

USE OF THE TERAHERTZ WAVES IN BIOLOGY AND MEDICINE

Kulaieva A. E.

Scientific supervisor: prof. Strizhachenko A. V.

National University of Pharmacy, Kharkiv, Ukraine

akulaeva98@gmail.com

Introduction. In the last decade the attention of scientists has been turned to the influence study of terahertz (THz) waves on physical and biological objects. Researches show that the biotropic parameters of THz waves allow to create the devices to control medicines aging, the quality of food products, and also to identify fakes and dangerous impurities in these technological processes.

Aim. Investigation of biological effects in the terahertz waves range to use it in the biology and practical medicine.

Materials and methods. Radiophysical methods of bioobjects studying.

Great experimental material indicates that electromagnetic waves of the THz range can influence on all known cell types (nerve, muscle, connective tissue, receptor, etc.). THz waves are high efficiency in the treatment medicine: ophthalmic (amblyopia); cardiovascular (angina pectoris, essential hypertension, myocardial infarction); neurologic (pain syndromes, radicular pain, osteochondrosis), skin (atopic dermatitis), gastroenterological (peptic ulcer, hepatitis), dental (periodontosis, periostitis); oncological. English physicists have learned to use terahertz radiation to determine areas of the skin that affected by cancer. Compared to healthy tissues, such cells contain more water, which absorbs radiation intensively in the frequency range from 100 GHz to 3 THz. If you know the intensity of terahertz radiation reflected by different parts of the skin, the complete map of the affected area can be build.

Studies to identify viruses with the help of terahertz waves are carried out. This is possible because the natural oscillation frequencies of viruses and some conformational motions of biomolecules are in the terahertz frequency range. This effect is planned to be applied to such viruses as bacteriophage M13, measles virus, influenza A.

THz therapy has the following features: non-invasiveness, polytherapeutic effect, antistress effect, immunomodulatory effect, analgesic effect, are well combined with other methods of treatment (chemical, physiotherapeutic, etc.) and has no absolute contraindications.

Therapy hasn't side effects unlike THz medicines. THz radiation has no ionizing effect. Using it, you can build the 3D of structures image, for example, for soft tissues.

A study published in 2010 and conducted by Boian S. Alexandrov created

mathematical models predicting how terahertz radiation would interact with double-stranded DNA, could allow terahertz waves to "unzip double-stranded DNA, creating bubbles in the double strand that could significantly interfere with processes such as gene expression and DNA replication".

THz radiation freely passes through paper, wood, plastic, ceramics, as well as through the upper layers of the skin and human clothes. Terahertz waves are used for transmission of passengers and cargo at airports instead of harmful X-ray waves in a number of European countries. Experts in the environmental monitoring field (determination of harmful impurities in the atmosphere, water, near space, etc.) associate great hopes with the development of THz waves.

The somatic cell of mammals has the 2.39 THz resonant frequency, 0.75-15 THz resonant frequencies are for chromosomes of different gene activity. The calculation shows that the resonance frequencies of the Pulmonary alveolus of the lungs are in the range of 0.3-0.5 THz, and the red blood cells are 0.5-1 THz.

Now work is under way which shows that biotropic parameters of THz waves allow to create devices to control medicines aging of medicines, quality of food products, as well as for identifying counterfeits and hazardous impurities in these technological processes.

Terahertz radiation could let art historians see murals hidden beneath coats of plaster or paint in centuries-old buildings, without harming the artwork.

Thanks to the use of THz waves, one can expect a breakthrough in a number of medical technologies. In the very near future Terahertz devices with harmless electromagnetic radiation will enter the practice of medical diagnostics and will be able to replace X-ray machines.

Conclusions. The systematization of the characteristics and biophysical effects of terahertz waves has been carried out. It shows the prospects for researches continuing of the influence of radio waves in the THz frequency range on living objects for creating new promising directions in medical and pharmaceutical technologies – physiotherapy, diagnostics and ecology, which can be called: terahertz therapy, terahertz diagnostics, and terahertz ecology.