TWO-PHOTON ABSORPTION IN AZOAROMATIC COMPOUNDS

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Abstract

We report on the two-photon absorption (2PA) cross-sections for eight azoarmatic compounds, using the Z-scan technique with femtosecond laser pulses at 775 nm. The 2PA cross-section, obtained in these chloroform solutions has been determined to be on the order of 10^{-50} cm^4 s photon^{-1}. The experimental 2PA cross-sections obtained for each azoaromtic compound are in good agreement with their dipole moments, as expected.

Samples samples

All samples were dissolved in dimethyl sulfoxide (Aldrich), with the concentrations given in Table 1, and placed in a 2-mm thick quartz cuvette. The absorption spectra in the UV-Vis region,obtained with a Cary 17-A spectrophotometer, are presented in Fig.2.

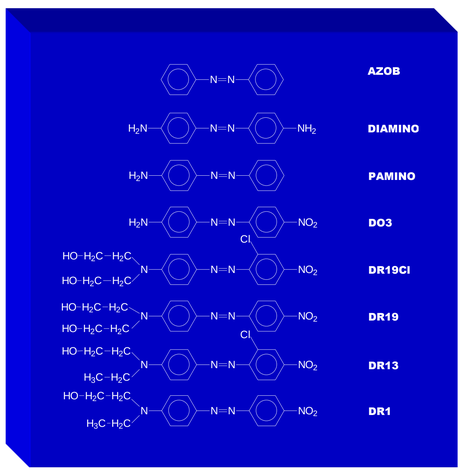

Figure 1 – Molecular structures of the compounds investigated.

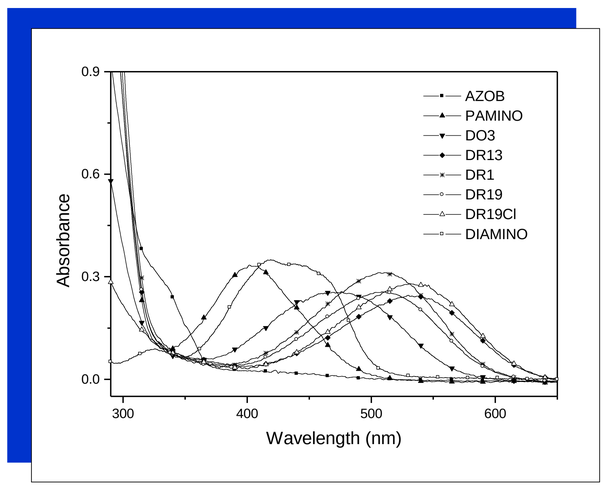

Figure 2 – Absorbance spectra for DMSO solutions of the eight samples studied.

Experimental Setup

Open aperture Z-scan experiments were performed using laser pulses at 775 nm delivered by a commercial Ti:sapphire chirped pulse amplified (CPA) system CPA-2001 from Clark-MXR Inc., operating at a 1 kHz repetition rate. The laser pulse energy employed in our measurements was typically 0.1 μJ.

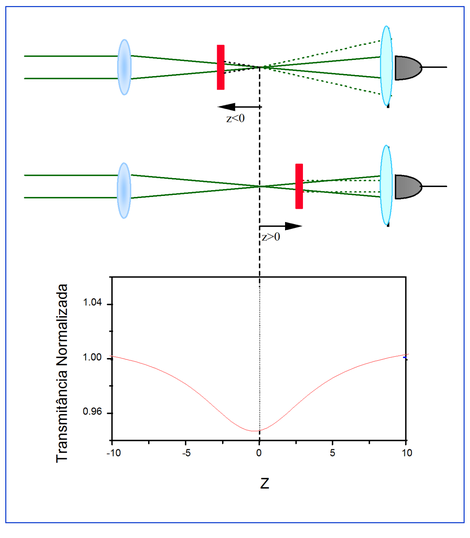

Figure 3 – Open aperture Z-scan experimental setup.

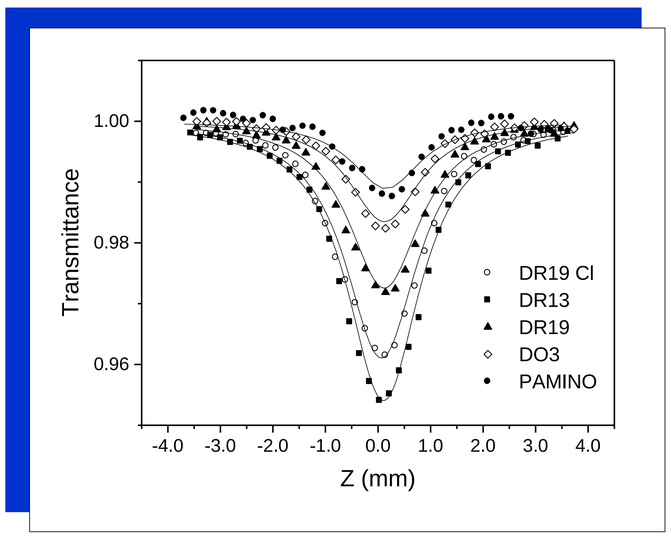

Figure 4 – Z-scan signature for the DR1-DMSO solution (open circles) performed with 190 fs pulses at 775 nm and an intensity of 87 GW/cm^2. The solid lines represent theoretical fittings with the parameters given in the Table 1.

Results

Z-scan measurements were carried out for the all azoaromatic compounds in order to determine their 2PA coefficients. The δ values are also listed in Table 1.

Table 1: Concentration and 2PA cross-sections for the compounds studied

Sample	Concentration (10^{17} molecules/cm^3)	β (cm/GW)	δ (10^{-50} cm^4 s/photon^{-1})
AZOB	8.4	0.0006	0.19
DIAMINO	4.6	0.0008	0.45
PAMINO	5.3	0.0018	0.90
DO3	6.2	0.0028	1.2
DR19	4.5	0.0048	2.7
DR1	4.8	0.0052	2.8
DR19Cl	4.3	0.0069	4.1
DR13	4.3	0.0082	4.9

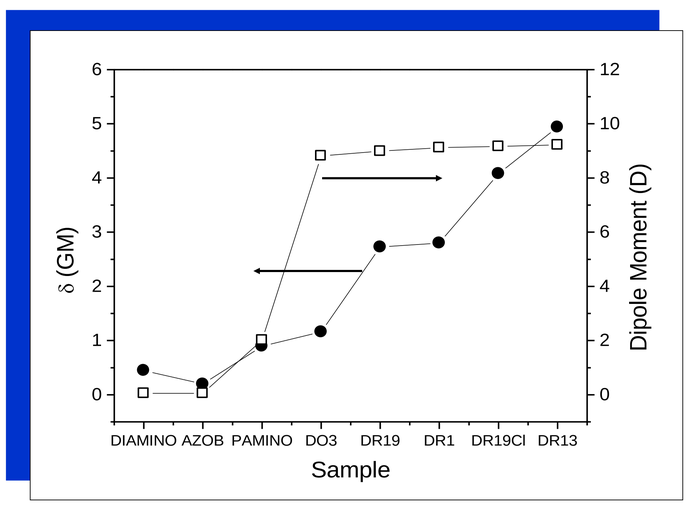

Figure 4 – Experimental values of the 2PA cross-section for the eight azoaromatic compounds studied, and its calculated dipole moment. The solid line in this figure was drawn to guide the eye.

Conclusion

We have carried out an investigation of 2PA in several azoaromatic/DMSO solutions using the Z-scan technique with 775 nm femtosecond laser pulses. The cross-section of the 2PA process increases with the dipole moment of the molecule. These results allow one to draw some correlation between the molecular structure and the 2PA process, corroborating strategies from the literature to design organic compounds with high nonlinear 2PA cross sections.