Third-Order Nonlinear Optical Behavior of Novel Polythiophene Derivatives Functionalized with Disperse Red 19 Chromophore.

Marilú Chávez-Castillo, Arelis Ledesma-Juárez, Marisol Güizado-Rodríguez, Jesús Castrellón-Uribe, Gabriel Ramos-Ortiz, Mario Rodríguez, José-Luis Maldonado, Jorge-Antonio Guerrero-Álvarez, Victor Barba.

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Abstract

Two copolymers of 3-alkylthiophene (alkyl = hexyl, octyl) and a thiophene functionalized with disperse red 19 (TDR19) as chromophore side chain were synthesized by oxidative polymerization. The synthetic procedure was easy to perform, cost-effective, and highly versatile. The molecular structure, molecular weight distribution, film morphology, and optical and thermal properties of these polythiophene derivatives were determined by NMR, FT-IR, UV-Vis GPC, DSC-TGA, and AFM. The third-order nonlinear optical response of these materials was performed with nanosecond and femtosecond laser pulses by using the third-harmonic generation (THG) and Z-scan techniques at infrared wavelengths of 1300 and 800 nm, respectively. From these experiments it was observed that although the TRD19 incorporation into the side chain of the copolymers was lower than 5%, it was sufficient to increase their nonlinear response in solid state. For instance, the third-order nonlinear electric susceptibility () of solid thin films made of these copolymers exhibited an increment of nearly 60% when TDR19 incorporation increased from 3% to 5%. In solution, the copolymers exhibited similar two-photon absorption cross sections with a maximum value of 8545 GM and 233 GM (1 GM = 10−50 cm4 s) per repeated monomeric unit.