Nanooptics and nanophotonics

Contribution of the nonlinear scattering in effects of optical limiting in SiC film nanostructures

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In our previous paper [1] the results of optical limiting studies in SiC thin film nanostructures of different polytypes carried out by means of Z-scan technique with open aperture are presented. SiC is known as a perspective medium to be used in different extreme conditions. The analyses of the experiment data show that the main mechanism of the effect is due to nonlinear two step absorption and absorption by non-equilibrium carriers. However, the results obtained by Z-scan with open aperture do not make it possible to consider scattering processes resulting from the nonlinear refraction in the SiC samples under study. Therefore, the aim of our studies is to separate both effects, namely, nonlinear absorption and nonlinear scattering and to estimate the contribution of the nonlinear scattering to the optical limiting. To do that we used Z-scan technique with varying aperture diameter which allow for separating both nonlinear effects.

To analyze the experimental data mathematically we used a model in which the extended extinction coefficient includes not only linear α_0 and nonlinear β absorption but also nonlinear scattering coefficient γ_S

$$\alpha(I) = \alpha_0 + \beta I + \gamma_S I,$$

where I = I (z) is the local laser light intensity (W/cm^2).

Using the model (1) after averaging the laser intensity on space and time Gauss profiles we approximated transparence data on the basis of approach minimizing errors and obtained values of the nonlinear scattering coefficient γ_S for both the first (λ =1064 nm) and second harmonics (λ = 532 nm) of a YAG:Nd^3 laser.

1. *A A Borshch, V N Starkov, V I Volkov, V I Rudenko, A Yu Boyarchuk, A V Semenov*, "Optical limiting effects in nanostructured silicon carbide thin films", *QUANTUM ELECTRON*, 2013, **43** (12), 1122–1126.