NONLINEAR ABSORPTION IN CHARGE TRANSFER MATERIALS

M. Cha*, N.S. Sariciftci+, A.J. Heeger+, J.C. Hummelen+ and F. Wudl+
* Research Center for Dielectric and Advanced Matter Physics
+ Institute for Polymers and Organic Solids, University of California at Santa Barbara, Santa Barbara, CA 93106

Nonlinear optical absorption in solid films of poly(3-octyl thiophene) (P3OT) sensitized with methanofullerene was investigated for wavelengths from 620 to 960 nm. A dye laser with nanosecond pulse width operationg at 10 Hz was used to cover the spectral range. The nonlinear absorption ($\Delta\alpha$) spectrum was measured by open aperture Z-scan method at each wavelength. The Z-scan data were analyzed with a simple excited state absorption model assuming a gaussian teporal and spatial profile for the laser pulses. As a result, the nonlinear absorption is enhanced over that in either of the component materials by more than two orders of magitude at 760 nm. The large nonlinearity results from efficient photoinduced intermolecular charge transfer from P3OT to methanofullerene, followed by absorption in the charge separated excited state. From the experimental fact, P3OT/fullerene films can be an excellent reverse saturable absorber. Indeed, its optical limiting performance is successfully demonstrated at 760 nm.

Another application for such an excellent nonlinear absorber is photorefractive material in a wide sence. In the case of P3OT/fullerene films, however, it is not necessary to crystallize the structure or align the molecules because it is not based on the electro-optic effect. From the measured nonlinear absorption ($\Delta\alpha$) spectrum, we could estimate a large nonlinear refractive index change (Δn) at a moderate laser excitation power using the Kramer-Kronig relation.

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