Nonlinear Optical Effects In Organic Polymers 1st Edition

This monograph contains all major achievements and future insights in the field of optical communication systems. It covers the molecular design and synthesis of new organic compounds, processing, processing of materials and their characterization due to novel techniques, device fabrications and assessment of optical devices in display and information processing.

This book covers the combined subjects of organic electronic and optoelectronic materials/devices. It is designed for classroom instruction at the senior college level. Highlighting emerging organic and polymeric optoelectronic materials and devices, it presents the fundamentals, principle mechanisms, representative examples, and key data.

Second-order nonlinear optical effects are forbidden in a medium with inversion symmetry, but are necessarily allowed at a surface where the inversion summary is broken. They are often sufficiently strong so that a submonolayer perturbation of the surface can be readily detected. They can therefore be used as effective tools to study monolayers adsorbed at various interfaces. We discuss here a number of recent experiments in which optical second harmonic generation (SHG) and sum-frequency generation (SFG) are employed to probe and characterize organic monolayers. 15 refs., 5 figs.

Molecular Dynamics in Restricted Geometries Edited by Joseph Klafter and J. M. Drake This investigation of the chemistry and physics of complex systems focuses on the role of spatial restrictions on molecular movement. A practical source-book for researchers in chemical physics, chemical engineering, and condensed matter physics, and for graduate students in these fields, it covers a broad range of topics and critically evaluates methods as they are employed. Among the many topics it covers are: relaxation and diffusion in restricted geometries, excitation energy transfer and photoinduced electron transfer phenomena in some confined systems, electron excitation transport in micelles, polymers and multilayers, and electron excitation transport on polymer chains. 1989 (0 471-60176-4) 437 pp.

Nonlinear Optical Properties of Organic Molecules and Crystals V1 ...

"Furnishes table of nonlinear optical properties of organic substances as well as experimental procedures for measuring the nonlinearity of the elements tabulated, including composite materials-offering support for scientists and engineers involved in characterizing, optimizing, and producing materials for manufacturing optical devices."

Photonics is being labelled by many as the technology for the 21st century. Because of the structural flexibility both at the molecular and bulk levels, organic materials are emerging as a very important class of nonlinear optical materials to be used for generating necessary nonlinear optical functions for the technology of photonics. Since the last NATO advanced research workshop on "Polymers for Nonlinear Optics"held in June 1988, at Nice - Sophia Antipolis, France. there has been a tremendous growth of interest worldwide and important development in

this field. Significant progress has been made in theoretical modeling, material development, experimental studies and device concepts utilizing organic materials. These important recent developments provided the rationale for organizing the workshop on "Organic Materials for Nonlinear Optics and Photonics" which was held in La Rochelle, France, in August 1990. This proceeding is the outcome of the workshop held in La Rochelle. The objective of the workshop was to bring together scientists and engineers of varied backgrounds working in this field in order to assess the current status of this field by presenting significant recent developments and make recommendations on future directions of research. The workshop was multidisciplinary as it had contributions from chemists, physicists, materials scientists and device engineers. The participants were both from industries and universities. The workshop included plenary lectures by leading international scientists in this field, contributed research papers and a poster session. Panel discussion groups were organized to summarize important developments and to project future directions.
Organic Nonlinear Optical Materials provides an extensive description of the preparation and characterization of organic materials for applications in nonlinear and electro-optics. The book discusses the fundamental optimization and practical limitations of a number of figures of merit for various optical parameters and gives a clinical appraisal o
Nonlinear Optics in Signal Processing covers the applications of nonlinear optics to optical processing in a range of areas including switching, computing, and telecommunications.
Nonlinear Optical Properties of Organic Molecules and Crystals, Volume 2 deals with the nonlinear optical properties of organic molecules and crystals, with emphasis on cubic nonlinear optical effects and and the intermolecular bond. Topics covered include the basic structural and electronic properties of polydiacetylenes; cubic effects in polydiacetylene solutions and films; and degenerate third-order nonlinear optical susceptibility of polydiacetylenes. Dimensionality effects and scaling laws in nonlinear optical susceptibilities are also considered. This volume is comprised of seven chapters divided into two sections and begins with a discussion on the basic structural and electronic properties of polydiacetylenes as well as their methods of preparation. Cubic nonlinearities in polydiacetylene solutions and films are then examined, paying particular attention to polarization in one-dimensional media; multiple reflections of fundamental and harmonic waves; and harmonic generation in an absorbing medium. The following chapters focus on degenerate third-order nonlinear optical susceptibility of polydiacetylenes; dimensionality effects and scaling laws in nonlinear optical susceptibilities; polarizabilities and hyperpolarizabilities of long molecules; and resonant molecular optics. The final chapter analyzes the nonlinear optics of a wide range of compounds that are held together by intermolecular bonding and form supramolecular assemblies. This monograph will be a useful resource for physicists, physical and organic chemists, and those

in the field of quantum electronics.

Photonics, the counterpart of electronics, involves the usage of Photons instead of electrons to process information and perform various switching operations. Photonics is projected to be the technology of the future because of the gain in speed, processing and interconnectivity of network. Nonlinear optical processes will play the key role in photonics Where they can be used for frequency conversion, optical switching and modulation. Organic molecules and polymers have emerged as a new class of highly promising nonlinear optical materials Which has captured the attention of scientists world wide. The organic systems offer the advantage of large nonresonant nonlinearities derived from the 1T electrons contribution, femtosecond response time and the flexibility to modify their molecular structures. In addition, organic polymers can easily be fabricated in various device structures compatible with the fiber-optics communication system. The area of nonlinear optics of organic molecules and polymers offers exciting opportunities for both fundamental research and technologic development. It is truly an interdisciplinary area. This proceeding is the outcome of the first NATO Advanced Research WOrkshop in this highly important area. The objective of the workshop was to provide a forum for scientists of varying background from both universities and industries to come together and interface their expertize. The scope of the workshop was multidisciplinary with active participations from Chemists, physicists, engineers and materials scientists from many countries.

Describing progress achieved in the field of nonlinear optics and nonlinear optical materials, the Handbook treats selected topics such as photorefractive materials, third-order nonlinear optical materials and organic nonlinear optical crystals, as well as electro-optic polymers. Applications of photorefractive materials in optical memories, optical processing, and guided-wave nonlinear optics in hotorefractive waveguides are described. As light will play a more and more dominant role as an information carrier, the review of existing and new materials given here makes this a keystone book in the field.

In recent years one has witnessed in physics a substantial increase in interest in carrying out fundamental studies in the nonlinear optics of condensed matter. At the Danish universities, this increase has been especially pronounced at the Institute of Physics at the University of Aalborg, where the main activities are centered around fundamental research within the domains of nonlinear quantum optics, nonlinear optics of metals and superconductors, and nonlinear surface optics. In recognition of this it was decided to arrange the first international summer school on nonlinear optics in Denmark at the Institute of Physics at the University of Aalborg. This book is based on the lectures and contributed papers presented at this international summer school, which was held in the period 31 July-4 Au gust 1989. About 60 experienced and younger scientists from 12 different countries participated. Twenty-eight lectures were given by 14 distinguished scientists from the United States, Italy, France, Germany, Scotland, England, and Denmark. In addition to the lectures given by the invited speakers, 11 contributed papers were presented. The programme of the summer school em phasized a treatment of basic physical properties of the nonlinear interaction of light and condensed matter and both theoretical and experimental aspects were covered. Furthermore, general principles as well as topics of current interest in the research literature were discussed.

This book is mostly concerned on the experimental research of the nonlinear optical characteristics of various media, low- and high-order harmonic generation in different materials, and formation, and nonlinear optical characterization of clusters. We also demonstrate the inter-connection between these areas of nonlinear optics. Nonlinear optical properties of media such as optical limiting can be applied in various areas of science and technology. To define suitable materials for these applications, one has to carefully analyse the nonlinear optical characteristics of various media, such as the nonlinear refractive indices, coefficients of nonlinear absorption, saturation absorption intensities, etc. Knowing the nonlinear optical parameters of materials is also important for describing the propagation effects, self-interaction of intense laser pulses, and optimisation of various nonlinear optical processes. Among those processes one can admit the importance of the studies of the frequency conversion of coherent laser sources. The area of interest for nonlinear optical characterization of materials is also closely related with new field of nanostructures formation and application during laser-matter interaction. We show how the nonlinear optical analysis of materials leads to improvement of their high-order nonlinear optical response during the interaction with strong laser fields. Ablation-induced nanoparticles formation is correlated with their applications as efficient sources of coherent short-wavelength photons. From other side, recent achievements of harmonic generation in plasmas are closely related with the knowledge of the properties of materials in the laser plumes. All of these studies are concerned with the low-order nonlinear optical features of various materials. The novelty of the approach developed in present book is related with inter-connection of those studies with each other.

Definitive guide to modern organic electro-optic and photonic technologies, from basic theoretical concepts to practical applications in devices and systems.

Organic Nonlinear Optical Materials provides an extensive description of the preparation and characterization of organic materials for applications in nonlinear and electro-optics. The book discusses the fundamental optimization and practical limitations of a number of figures of merit for various optical parameters and gives a clinical appraisal of the potential of organic materials for applicators in optical technology. Among the topics addressed are the basic molecular design of ;nonlinear optical chromophores, fundamentals and novel techniques of organic crystal growth, preparation and characterization of Langmuir-Blodgett and polymer films, experimental methods for determining microscopic and macroscopic optical properties. Also included is a discussion of first results of the photorefractive effect in organic crystals and the potential of organics for photorefractive applications, as well as an extensive review of published linear and nonlinear optical measurement of organic materials.

Partial contents: Linear and Nonlinear Polarizability: A Primer; Second-Order Nonlinear Optical Processes in Molecules and Solids; Third-Order Nonlinear Optical Effects in Molecular and Polymeric Materials; Nonlinear Optical Properties of Molecules and Materials; Electronic Hyperpolarizability and Chemical Structure; Electrooptic Polymer Waveguide Devices: Status and Applications; Waveguiding and Waveguide Applications of Nonlinear Organic materials; Nonlinear Optical materials: The Great and Near Great; Donor- and

Acceptor-Substituted Organic and Organometallic Compounds: Second-Order Nonlinear Optical Properties; Use of a Sulfonyl Group in Materials for Nonlinear Optical Materials: A Bifunctional Electron Acceptor.

Nonlinear optics is a topic of much current interest that exhibits a great diversity. Some publications on the subject are clearly physics, while others reveal an engineering bias; some appear to be accessible to the chemist, while others may appeal to biological understanding. Yet all purport to be non linear optics so where is the underlying unity? The answer is that the unity lies in the phenomena and the devices that exploit them, while the diversity lies in the materials used to express the phenomena. This book is an attempt to show this unity in diversity by bringing together contributions covering an unusually wide range of materials, preceded by accounts of the main phenomena and important devices. Because ofthe diversity, individual materials are treated in separate chapters by different expert authors, while as editors we have shouldered the task of providing the unifying initial chapters. Most main classes of nonlinear optical solids are treated: semiconductors, glasses, ferroelectrics, molecular crystals, polymers, and Langmuir-Blodgett films. (However, liquid crystals are not covered.) Each class of material is enough for a monograph in itself, and this book is designed to be an introduction suitable for graduate students and those in industry entering the area of nonlinear optics. It is also suitable in parts for final-year undergraduates on project work. It aims to provide a bridge between traditional fields of expertise and the broader field of nonlinear optics.

This book presents an excellent overview of the exciting new advances in nonlinear optical (NLO) materials and their applications in emerging photonics technologies. It is the first reference source available to cover every NLO material published through 1995! All theoretical approaches, measurement techniques, materials, technologies, and applications are covered. With more than 1,800 bibliographic citations, 324 figures, 218 tables, and 812 equations, this book is an invaluable reference source for graduate and undergraduate students, researchers, scientists and engineers working in academia and industries in chemistry, solid-state physics, materials science, optical and polymer engineering, and computational science.

This treatise is a compendium of papers based on invited talks presented at the American Chemical Society Symposium on Electroactive Polymers which covered nonlinear optical polymers and conducting polymers, the common denominator being the correlated pi-electron structures. The improved understanding of the consequences of pi-electron delocalization upon nonlinear optical properties and charge carrier dynamics has laid the foundation for the rapid development and application of the electroresponse of conjugated polymers. As a result, the area of electroactive and nonlinear optical polymers is emerging as a frontier of sCience and technology. It is a multidisciplinary field that is bringing together scientists and engineers of varied background to interface their expertise. The recent explosion of interest in this area stems from

the prospect of utilizing nonlinear optical effects for optical switching and logic operations in optical computing, optical signal processing, optical sensing and optical fiber communications. Polymers and organic are rapidly becoming one of the major material classes for nonlinear optical applications along with multiple quantum wells, ferroelectrics and other oxides, and direct band-gap semiconductors. The reasons for this lie in the unique molecular structures of polymers and organics and the ability to molecularly engineer the architecture of these structures through chemical synthesis.

Nonlinear optical materials play a pivotal role in the future evolution of nonlinear optics in general and its impact in technology and industrial applications in particular. The progress in nonlinear optics has been tremendous since the first demonstration of an all-optical nonlinear effect in the early sixties, but until recently the main visible emphasis was on the physical aspects of the nonlinear radiation matter interaction. In the last decade, however, this effort has also brought its fruits in applied aspects of nonlinear optics. This can be essentially traced to the improvement of the performances of the nonlinear optical materials. Our understanding of the nonlinear polarization mechanisms and their relation to the structural characteristics of the materials has been considerably improved. In addition, the new development of techniques for the fabrication and growth of artificial materials has dramatically contributed to this evolution. The goal is to find and develop materials presenting large nonlinearities and satisfying at the same time all the technological requirements for applications such as wide transparency range, fast response, high damage threshold but also processability, adaptability and interfacing with other materials. Improvements, besides rendering possible the implementation of nonlinear effects in devices, open the way to the study of new nonlinear optical effects and the introduction of new concepts. This book describes new concepts which are emerging in the field of nonlinear optical materials, concentrating the attention on materials which seem more promising for applications in the technology of information transmission and processing.

Recent developments in organic nonlinear optical materials for application to eye and sensor protection are reviewed. This compendium includes a brief discussion of the functioning of the eye, delineation of some of the important eye protection parameters and an introduction to the origin of nonlinear optical effects and how they are measured. Specific examples of proposed or prototyped protection devices are also presented. A compilation of noteworthy organic third-order nonlinear optical materials is included as an appendix. Lasers are playing an important and increasing role in modern society. Their present uses range from compact disc players to optical data-storage and communication systems. Because of this wide-spread use, the continuing expansion of lasers into other arenas and the low damage thresholds of human eyes and electro-optic sensors, there is increasing concern about eye and sensor protection from laser irradiation.

The main objective of this research has been to establish the potential of nonlinear optics (NLO) to study relationships between chemical structure and properties of organic materials. Using properly constructed molecules or photoactive dopants, phenomena such as molecular relaxation, dipolar ordering, poling dynamics, and intermolecular forces in organic materials were investigated. A second objective has been to identify mechanisms to optimize and stabilize second harmonic generation (SHG) signals through materials processing techniques. This investigation includes studies in three main topics: nonlinear optical properties of magnetically aligned alloys of nematic polymers and organic dyes, two-dimensional polymers, and novel single crystal films that exhibit zero-field SHG. The second order nonlinear optical response of a solidified nematic polymer containing a photoactive organic dye as a dissolved solute or as phase separated crystals was investigated upon exposure to a magnetic field. The magnetically aligned nematic alloy can be regarded as an "Ising-like" medium in which the nematic and the magnetic fields confine the dipolar dye molecules along directions parallel or anti-parallel to the external DC field. An increase of the second order susceptibility by a factor of five in an idealized system has been predicted by theory. Relative to theoretical predictions, magnetically induced order in the nematic solvent was found to result in second harmonic signals which are 6-9 times more intense and the second order susceptibility of the system triples. Due to the randomization of polar ordering after poling, the stability of SHG activity in the guest-host system was difficult to maintain. Thus, a special molecular architecture, i.e. a two-dimensional (2D) polymer, was investigated to address the stability problem. This investigation revealed that a chiral oligomer can be transformed into a two-dimensional structure through a dual chemical reaction. Homochiral recognition among strongly dipolar cyano groups was found to play an important role in the transformation of the oligomer to a 2D polymer. In contrast to its analogous comb polymer synthesized by free radical polymerization, this 2D polymer shows remarkable stability in SHG activity. Thermally stimulated discharge (TSD) results suggest that higher discharge currents correlate with higher values of $chisp{(2)}$. Some derivative compounds of the 2D precursor exhibited enormous and stable SHG activity without poling, suggesting that the molecules crystallize into highly polar noncentrosymmetric structures. Through a series of analyses for the relationship between the chemical structure and SHG activity, a novel way to prepare promising SHG films was developed in one of the derivative compounds. The origin of this extraordinary NLO property was due to the formation of an active phase possibly consisting of aligned single crystals. This study shows the importance of materials processing and molecular tailoring in the development of NLO-active materials.

At this Workshop on Organic and Polymeric Nonlinear Optical Materials, the latest developments in the areas of theory, characterization, synthesis, molecular assemblies, and potential device applications for organic and polymeric materials

exhibiting nonlinear optical behavior are discussed. Topics discussed include: An Overview on Nonlinear Optical Polymer Systems and Devices, Nonlinear Optical Effects in Polymeric Films, Recent Advances in Nonlinear Optical Properties of Organic and Polymer Systems, Anisotropy of the Third Order Nonlinear Optical Susceptibility in Conjugated Polymers, Nonlinear Optics in Ordered Molecular Systems, Several Series of Novel Polydiacetylenes for Nonlinear Optics, Resonance Effects in Cubic Hyper-polarisabilities of Conjugated Polymers, Nonlinear Optical Measurements on Liquid Crystals and Quasi-Liquid Crystals, Optical Nonlinearity: Molecules, Assemblies and Wave Phenomena, Preparation and Characterization of Organo-Transition Metal Langmuir-Blodgett Films, Advances in Organic Electro-Optic Devices, Organic Nonlinear Optical Devices and Material Considerations, High Resolution Laser Spectroscopy in Polymers. (aw).

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