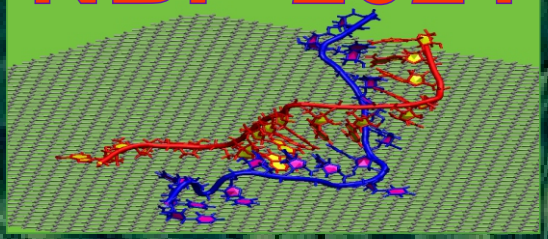
B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine

Institute of Physics of the National Academy of Sciences of Ukraine

NBP-2021

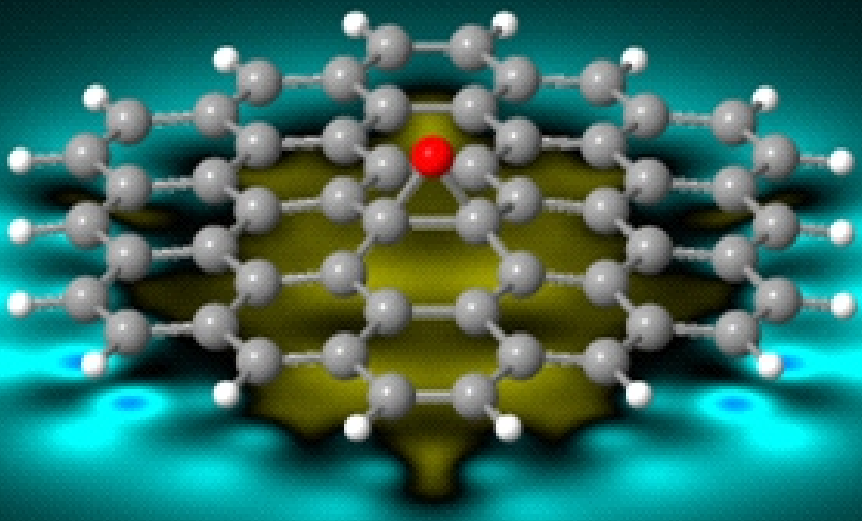


7-th International Conference

NANOBIOPHYSICS:

Fundamental and Applied Aspects

Book of Abstracts



October 4-8, 2021, Kharkiv, Ukraine

P4

DIELECTRIC CHARACTERISTICS OF BLOOD CELLS AS BIOMARKERS FOR DIAGNOSTICS: EXPERIMENTAL DATA AND MATHEMATICAL MODELING

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

[1] *Kharkiv National Medical University, 4 Nauky Ave., Kharkiv, 61022, Ukraine.*

[2] *Warsaw University of Technology, Institute of Aviation and Applied Mechanics, Poland; PoreLab, Department of Chemistry, Norwegian University of Science and Technology, Norway.*

liliya-batyuk@ukr.net

In this study a comprehensive review of recent experimental materials published on dielectric properties of RBCs and their membranes is presented [1-3]. Molecular and cellular components of human blood exhibit dielectric properties that can be described by complex dielectric permittivity: $\varepsilon^* = \varepsilon' - i\varepsilon''$, where ε' is the relative permittivity, ε'' is the loss factor. It was shown, the both ε' and ε'' values of the red blood cells (RBCs) and their ghosts at different frequencies differ significantly in healthy blood of donors and in the cancer and stroke patients [1], that can be used in medical diagnostics and estimation of the individual treatment success including the use of nanodiamonds [2]. The measurement data are systematized by electric parameters, frequency limits, and diseases. Mathematical models of RBCs as fluid-filled multilayer viscoelastic shells are discussed. A generalized model of RBC accounted for bond water layer of different structure and density depending on the disease type/stage is proposed. The blood is considered as a concentrated suspension of aggregating microparticles suspended in the complex fluid containing the nanoparticles with additional degrees of freedom is developed. Complex dielectric properties of the single RBC model and blood suspension of different concentrations are computed. It is shown, the dielectric properties of RBCs, their membranes (water-filled shells) and blood with different RBC concentrations can be considered as biomarkers that are unique for the breast and lung cancer, different disease stage and treatment applied (chemotherapy or X-ray therapy).

1. L. Batyuk, N. Kizilova, In: Development trends in medical science and practice: the experience of countries of Eastern Europe and prospects of Ukraine. – Riga, Latvia: Baltija Publishing, 2018.
2. L. Batyuk, N. Kizilova, Acta Scientific Cancer Biology, **4**(**3**), 01 (2020).
3. L. Batyuk, N. Kizilova, O. Muraveinik, Proceedings of the 2018 IEEE 8th International Conference on Nanomaterials: Applications and Properties, 1 (2018).