

Fullerenes, Nanotubes and Nanoclusters as Nonlinear Optical Limiters.

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Optical limiting mechanism in fullerene containing liquids and solid-state matrices, and suspensions of nanotubes and nanoclusters were investigated in wavelength range 0.3-1.315 μm . /1/

We are studied solutions of fullerenes C_{60} and C_{70} in toluene and CCl_4 . The optical limiting in fullerene-containing media was determined by two processes—the reverse saturated absorption (RSA) and optically induced stimulated scattering (SS) at small-scale inhomogeneous. The impact two processes into optical limiting is some 8-10 times for RSA and (for pulse duration over 1 ns) some 10 times for SS. /2,3/.

We have developed several variants multi-stage schemes of optical limiters on the base of fullerene-containing systems $\text{C}_{60}\text{-CCl}_4$, C_{60} -toluene and also at the suspensions of Astralene.

A lot of attention is paid today to the optical limiting by suspension of carbon and other materials in various solvents.

The interest to these studies is explained by the properties of suspensions, including visible range and near- IR range of spectrum. In addition, the suspensions have the limiting properties in time range from several nanoseconds to 150 microseconds. The important feature of this type of limiter is color-comfortable vision through it, i.e. the absence of limiter color.

It is important to note that limiters on the base of carbon suspensions have a significant disadvantage – they are destroyed by action of laser radiation /4/

Along with the widely used suspensions of carbon (100-200 nm) and of other particles, we have proposed the suspensions of newly synthesized fulleroid materials – Astralens (patent

application #200117530/28 (018350) of June 18, 2001 « Nonlinear-optical element for limiting the fluency of electromagnetic radiation»).

The nonlinear- optical properties of suspensions were determined under following wave length- $\lambda = 308 \text{ nm}$ (eximer laser), $\lambda = 532 \text{ nm}$ (Nd:YAG laser), $\lambda = 1315 \text{ nm}$ (photo dissociation iodine laser). /5/

The result can provide in Astralene suspensions the high limiting (50-80 times) in single –element limiter with $l = 3 \text{ mm}$, starting transparency $T = 50\%$ and not depended upon radiation wavelength.

On the base suspension of Astralene was developed multistage limiter of laser radiation with dynamic range of limiting 10^3 from 10 J/cm^2 to 10 mJ/cm^2 due to the joint action of two mechanisms –SS and RSA with response time 10^{-9} sec and initial transmission $\sim 50\%$ with color comfort and with working band from 0.3 to 1.315 μm .

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