изменению μ_p. Полученные экспериментальные результаты дают основание считать, что механизм рассеяния в таких материалах существенно отличается от обычных полупроводниковых материалов. При этом в достаточно широкой области температуры 100-300 К, в таких материалах основным механизмом является рассеяние в многозарядных центрах. Очень важным фактором является управление подвижности дырок с помощью освещенности света, что и позволяет создать принципиально новые фотоэлектронные приборы с большой высокой чувствительностью.

Литература

1. Бахадырханов М.К., Аюпов К.С., Мавлянов Г.Х., Илиев Х.М., Исамов С.Б. Фотопроводимость кремния с нанокластерами атомов марганца // Микроэлектроника, 2010. том 39, № 6. С. 426-429.
2. Абдурахманов Б.А., Аюпов К.С., Бахадырханов М.К., Илиев Х.М., Зикриллаев Н.Ф., Сапарниязова З.М. Низкотемпературная диффузия примесей в кремнии // Доклады АН РУз, 2010. № 4. С. 32-36.

C_{70}-CLUSTERS FORMATION IN SOLUTIONS

S.A. Bakhramov[1], A.M. Kokhkharov[2], E.A. Zakhidov[2], U.K. Makhmanov[1], Sh.P. Gofurov[2]

[1] *Special Construction Department of Ion-plasma and Laser Technology Institute of AS of Uzbekistan, Tashkent,* bahramov@mail.ru

[2] *Ion-plasma and Laser Technology Institute of AS of Uzbekistan, Tashkent, Republic of Uzbekistan,* kokham@yandex.com

TEM-studies of C_{70}-solutions showed stable ball-shaped C_{70}-clusters formation in toluene+acetonitrile mixtures. It has been demonstrated, that the C_{70}-clusters sizes depend on initial concentration of C_{70}, as well as volume fraction of acetonitrile in solvent mixture. Correlations between change of electronic absorption spectra and C_{70}-clusters formation in solutions have been demonstrated. Nonlinear ellipse rotation (NER) of laser pulses (λ =532 nm, τ_{FWHM}~12 ns) in benzene, toluene, and toluene+acetonitrile solutions of C_{70}–D(5h) has been investigated experimentally..

For an isotropic medium, the third-order susceptibility tensor $\chi^{(3)}(\omega)$ has three independent components: $\chi^{(3)}_{xxyy}$, $\chi^{(3)}_{xyxy}$, and $\chi^{(3)}_{xyyx}$ [1], which have not been taken into account in Z-scan measurements [2]. The NER-effect (using an elliptically polarized wave) in C_{70} solutions is quite sensitive to changes in both intensity and degree of ellipticity of the laser pulses, as well as the solvent composition. This effect allows to define absolute values and signs of nonlinear cubic susceptibility $\chi^{(3)}_{xyyx}$ of solutions at various polarizations of laser pulses (see Table 1). Sign of n_2 determines by the direction of nonlinear rotation of polarization ellipse in a medium and considers as positive at left rotation of the polarization ellipse in case of $I_+ > I_-$, and at the right rotation in case of $I_+ < I_-$ from the viewer's position, where I_+ and I_- are the intensities of right– and left–handed polarized circular components of laser radiation, respectively. In the counter case, the sign of $\chi^{(3)}_{xyyx}$ considers as negative.

Formation of molecular aggregates (clusters) of C_{70} in two-component organic solvents (<C_{70}+Toluene+Acetonitrile>) is accompanied by critical changes in the nonlinear rotation of laser beam polarization ellipse in solutions.

Table 1

Values of basic nonlinear optical parameter $\chi^{(3)}_{xyyx}$ of C_{70} in toluene (TOL) and benzene (BZ) at different laser beam ellipticity $\theta = (|I_+| - |I_-|)/(|I_+| + |I_-|)$. Concentration of C_{70} in TOL was $5\cdot10^{-2}$ wt.% C_{70}, and in BZ $6\cdot10^{-2}$ wt.% C_{70}, λ=532 nm.

θ		0.2	0.3	0.4	0.6
TOL	$-\mathrm{Re}\,\chi^{(3)}_{xyyx}(\omega)$, (x$10^{-11}$, CGS units)	1.41	2.3	2.8	3.5
BZ		2.73	3.8	5.3	5.8

Increase of C_{70} concentration in toluene, as well as in benzene, leads to drastic shape changes in the electronic absorption spectra of solutions, namely to disproportional decrease of specific characteristic of

absorption band in a range between 350–400 nm, and enhancement in 450–500 nm, that we associate with increase in size of stable C_{70}-clusters by the following schema: $nC_{70} \rightarrow (C_{70})_n$.

Table 2.

Values of $\chi^{(3)}_{xyyx}(\omega)$ of fullerene C_{70} solutions at various concentrations (C) of C_{70} and volume fractions of acetonitrile (ACE) in mixture (TOL+ACE). Laser beam parameters: $I \sim 5 \cdot 10^6$ W/cm^2, $\theta \approx 0.42$, $\lambda = 532$ nm.

C, (x10^{-4}, M)		11.9	9.52	5.95	2.38	0.595
$-\mathrm{Re}\,\chi^{(3)}_{xyyx}(\omega)$, (x$10^{-11}$, CGS units)	10% ***ACE***	1.2	2.97	3.06	1.42	0.37
	20% ***ACE***	0.37	0.94	2.34	1.35	0.36
	30% ***ACE***	0.03	0.35	1.49	1.17	0.34

The NER-effect is quite sensitive to changes of laser beam intensity and polarization ellipticity, as well as concentration of fullerene in solutions, and solvent content. Increase of intensity and degree of ellipticity leads to an increase and gradual rotation angle saturation in toluene and benzene.

The nonlinear coefficient n_2 is related to the of third-order nonlinear susceptibility $\chi^{(3)}_{xyyx}$ through $n_2 = 3\mathrm{Re}(\chi^{(3)}_{xyyx})/4\varepsilon_0 n_0 c$ [2], where ε_0 is the permittivity of vacuum, $n_0 \approx 1$, c is light velocity.

The formation of C_{70}-molecular aggregates in *TOL+ACE* leads to the substantial changes in the nonlinear rotation of polarization ellipse. Gradual increase of C_{70} concentration in solvent mixture (*TOL+ACE*) is accompanied with the decrease of specific polarization rotation. For a fixed laser beam parameters (intensity and degree of ellipticity) and concentration of C_{70} in the *TOL+ACE*, increase in volume fraction of *ACE* leads to a decrease of nonlinear specific rotation magnitude.

For determination of C_{70}-nanocluster's size distribution in *TOL+ACE* ($5 \cdot 10^{-2}$ wt.% C_{70}) we have measured the diameters of ~100 clusters that occurred on 5 transmission electron microscopy grids (*copper grid with thin formvar film, 3.05 mm 300 mesh*). The mean value of C_{70}-nanoclusters diameter was ~242 nm. It is important to note, that around 90% of all nanoclusters on TEM–grids had perfect spherical form, with diameter ranging ~180÷291 nm. The rest ~10 % were omitted because of none spherical, often indefinite form.

The observed NER–effect in C_{70}-solutions indicates the possibility of analogous effect in solutions of higher fullerenes (C_{76}, C_{78}, C_{80}, C_{84}) and their endohedral complexes $A_m@C_n$ (where the hetero atoms A_m are found in an inner cavity of the C_n molecule). Future studies of NER–effect in solutions of endometallofullerenes ($M_m@C_n$) will possibly to obtain the important information: migration of the metal atoms (M_m) within the fullerene skeleton, charge transfer from "guest" metal atom to the carbon shell, cluster formation of endometallofullerenes in solutions, etc.

Further detailed research of NER-effect in fullerene-containing materials is very useful for electronic engineering and can lead to creation of electronic components, which can be reversibly and multiply activated on switch from linear to elliptical polarization of high–intensity light pulses.

Reference

1. R.W. Boyd, Nonlinear Optics, 2nd ed. (Academic Press: Boston, 2003).
2. Zhi-Bo Liu, Xiao-Qing Yan, Jian-Guo Tian, Wen-Yuan Zhou, and Wei-Ping Zang. Nonlinear ellipse rotation modified Z-scan measurements of third-order nonlinear susceptibility tensor. OPTICS EXPRESS. Vol. 15, No. 20, P. 13351-13359 (2007).

ИСПОЛЬЗОВАНИЕ Nd:Cr:GSGG В КАЧЕСТВЕ АКТИВНОГО ЭЛЕМЕНТА В ДИСКОВЫХ ЛАЗЕРАХ С СОЛНЕЧНОЙ НАКАЧКОЙ

С.А. Бахрамов, Ш.Д. Пайзиев, Ф.Ф. Шайимов

Специализированное конструкторское – технологическое бюро при институте ионно – плазменных и лазерных технологий АН РУз. Ташкент,
Дурмон йули 28, тел: 2625972, email: fayzi2008@mail.ru

В данной работе рассмотрен лазерный материал Nd:Cr:GSGG, который может конкурировать с Nd:Cr:YAG керамическим материалом по эффективности преобразования солнечного излучения в лазерное.

Несмотря на многочисленные достоинства, наиболее распространенные лазеры на кристаллах и стеклах имели существенный недостаток при ламповой накачке — низкий к.п.д. генерации. Так,