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Dependence of the random lasing threshold and spectrum of dyes on the parameters of the active scattering medium

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In multiply scattering media, there is the possibility of light lasing without optical resonator. This phenomenon is possible due to the formation of positive feedback resulting from the repeated extension of the path of a scattered photon in the active region and called random lasing.
The main parameters that influence the occurrence of random lasing in the active medium are: the concentration of scattering centers, dye concentration, and temperature. Vesicular films provide the most efficient light scattering. The concentration of vesicles in the films determines the degree of elastic light scattering in the sample. As the concentration of vesicles increases, the efficiency of elastic scattering in the active medium increases.
Increasing the concentration of dye molecules in the film increases the probability of photon interaction with these molecules. Lowering the temperature affects the process of random lasing by reducing the threshold intensity for its occurrence. Low temperature promotes more efficient amplification in the active medium due to reduced reabsorption of random lasing radiation caused by the overlap of the amplification spectral contour with the absorption band.
Based on experimental data, it has been shown that increasing the concentration of vesicles and dye molecules, and a lowering the temperature, leads to a reduction in the random lasing threshold. Increasing the concentration of vesicles and dye molecules, along with lowering the temperature, leads to a broadening of the random lasing spectrum and its shift toward the long-wavelength region. A decrease in temperature results in a broadening of the random lasing spectrum and to shift to short-wavelength region.

Keywords: random lasing, laser dyes, strongly scattering media, vesicular polymer films.

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