Nonlinear optical switching response of natural dye-polymer freestanding composite films for all-photonic devices

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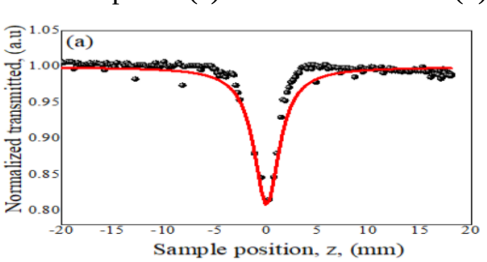
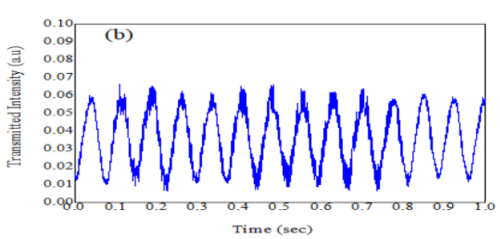
Abstract Natural dyes were extracted from hibiscus sabdariffa (Hs) flowers and pomegranate seeds (Ps) and purchased from local market and embedded in polymeric matrices such as Polyvinyl alcohol (PVA) and Poly(vinyl pyrrolidone) (PVP) to prepare freestanding composite films. The possibility for the optical nonlinear responses of the dyes is studied and characterized by the Z-scan technique using a continuous wave low power laser beam. The figures of merit (FOM) for the dyes are found to be less than 1 and therefore are beneficial for all-optical switch devices. The results confirm that the freestanding composite films offer the possibility of developing and designing all-optical switch in future all-photonic devices with switching contrast and modulation depth at more than 7.5 dB and 75%, respectively, for switching time of 15 ms

Introduction There is an important interest and research work being undertaken by various research groups worldwide on natural dye applications due to the viability and the high potential of these dyes to be an attractive novel type of organic nonlinear media for all-photonic applications. Several organic materials including dye-doped polymer films are attracting many researchers due to their advantages in terms of enhanced efficiency, and acceptable mechanical properties to fabricate useful devices. Indeed, there is a needing interesting in developing green novel hybrid photonics. The nonlinear optical (NLO) response can be used for the fabricating of all-optical switching in all-photonic devices [1-3].

Results and discussion The NLO response of Hs/PVA, Hs/PVP, Ps/PVA, and Ps/PVP freestanding composite films was measured using of Z-scan technique at laser wavelength of 532 nm, and found excellent NLO effect. The all-optical switching (AOS) behaviors of the prepared samples were characterized. To achieve high performance all-optical switching of the samples in all-photonic devices, the device was prepared using composite film at input power of 15 mW, switching contrast S_C modulation depth M_D with values of approximately 7.5 dB and 75%, respectively, and switching time S_T equal to 15 ms. Some of obtained results for NLO response (a) and AOS behavior (b).





References

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