Measurement of the impulse response function in nonlinear optics

David J. Hagan

CREOL, The College of Optics & Photonics, University of Central Florida, Orlando, FL

Abstract

We review advances in ultrafast nonlinear optical materials characterization and the improvements in understanding that have resulted. When applied to nonlinear refraction or absorption, the "nonlinear" optical response may be analyzed in ways that are usually reserved for linear systems. Our ultrafast nonlinear beam deflection technique allows unambiguous separation of slow and fast nonlinearities and allows prediction of nonlinear properties for much longer pulses. It is also highly sensitive, allowing testing of models, e.g. gas phase vs liquid phase to test local field correction factors. We have applied these methods to characterize many solvents, which can have nonlinearities that are highly dependent on pulse width. In turn this results in solutions that can have tailorable nonlinearities, and, in the case of solutes with negative nonlinear refraction, we may adjust the effective nonlinearity to be positive, negative or even zero. Our methods have also been applied to exploration of the extremely large nonlinear absorption and refraction in semiconductors that occurs when two very different wavelengths are used. This leads to diverse applications such as sensitive mid IR detection switching via group index modulation and 2-photon gain.

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 Professor of Optics and Physics and also serves as Associate Dean for Academic Programs. He was the founding Editor-in-Chief of the OSA journal, Optical Materials Express, 2010-2015, and served as General Chair for the OSA Frontiers in Optics Conference, 2015. 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.