Definition of thresholds of the heating effects of THz radiation on cancer cells

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The main objective of the investigation is to determine the threshold parameters of THz radiation for its use in non-invasive therapy and diagnosis of cancer. This paper presents a model that allows identifying and calculating the thermal effects caused by THz radiation. The possibility of using these effects for the diagnosis and treatment of cancer is also being considered.

Cancer is a tumor formed by epithelial tissues that covers almost all human organs. Modern statistics show that every year cancer is registered in 10 million people around the world. In Russia, cancer mortality ranks second after heart and vascular diseases. (see [1]) Nowadays, medicine has achieved good success in the field of oncology, but the problem is that there is still no effective cure for cancer cells, and timely diagnosis in the early stages is a huge range of different tests. Therefore, it is important to create an effective technique aimed at diagnosing and combating cancer.

The scientific novelty of the study is determined by the fact that it examines the currently little-known thermal effects (see [2,3]) that occur when exposed to THz radiation (see [4]).

This model performs calculations (by solving the equation of thermal conductivity using the Debye model) for a cylindrical sample of water (see [5]), with the radiation frequency from 0 THz to 25 and temperatures from 0 C° up to 100 C°. The program interface includes several input parameters such as incident radiation parameters, sample parameters, coordinates and environmental conditions. The experimental values are presented in the table below:

Input parameter	Value
Radial coordinate	[-2:2]
Input power, mWt	1
Beam radius, mm	5
Initial temperature, K	295
Frequency, THz	1
Sample radius, mm	50
Sample thickness, mm	5

Figures 1 and 2 illustrate the results. It is obvious that with these values of the input parameters, the temperature increase reaches from 0.035 degrees in the center of the sample to 0.02 degrees at the periphery.

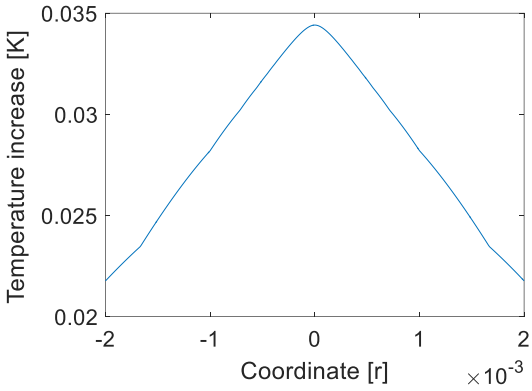

Fig. 1. The temperature increase in the sample along the radial coordinate

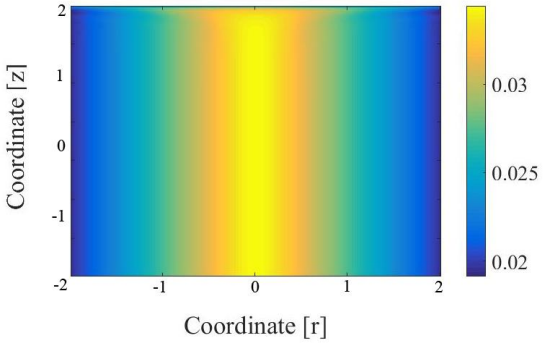

Fig. 2. The temperature increase in the sample caused by exposure to THz radiation

In addition, this model assumes the possibility of using the results of real experiments. Firstly, in the experiment, the cultivation of a line of cancer cells is carried out. Then their optical parameters are determined on the pulse THz spectrometer, such us the dispersion of the complex permittivity and the refractive index. The obtained parameters are loaded into the program. The results may lead to the conclusions about the value of the input parameters of radiation that can cause apoptosis of cancer cells and apply THz radiation for the diagnosis of diseases.

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