

An Investigation of the Thermophysical Properties of Magnetoactive Media Using the Method of Resonant Photoacoustic Spectroscopy

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An expression for the amplitude-phase characteristics of photoacoustic signals received from a piezotransducer for the cases of free, nonfree, and singly nonfree boundaries in a sample-piezotransducer system was found. Resonant phenomena were found in a range of megahertz frequencies of modulation inside absorbing simple bessel light beams.

The investigation of physical and thermophysical properties of condensed media is considered to be an important task of both applied and fundamental character. There are several methods to measure thermophysical parameters. One of them is the method of laser photoacoustic spectroscopy [1] based on thermo-optical excitation of acoustic waves in the media, by absorbing modulated laser emission. The parameters of a photoacoustic signal depend on the characteristics of the absorbed radiation, and on optical, thermophysical, acoustic and dissipative properties of the absorbing media. The method of resonant photoacoustic spectroscopy [2] has been widely developed. Usage of the method of bessel light beams [3-4] as the exciting radiation is associated with the presence of some specific properties, for example: non-diffraction propagation in space, presence in a stream of energy of TH-modes, except axial, radial components, etc. Bessel light beams have wide use from the perspectives of thermophysics, biophysics, medicine, nanotechnologies, and integrated and digital optics.

The present work is devoted to an investigation of the thermophysical properties of elastic-stressed absorbing magnetoactive samples using a photoacoustic method of exciting thermoelastic waves by bessel light beams of various modes. It was found that the expression for the amplitude-phase characteristics of the photoacoustic signal received from piezotransducer depends on the different boundary conditions. It has been established that values of the amplitude signal depend on the cross-sectional radius of the bessel light beams and on their mode, on the azimuthal coordinate, dissipative, thermophysical and non-linear-elastic properties of the sample and on the geometric parameters of the system sample-piezotransducer. In a range of high frequencies of modulation ($\Omega > 1$ MHz), resonant phenomena were found and their volume dependence on geometrical parameters of the compound resonator (which is system sample-piezodetector) were analyzed.

The opportunity of using resonant phenomena in order to increase the spatial resolution of the photoacoustic spectroscopy method in application to magnetoactive media, possessing an internally stressed condition, is shown.

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