An introduction to ultrafast nonlinear refraction and absorption.

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Abstract

One reason for using electromagnetic waves (radio, light. etc.) in communication is that photons do not directly interact with each other. However, this property presents obstacles for tasks such as light-by-light switching or optical computing. Nonlinear optics, where intense light may change the properties of a material, in turn affecting the propagation of other light waves, provides a method where all-optical switching and related effects may be realized. We will describe some of the basic mechanisms for these effects, and how we go about characterizing materials and resolving the various contributions to irradiance-dependent refractive index (nonlinear refraction) and absorption (nonlinear absorption). Our understanding of nonlinear optical materials characterization has progressed sufficiently over the years to allow a reliable picture of the physical processes leading to the nonlinear optical properties of a material. This is largely thanks to the development of reliable and complimentary methods for characterization of nonlinear optical properties. I will provide an overview of our techniques in nonlinear refraction and absorption characterization. Additionally, I will describe how nonlinear refraction and absorption can be strongly enhanced when two very different wavelengths interact in a material. In addition to the obvious applications of this effect, I will show how this can be applied to such diverse applications as infrared detection and tunable mid-IR sources.

Biography:

David J. Hagan received his PhD degree in Physics at Heriot-Watt University, Edinburgh, Scotland in 1985. After a brief spell as research scientist at the University of North Texas, he moved to UCF in 1987 as a founding member of the CREOL faculty. He is currently Pegasus Professor of Optics and Physics and also serves as Associate Dean for Academic Programs. He is currently executive Editor-in-Chief of Chinese Optics Letters and was the founding Editor-in-Chief of Optical Materials Express. His current research interests include nonlinear optical materials, especially semiconductors and organics, applications of extremely nondegenerate nonlinear optics, and techniques for nonlinear optical characterization and spectroscopy. Dr. Hagan is a Fellow of OSA and SPIE.