

Polythiophene derivative functionalized with disperse red 1 chromophore: Its third-order nonlinear optical properties through Z-scan technique under continuous and femtosecond irradiation

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Abstract

A copolymer of 3-hexylthiophene and thiophene functionalized with disperse red 1, poly(3-HT-co-TDR1), was synthesized. Chemical structure, molecular weight distribution, optical and thermal properties of this copolymer were characterized by NMR, FT-IR, UV-vis, GPC and DSC-TGA. An optical nonlinear analysis by Z-scan method was also performed for both continuous wave (CW) and pulsed laser pumping. In the CW regime the nonlinearities were evaluated in solid films, and a negative nonlinear refractive index in the range $2.7\text{--}4.1 \times 10^{-4} \text{ cm}^2/\text{W}$ was obtained. These values are notoriously high and allowed to observe self-defocusing effects at very low laser intensities: below 1 mW. Further, nonlinear self-phase modulation patterns, during laser irradiation, were also observed. In the pulsed excitation the nonlinear response was evaluated in solution resulting in large two-photon absorption cross section of 5725 GM for the whole copolymer chain and with a value of 232 GM per repeated monomeric unit.