetric symmetry that can generate an effectively non-counterbalanced spontaneous electronic polarization. The SHG was characterized and tuned by IEF. This work breaks the structural symmetry constraint on NLO materials. Besides, the phase-matching-like condition was realized for the further improvement of the efficient frequency conversion.

Nonlinear effects fall into two qualitatively different categories, parametric and non-parametric effects. A parametric non-linearity is an interaction in which the quantum state of the nonlinear material is not changed by the interaction with the optical field. As a consequence of this, the process is "instantaneous". Energy and momentum are conserved in the optical field, making phase matching important and polarization-dependent.

—Author

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CHAPTER 1

Organic Nonlinear Optical Materials: Overview

Nonlinear optics (NLO) is the branch of optics that describes the behaviour of light in nonlinear media, that is, media in which the polarization density P responds non-linearly to the electric field E of the light. The non-linearity is typically observed only at very high light intensities (when the electric field of the light is $>10^8$ V/m and thus comparable to the atomic electric field of ~10^{11} V/m) such as those provided by lasers. Above the Schwinger limit, the vacuum itself is expected to become nonlinear. In nonlinear optics, the superposition principle no longer holds.

Nonlinear optical materials can be useful for a variety of applications varying from modulation of optical signals facilitated by the electro-optic effect—the effect whereby the refractive index of a material changes in response to an applied electric field—to microfabrication, sensing, imaging, and cancer therapy facilitated by multiphoton absorption, wherein molecules simultaneously absorb two or more photons of light. This short Focus article is a brief personal perspective of some of the key advances in second-order NLO materials and in multiphoton-absorbing materials, and of how and why these advances have led to renewed interest in organic NLO materials.

L-arginine Maleate Dihydrate

L-arginine is one of the essential amino acids widely distributed in biological substances. It forms a number of salts with organic and inorganic acids showing non-linear optical properties. L-Arginine maleate dihydrate ($C_6H_{14}N_4O_2.C_4H_4O_4.2H_2O$) is one of these L-arginine salts which is a complex of strongly basic amino acid, carboxylic acid and provides useful information in relation to molecular interaction in present-day biological systems and to prebiotic self-organisms.

It is also a nonlinear optical material with second harmonic generation efficiency 1.68 times that of KDP. L-arginine maleate dihydrate crystals are grown from solution by solvent evaporation; they belong to the triclinic space group P1.