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The non-linear characteristics of working substances of laser limiters

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Laser radiation limiter

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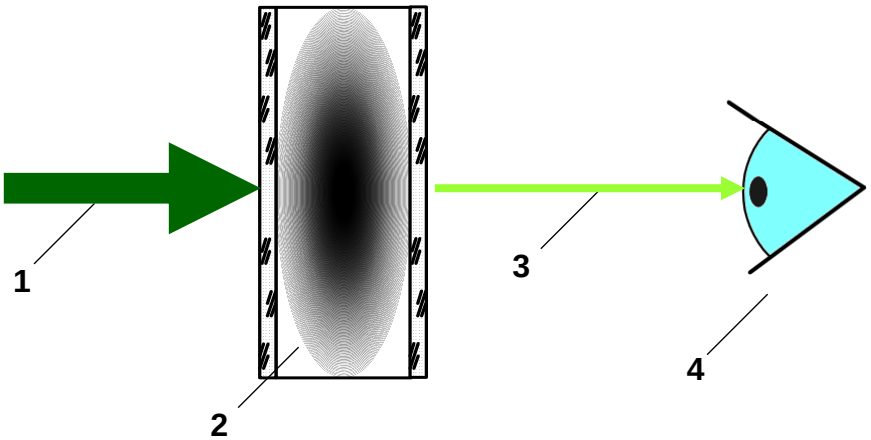

1 - high-intensity incident radiation, 2 - laser limiter, 3 - low-intensity output radiation, 4 – human eyes or sensitive elements of optical systems

Structural formulas of organic dyes

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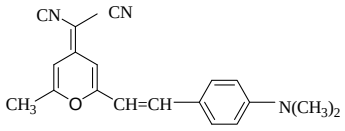
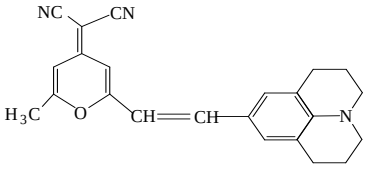
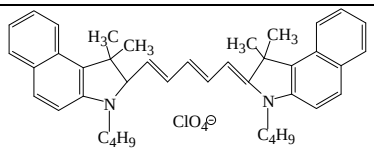
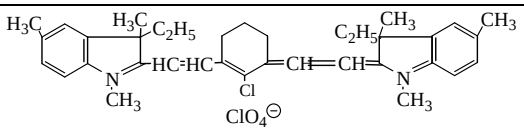
Styryl dyes DCM	
DCM ululidine	
Polymethine dyes PD-792	
PD-7098	

Absorption spectra of organic dyes solutions in propylenglycolcarbonate (PGC)

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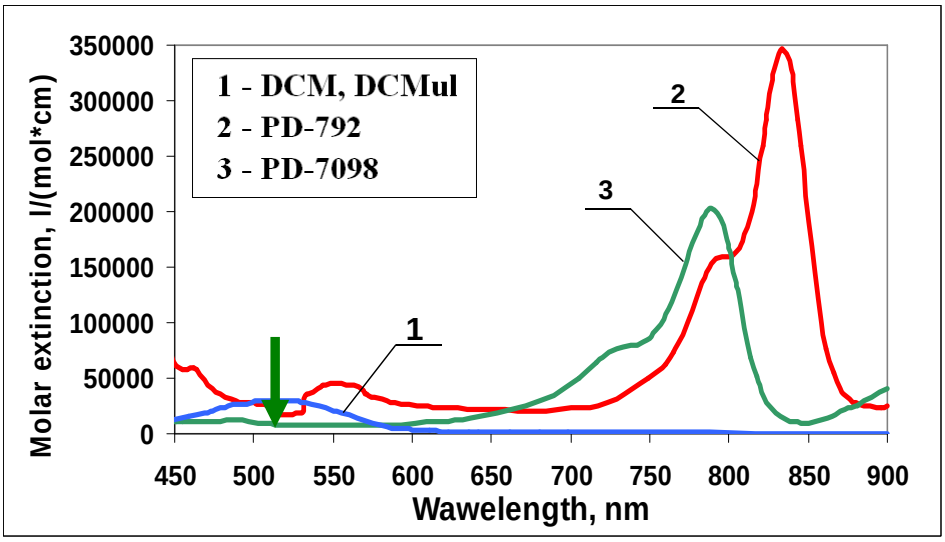

$\lambda_{gen} = 532$ nm

Experimental scheme for measurements of nonlinear optical characteristics of limiter working substances

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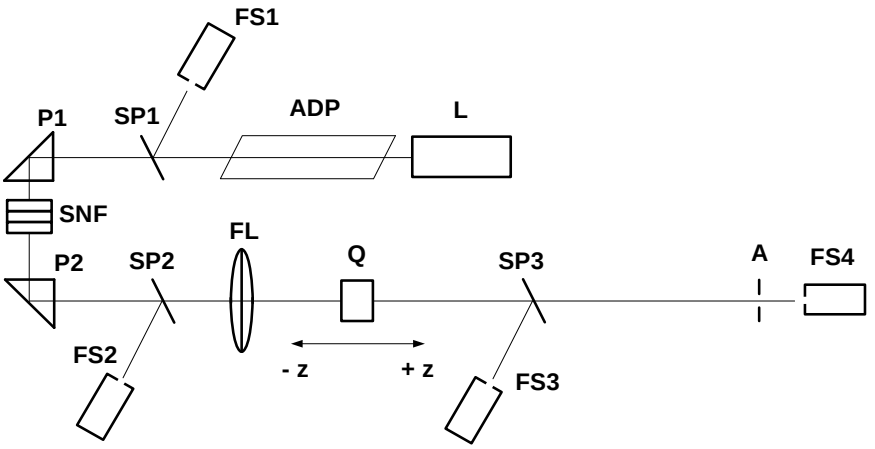

L - laser; ADP - nonlinear crystals - for the second harmonic generation (λ = 532 nm); FS - sensors; SP - semi-transparent plate; P - prisms; SNF - a set of neutral filters, FL - focusing lens; Q - cuvette; A - aperture

Z-scan experimental scheme

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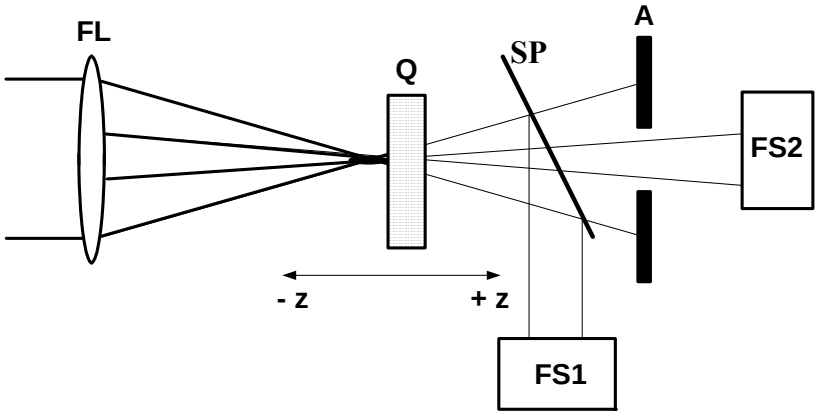
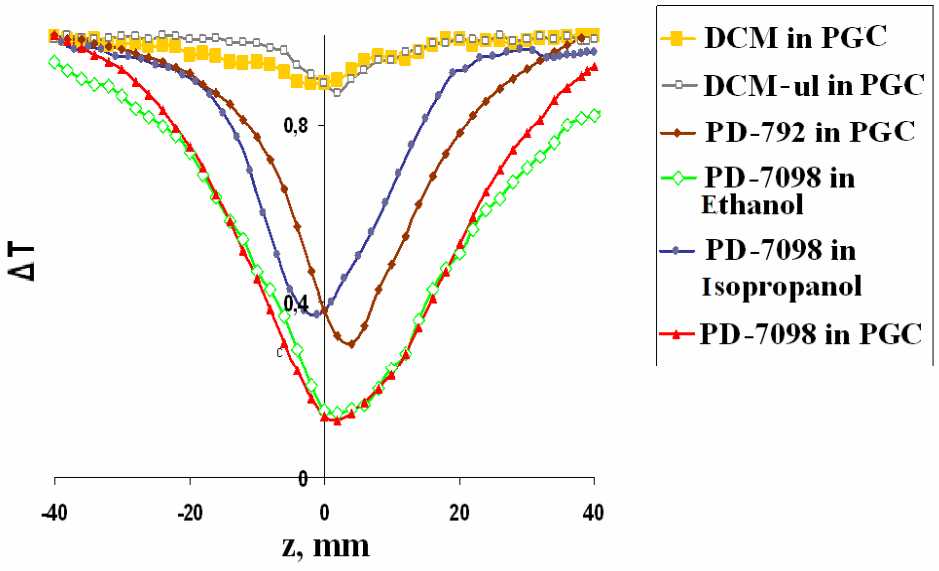


L - focusing lens; Q - cuvette; FS1, 2 - sensors; SP - semi-transparent plate; A – aperture

Z-scan results for organic dye solutions 7



Nonlinear characteristics of the investigated working substances 8

Dyes	Solvent	C, mmol/l	n_2, 10^{-14} ESU	β , 10^{-14} m/W	Re $\chi^{(3)}$, 10^{-15} ESU	$\chi^{(3)}$, 10^{-9} ESU
DCM	PGC	1,05	17,2	1,12	1,83	1,32
DCMul	PGC	1,05	5,43	1,34	8,48	1,57
PD-792	PGC	0,9	2,49	243,0	38,80	267,5
PD-7098	Ethanol	1,0	8,05	351,0	11,60	417,9
PD-7098	Isopropanol	0,4	2,36	144,0	3,44	158,0
PD-7098	PGC	0,4	3,94	201,0	61,4	235,4
PD-7098	PGC	1,0	5,47	370,0	85,3	433,9

- The nonlinear characteristics of tested substances were determined: nonlinear refractive n_2 index, nonlinear absorption coefficient β, third-order nonlinear susceptibility $\chi^{(3)}$, as well as its real part corresponding to the non-linear radiation refraction and the imaginary part corresponding to nonlinear absorption.
- The real part of $\chi^{(3)}$ is less compared with the imaginary part. This means that there is no nonlinear refraction in these organic dyes.
- The solution of PD-7098 in PGC with concentration C = 1 mmol/l has the largest nonlinearity showing 5 fold decreasing of high rate radiation transmission in comparison with other dyes.

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Thank you!