Investigation of Nonlinear Optical Properties of Natural Dye Extracted from Fruits Using Z-scan Technique

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ABSTRACT

Nonlinear materials have attracted considerable attention of many researchers; as they explore their linear and nonlinear optical properties attempting to develop photonic devices. Such materials must encompass a high nonlinearity, low absorption, fast response time, large dynamic range and broadband spectral response. To accomplish the same scientific achievement, this study focused on investigating some linear and nonlinear optical properties of specific types of natural dyes extracted from some fruits at prepared at different conditions. This project aims to develop nonlinear optical properties archive of the investigated dye extracts that are available in the Kingdom of Bahrain.

In this study, 52 samples of dye extracts from assortment of fruits were extracted such as orange, pomegranate, blueberry, cranberry, cherry, black raisin, tropical almond, avocado, prune, strawberry, mangosteen and apricot. These samples were arranged in five groups. Most of the samples were prepared at three different concentrations. pH level has been changed for some samples at specific concentration by addition of specific volume of HCl in order to realize the effect of such factor. Samples absorbance was measured in order to quantify the spectral linear absorption coefficient ($\alpha(\lambda)$) and to gain insight on absorption behaviour at range of wavelength from 400-1000 nm. Fluorescence spectra are recorded. Also, the linear refractive index was measured using the Refractometer. Under different excitation power level and three different wavelength (i.e., 488 nm, 514 nm and 633 nm) nonlinear refractive index ($n_2$) sign and value, nonlinear absorption coefficient, third-order nonlinear optical susceptibility $\chi^{(3)}$ were quantified after fitting raw data obtained using single beam Z-scan technique. The investigated samples show
potential capability of them to be used as optical limiters as well as all optical switching devices.