



## **Investigation of Activation Mechanism for Nanostructured Liposomal Capsules by Ultrashort Electric Pulses for Targeted Drug Delivery Problems**

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At present in all industrially developed countries, the active research in the field of targeted drug delivery are conducted. Capsules of different composition type and structure are tested, different ways for control of capsule movement in bloodstream are under consideration, but the problem of decapsulation control remains open.

The authors of the report investigate the mechanisms for nonthermal impact by ultrashort electrical pulses (not more than 10 nanoseconds duration) on nanostructured liposomal capsules containing in the membrane the conducting quasi-spherical or anisotropic nanoparticles for controlled decapsulation. A model for the nonthermal impact of the external pulsed electric field on nanostructured liposomal capsules containing in the membrane the conducting quasi-spherical or anisotropic nanoparticles are developed. Disruption resistance for nanostructured liposomal capsules and the critical parameter values for the external electric field leading to the disruption of such capsules are investigated. The effect of threshold value reducing for the external electric field due to the presence of nanoparticles in the liposomal capsule membrane are described. This effect is responsible for selectivity of the external pulse impact under that the only nanostructured liposomal capsules are activated, while the surrounding cells that do not contain nanoparticles are not disrupted. This selectivity of the impact is very significant for practical applications related to controlled drug delivery in the human body, since it allows to avoid the damage of the body's cellular membranes, providing structural changes only in the membranes of nanocomposite liposomal capsules. Criteria that allow predicting and selecting the optimal sizes and shape of nanocomposite liposomal capsules, as well as the optimal size and shape of conducting nanoparticles immobilized in the membrane of such capsules, in order to achieve the minimum values of the critical electric field leading to its decapsulation, could be defined.

Impact duration is significant parameter because of ultrashort pulse impact with duration up to 50 ns has direct effect on intracellular structures, that opens new possibilities for the gene delivery to cell nucleus, inducing apoptosis and controlling intracellular processes.

The unique approach developing by the authors will have the great scientific and practical significance for the development of new effective and safe methods of remote nonthermal activation of nanocomposite capsules by external electromagnetic impacts for solution of targeted drug delivery problems for human body.

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