ABSTRACT BOOK

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Abstract book

Determination of the dielectric parameters of nanoparticles suspensions in human blood: a thermodynamic model

***Batyuk L.V.*[1], *Kizilova N.N.*[2]**

[1] *Department of Medical and Biological Physics and Medical Information Science, Kharkiv National Medical University,*
4 Svobody Sq., Kharkiv, 61022, Ukraine, E-mail: liliya-batyuk@ukr.net

[2] *Warsaw University of Technology, Pl. Politechniki 1, 00-661 Warsaw, Poland.*

Most cells, including blood cells (erythrocytes and platelets), endothelial cells, immune cells, and cancer cells, are able to interact with suspensions of nanoparticles (NP, d=1-100 mcm) through dynamic redistribution of phospholipids and proteins in the membranes of cells [1]. Complex dielectric permittivity $\varepsilon^*=\varepsilon'-i\varepsilon''$, where ε' is the relative permittivity, ε'' is the loss factor, of the red blood cells differ significantly in healthy blood and in the cancer and stroke patients [2,3], that can be used in medical diagnostics and estimation of the individual treatment success. In this study physical behavior of such fluids and their dielectric properties in the microwave electromagnetic fields (MW) is considered. The erytrocytes are considered as a concentrated suspension of aggregating particles suspended in the complex fluid containing the microparticles (MP) with additional degrees of freedom. In many severe diseases like tumor the blood plasma is rich of products of tissue degeneration and necrosis, and those particles are able to rotate, orient and deform, that can be described by additional internal variables. The physical phenomena at the micro/nano scale in MW fields is described by the enhanced irreversible thermodynamics (EIT) that introduces the Helmholtz free energy $\Im$ as a function of its parameters X,Y, their fluxes $J_{X,Y}$, and their time and space derivatives in the form $\Im=\Im(X,Y,J_{X,Y},\nabla J_{X,Y},\dot{J}_{X,Y})$, where dot corresponds to the time derivative. In the complex MP+NP suspensions in MW fields a series of novel coupled heat J_T and mass J_p transfer phenomena are studied. The entropy production is computed and the generalized Dufour, Soret, thermo-, electro- and diffusiophoresis relations are obtained. Based on the comparison of the thermodynamic model dependents as functions of external temperature and experimental data several novel indexes for early medical diagnostics of tumor growth and stroke have been proposed.

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2. Batyuk L.V., Kizilova N., Muraveinik O. Assessment of Protein Fractions of RBCs in Stroke under Influence of Nanodiamonds in vitro // Conference : 2018 IEEE 8th International Conference Nanomaterials: Application & Properties (NAP).-2018.- P.1-8; doi: 10.1109/NAP.2018.8915073

*3. Batyuk L., Kizilova N. Dielectric properties of red blood cells for cancer diagnostics and treatment // AS Cancer Biology. - 2018. – **2**, N10. – P. 55-60.*