Ukrainian Conference with International Participation

«CHEMISTRY, PHYSICS AND TECHNOLOGY OF SURFACE»

and

Workshop

«MICROWAVES AND NANOPARTICLES FOR REAL-TIME DETECTION OF HUMAN PATHOGENS»

(multinational research NATO SPS project G5798 «A novel nanoparticle based real-time sensor for *B. anthracis* and *M. Tuberculosis*»)

NATO OTAN

This workshop is supported by: The NATO Science for Peace and Security Programme

19-20 October 2022
Kyiv
Ukraine

Матеріали Всеукраїнської конференції з міжнародною участю «Хімія, фізика і технологія поверхні» і семінару «Застосування мікрохвиль та наночастинок для визначення патогенів людини в реальному часі» – Київ, 2022. – 206 с.

Proceedings of Ukrainian Conference with International Participation “Chemistry, Physics and Technology of Surface” and Workshop “Microwaves and nanoparticles for real-time detection of human pathogens” – Kyiv, 2022. – 206 p.

Workshop is held within the framework of multinational research project G5798 “A novel nanoparticle based real-time sensor for *B. anthracis* and *M. tuberculosis*” supported by the NATO Science for Peace and Security Programme.

Збірник містить тези доповідей, які було представлено на конференції і семінарі. Тематика конференції: теорія хімічної будови та реакційна здатність поверхні твердих тіл; фізико-хімія поверхневих та міжфазних явищ; хімія, фізика та технологія наноматеріалів; медико-біологічні та біохімічні аспекти вивчення наноматеріалів. Тези доповідей подано в авторській редакції.

Надруковано за ухвалою Вченої ради Інституту хімії поверхні ім. О.О. Чуйка Національної академії наук України (протокол №11 від 15. 09. 2022 р.).

Sponsors

Interbranch Scientific and Technical Complex “Surface Chemistry” of National Academy of Sciences of Ukraine

State Enterprise “Kalush Experimental Plant of Chuiko Institute of Surface Chemistry of National Academy of Sciences of Ukraine”

Study of mechanism of hemoglobin oxidation in the presence of silver nanoparticles in cancer conditions

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

[1]Kharkiv National Medical University,
4 Nauki Ave., Kharkiv 61022, Ukraine, liliya-batyuk@ukr.net
[2]Department of Theoretical and Applied Mechanics, V.N. Karazin Kharkiv National University, Kharkiv 61000, Ukraine, n.kizilova@gmail.com

The antibacterial properties of silver-nanoparticles (AgNPs) have been well studied at low concentrations [1]. The ratio between surface area and volume AgNPs in the range 1–50 nm can increase the reactivity AgNPs and as a consequence increases toxicity. Toxicity may limit the use of AgNPs in medicine as a nanocomposite material. In our recent study, we showed that AgNPs penetrate into the RBCs of blood of cancer patients 60% (diameter d~100 nm) and 38% (d~35 nm) more actively, where they probably interact with hemoglobin molecules [2]. This article explored the effect AgNPs on human hemoglobin autoxidation *in vitro*. Protein absorption spectra were recorded using spectrophotometers in cuvettes 1 cm long in characteristic wavelength intervals. The absorbance data was used to determine the concentration as well as to identify the structural state of the protein. A feature of the proposed approach is that we studied the effect of AgNPs on the redox process already taking place in the erythrocytes of patients with lung cancer – the spontaneous conversion of Hb in the oxy-form of Hb (II) O2 into the physiologically inactive met-form of Hb (III) (autoxidation Hb). As a result, it was found that the presence of AgNP in the oxy-Hb solution significantly increased the concentration of met-Hb, which indicates its prooxidant effect. Differences in the results obtained in the experimental (n=15) and the control group (n=17) consisted in the slope of the curves and, accordingly, the rate of the Hb oxidation reaction. There is a dependence of the duration of the transition and the amplitude of the Hb transition on the concentration of AgNPs. The nature of the time dependence is sigmoid, with a pronounced transition from one effect level to another (the range of 30–40 min). The transition to a new state Hb (AgNPs, d~100 nm) ends in about 1 hour, since the curve completely reaches a plateau by this moment. Thus, it is a process whose rate is much faster than the autoxidation itself, which leads to a plateau only after 1.5 hours, as follows from the data on the kinetics of oxidation at various pH. The kinetic curves of autoxidation at pH 7.9 (AgNPs, d~35 nm) are close to linear, which means that the rate of oxidation does not change with time.

1. M. Mahato *et al.* Colloids and Surfaces B: Biointerfaces. **88** (2011) 141.
2. L.V. Batyuk, N.N. Kizilova *et al.* Nanostructures and Nanomaterials in Medicine: Challenges, Tasks and Perspectives: Ukrainian Conference with International Participation, Kyiv, Ukraine: Book of abstracts, 2021, p. 31.