

Nonthermal impact of terahertz (THz) radiation on living systems

S.E. Peltek^{1*}, I.A. Meshcheryakova¹, T.N. Goryachkovskaya¹, E.V. Kiseleva¹, A.S. Rozanov¹, E.V. Demidova¹, K.V. Starostin¹, A.V. Bryanskaya¹, S.V. Sergeeva¹, P.S. Loshenova, D.Y. Oshchepkov¹, E.A. Demidov¹, G.L. Dianov¹, M.A. Logarkova³, S.L. Kiselev³, M. Timofeeva², N.A. Vinokurov², V.M. Popik², M.A. Scheglov²

¹ Institute of Cytology and Genetics SB RAS, Novosibirsk, Russia

² Budker Institute of Nuclear Physics SB RAS, Novosibirsk, Russia

³ Vavilov Institute of General Genetics RAS, Moscow, Russia

* e-mail: peltek@bionet.nsc.ru

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An analysis was made of the reaction of mesophilic and extremophilic microorganisms to the non-thermal impact of terahertz radiation (THz) of the Novosibirsk free-electron laser. Transcriptome analysis of irradiated and control cells revealed the activation of genes controlling of adhesive structure of the cell wall, transport through the cell membrane and the metabolism of organic substrates. Additional, by electron microscopic method shows, shown that irradiated *E. coli* cells with THz increases the unevenness of the positioning of the pilus on the surface of the bacteria, and also causes the pilus to stick together and form their 2–3-layer bundles.

In this study we also performed a differential proteomic analysis of the total microorganisms soluble protein fraction after exposure to THz radiation. Based on results of the analysis of the proteome of irradiated and control cells the biosensor *E. coli*/glnA-gfp which react to impact to THz was created. Using this and other biosensors it has been shown that systems sensitive to oxidative stress and the presence of metal ions react to the action of THz and the system sensitive to the presence of antibiotics do not respond. The results of proteomic analysis of the response to the influence of THz on extremophilic bacteria *Halorubrum* indicate a change in the expression of genes that control the regulation of the components of the cell wall.

Analysis of the reaction of human cells to the nonthermal exposure of terahertz radiation showed that in the genetic apparatus of human embryonic stem cells, mutations also do not occur. Changes in the transcription activity of genes are primarily due to the genetic apparatus of the mitochondria.

The SILAC method shows that the expression of mitochondrial proteins involved in the synthesis of ATP and the activity of the gene network controlling the synthesis of the myelin protein increases in the human THz-exposed fibroblasts.