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EDITORIAL

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7th INTERNATIONAL CONFERENCE "NANOBIOPHYSICS: FUNDAMENTAL AND APPLIED ASPECTS"

7th International conference "NANOBIOPHYSICS: Fundamental and Applied Aspects" – NBP-2021 took place on October 4-8, 2021 in Kharkiv, Ukraine, at the Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine.

"NanoBioPhysics" conference series was jointly launched in 2009 by B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine (ILTPE NASU) and the Institute of Physics of the National Academy of Sciences of Ukraine (IP NASU). Previous conferences were organized on biennial basis in Kharkiv and Kyiv in rotation.

Pandemic situation of the recent years predetermined the hybrid offline/online format of the NBP-2021 conference: among 80 registered participants about 40 scientists have presented their lectures and posters offline (Photo 1) and up to 40 participants were joining the sessions online (Photo 2). Contributions coauthored by scientists from Ukraine, Germany, Poland, Italy, Belgium, Belarus, Bulgaria, Lithuania, Sweden, Romania, Czech Republic, United Kingdom, USA, China, France, and Denmark were presented. 16 keynote lectures and 18 oral presentations were made and 51 posters were discussed offline (Photo 3) and online. Book of abstract of the NBP-2021 contributions was published [1].

Photo 1. Offline participants of the 7th International conference "NANOBIOPHYSICS: Fundamental And Applied Aspects", 2021, ILTPE NASU, Kharkiv, Ukraine.

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In order to discuss urgent problems in an emerging scientific field combining biophysics and nanotechnology, as well as its progress and prospects, the following sessions were organized:

- Nanobiohybrids formed by 1-D or 2-D nanomaterials with bioobjects,
- Biomolecules on nanoparticles and nanostructured surfaces,
- Physical aspects of biomolecular nanosystems,
- Theoretical calculations and computer modeling of nanobiosystems,
- Applied aspects of nanobiophysics.

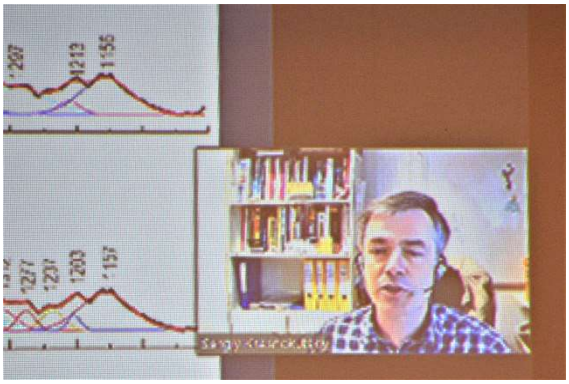

Photo 2. Online lecture delivered from Germany by Dr. S. Krasnokutski.

Photo 3. Signs of the times: poster session discussion under the quarantine conditions. Drs. O. Vashchenko, A. Ivanov, G. Dovbeshko.

Recent research advances in the field of nanobiophysics achieved by the scientists from the host ILTPE NASU (*Kharkiv, Ukraine*) organization were reported in a number of presentations. Chairman of the NBP-2021 conference, the head of the Department of molecular biophysics of the ILTPE NASU, corresponding member of the NAS of Ukraine, Professor ***Karachevtsev V. A.*** summarized the results of investigations of the nucleic acids interactions with nanomaterials in his plenary lecture "Single- and double-stranded polynucleotides on graphene/graphene oxide: structures and binding energies". A variety of experimental and theoretical methods as well as their combination, successfully applied to characterization of nanobioobjects, was presented. Vice chairman of the conference, Dr. ***Stepanian S. G.*** highlighted a problem of quantum-mechanical insight into complexation of 2D nanomaterials with biomolecules. Dr. ***Ivanov A. Yu.*** talked about experimental FTIR spectral studies combined with and *ab initio* calculations of the pyrimidine nucleosides in Ar matrices and condensed films with graphene oxide at low temperatures. Dr. ***Glamazda A. Yu.*** reported on spectroscopic studies of porphyrin functionalized aligned SWNT:DNA nanohybrids encapsulated in stretched gelatin films. Dr. ***Kurnosov N. V.*** described spectroscopic and AFM characterization of the molybdenum disulfide exfoliated with nucleotides and electronic transport in composite film of carbon nanotubes with molybdenum disulfide. Dr. ***Karachevtsev M. V.*** discussed the disclosure of the influence of flexible surface of graphene on RNA duplex adsorption by means of molecular dynamics simulation. Dr. ***Usenko E. L.*** presented results of study of effect of UV irradiation on the thermal stability of native DNA in the presence of TiO_2 nanoparticles. Dr. ***Plokhotnichenko A. M.*** described implementation of the refined method of electrospinning preparation of nanofibers containing Ag nanoparticles or carbon nanotubes. Dr. ***Pashynska V. A.*** publicized the development of mass spectrometry approach to study of nanobiocomplexes which was aimed to search of mass spectrometric molecular markers of modulation effects occurring under

drugs co-administering. The point-contact spectroscopy developed at the ILTPE NASU was applied by Dr. ***Kamarchuk G. V.*** to elaboration of the point-contact sensors as an advanced tool for real-time analysis of molecular systems.

The achievements of biophysicists from the co-organizer of the conference, IP NASU *(Kyiv, Ukraine),* were introduced in the talk of the head of the Department of physics of biological systems, Professor ***Dovbeshko G. I.*** in her plenary lecture called "Graphene-like nanostructures as a platform for studying biological macromolecules and cells: FTIR, RAMAN, CARS, fluorescent spectroscopy and microscopy data".

The response of biophysicists to the present challenge of COVID pandemic was reflected in the lectures by Professor ***Shestopalova A. V.*** (*Kharkiv, Ukraine*) "Blocking the binding of the SARS-CoV-2 coronavirus to the ACE2 cell receptor: results of molecular modeling" and by Professor ***Zholobak N. M.*** *(Kyiv, Ukraine)* **"**Physicochemical determinants of virus-cell interaction". During the concluding session a vivid discussion of this subject took place in the framework of the Round Table "How biophysics and nanosciences meet modern challenges: the case of COVID-19". In particular, evaluation of experimental mass spectrometric facilities for addressing the viruses and coronoviruses related problems was made in a poster presentation by Dr. ***Shelkovsky V. S***. (*Kharkiv, Ukraine*).

Contribution of biophysics and nanoscience to solution of another urgent biomedical problem of cancer research and anticancer therapy was highlighted in the lecture delivered by Professor ***Kutsevol N. V.*** *(Kyiv, Ukraine)* "Multicomponent nanosystems for anticancer therapy: recent advances and disadvantages". Elaboration of novel nanomaterials for a promising method of anticancer and antimicrobial photodynamic therapy was addressed in a series of presentations: "Study of zinc tetraphenylporphyrin/dextran graft polyacrylamide copolymer/Au nanoparticles nanosystem applicability for photodynamic therapy" by Professor ***Yeshchenko O. A.*** *(Kyiv, Ukraine),* "New hybrid structures based on oxygen-free graphene and aluminum phthalocyanine chloride for photodynamic therapy" by Professor ***Klimenko I. V.,*** "Hydrogel-silver nanoparticle composites for antibacterial photodynamic therapy" by Professor ***Nadtoka O. M.*** *(Kyiv, Ukraine).* Bionanophotonic approach to some modern health challenges was described in the lecture by Professor ***Yashchuk V. M.*** *(Kyiv, Ukraine).*

Wide range of biomedical aspects of applications of nanomaterials and related investigations at the nano level was embraced in a set of presentations. Here it is worth to stress the contribution of research teams headed by the "women in science" being recently elected as corresponding members of the National Academy of Sciences of Ukraine, namely Professor ***Yefimova S. L.*** (*Kharkiv, Ukraine*) with her scientific direction of "Biomedical applications of ROS-regulating nanomaterials", and Professor ***Trusova V. M.*** (*Kharkiv, Ukraine*) with her scientific direction related to biophysical basis of fight against neurodegenerative diseases: "Amyloid fibrils as a scaffold for multistep energy transfer". Dr. ***Kuznetsova K. S.*** (*Kharkiv, Ukraine*) described possibilities of dynamic control of enzymatic reactions using microwave dielectrometry method for biomedical applications. Professor ***Sukhoviya M. I.*** *(Uzhgorod, Ukraine)* presented data on biophysical mechanisms of the influence of slow electrons on biostructures.

Another set of talks was connected with the advances in development of novel nanomaterials. Professor ***Sorokin A. V.*** (*Kharkiv, Ukraine*) lectured about features of the "AMPHI-PIC J-aggregate – bovine serum albumin" complexes. Dr. ***Vashchenko O. V.*** (*Kharkiv, Ukraine*) described molecular aspects of recylization of N-substituted 2-iminocoumarines and Dr. ***Tatarets A. L.*** (*Kharkiv, Ukraine*) introduced squaraine and norsquaraine fluorescent dyes for protein investigation. Professor ***Buchatskyi L. P.*** *(Kyiv, Ukraine)* addressed an interesting theme of application of spherical virus-like particles

for nanobiotechnology. Dr. ***Kalinkevich O. V.*** *(Sumy, Ukraine)* presented data on controllable structures on the surface of natural polymers made by proton beam writing and femtosecond laser treatment.

More results of theoretical calculations and computer modeling of nanobiosystems were covered in the lectures of Professor ***Volkov S. N.*** *(Kyiv, Ukraine)* "On possible role of hydrogen peroxide molecules in ion beam therapy of cancer cells" and Dr. ***Perepelytsya S.*** *(Kyiv, Ukraine)* "Mechanisms of spermidine^{3+} interactions with the DNA double helix at the nanoscale". Dr. ***Lisnyak Yu. V.*** (*Kharkiv, Ukraine*) presented data on modeling of drug-target interactions of antimicrobial peptides with phospholipids of the inner membrane of gram-negative bacteria and Dr. ***Dubey I. Ya.*** (*Kyiv, Ukraine*) reported on quantum chemical study of binding of cyanine-based telomerase inhibitor to a parallel DNA quadruplex.

Several talks were devoted to biophysical investigations of nanoobjects related to space research problems and (bio)chemical evolution in space. Dr. ***Krasnokutski S. A.*** (Jena, Germany) described novel experiments initiated by the Astrophysics group of the Max Plank Institute for Astronomy of the Friedrich Schiller University, aimed at investigation of processes of condensation of atomic carbon as a route to proteins origin in space. A vice chairman of the conference, Dr. ***Kosevich M. V.*** (*Kharkiv, Ukraine*) lectured about mass spectrometric simulation of nanoclusters related to chemical evolution in space.

A special session of the Ukrainian Biophysical Society (UBFT) was organized in the framework of the conference. About 40 UBFT members joined online broadcast of the offline session. The participants of the event were greeted by the president of the UBFT, head of Department of Biophysics and Medical Informatics of Taras Shevchenko National University of Kyiv, Professor ***Zholos A. V.*** Current problems and future activities of the UBFT were lively discussed by the participants. In the scientific part of the session the head of the Kharkiv branch of the UBFT, head of Department of molecular and medical biophysics of the V. N. Karazin Kharkiv National University, Professor ***Berest V. P.*** gave a lecture on the subject of adsorption of Gramicidin S on nano-sized liposomes, which can mitigate severe side effects of the antimicrobial peptide**.** Professor ***Soloviev A. I.*** *(Kyiv, Ukraine)* lectured on nontraditional nano-openers of large-conductance Ca-activated K channels. Young scientist Dr. ***Dryn D. O.*** *(Kyiv, Ukraine)* gave a talk on nanostructured carbon materials as novel modulators of diverse types of ion channels.

A special attention was paid to the promotion of young scientists and professional orientation of students. A team of the Young Scientist Council of the ILTPE NASU involving Drs. ***Mysko-Krutik N., Herus A., Kravchuk O., Shchuka M.*** together with SPIE (The International Society of Optics and Photonics) and OSA (The Optical Society) branches in Kharkov have organized SPIE & OSA Workshop "Career development opportunities for scientist and students" in the framework of the conference. Young scientists of the Kharkov academic institutes as well as students of Kharkov institutes and universities took active part in this event.

Traditional competition for the best presentation awards resulted in nomination of three presentations: "Mechanism of reactive oxygen species scavenging by GdYVO4:Eu^{3+} nanoparticles" by Dr. ***Hubenko K. O.*** (*Kharkiv, Ukraine*); "The determination of melatonin content in the human body using exhaled gas analysis" by Dr**.** ***Harbuz D. O.*** (*Kharkiv, Ukraine*); "Molybdenum disulfide exfoliated with nucleotides: spectroscopy and AFM characterization" by Dr. ***Kurnosov N. V.*** described spectroscopic and AFM characterization of the molybdenum disulfide exfoliated with nucleotides".

The next conference of the series is expected to be organized in autumn 2023 in Kyiv.

CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest.

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7th INTERNATIONAL CONFERENCE "NANOBIOPHYSICS: FUNDAMENTAL AND APPLIED ASPECTS"

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7th International conference "NANOBIOPHYSICS: Fundamental and Applied Aspects" (NBP-2021) took place on October 4-8, 2021 at B. Verkin Institute for Low Temperature Physics and Engineering of the National Academy of Sciences of Ukraine (Kharkiv, Ukraine). Previous six conferences, starting from 2009, were organized due to joint efforts of B. Verkin Institute for Low Temperature Physics and Engineering of the NAS of Ukraine and Institute of Physics of the NAS of Ukraine on biennial basis in Kharkiv and Kyiv alternatively. Among 80 registered participants from 16 countries about 40 scientists have presented their lectures and posters offline and other participants were joining the sessions online. 16 keynote lectures and 18 oral presentations were made and 51 posters were discussed offline and online. The goal of the conference was achieved: urgent problems, advances and perspectives of the topical scientific direction of nanobiophysics which embraces achievements of modern molecular biophysics and nanotechnology were discussed. The subjects of physical aspects of biomolecular nanosystems, properties of biomolecules on nanoparticles and nanostructured surfaces, nanobiohybrids formation by 1-D or 2-D nanomaterials with bioobjects, theoretical calculations and computer modeling of nanobiosystems, and applied aspects of nanobiophysics were highlighted at the related sessions. Several additional accompanying events were organized in the framework of the conference, including a Round Table "How biophysics and nanosciences meet modern challenges: the case of COVID-19", a special session of the Ukrainian Biophysical Society, and SPIE (The International Society of Optics and Photonics) and OSA (The Optical Society) Workshop "Career development opportunities for young scientist and students". Book of abstract based on NBP-2021 materials was published.

KEY WORDS: nanobiophysics; biomolecular nanosystems; bionanomaterials; bionanocomposites; nanostructured surfaces; intermolecular interactions; computer simulation.

7 МІЖНАРОДНА КОНФЕРЕНЦІЯ «НАНОБІОФІЗИКА: ФУНДАМЕНТАЛЬНІ ТА ПРИКЛАДНІ АСПЕКТИ»

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Сьома міжнародна конференція «НАНОБІОФІЗИКА: фундаментальні та прикладні аспекти» (NBP-2021) відбулася 4-8 жовтня 2021 р. у Фізико-технічному інституті низьких температур

ім. Б. І. Вєркіна НАН України (Харків, Україна). Попередні шість конференцій починаючи з 2009 року проводилися на дворічній основі спільними зусиллями Фізико-технічного інституту низьких температур ім. Б. І. Вєркіна НАН України та Інституту фізики НАН України по черзі у Харкові та Києві. Серед 80 зареєстрованих учасників з 16 країн біля 40 вчених зробили лекції та постерні презентації наживо та решта приєднувалася до сесій онлайн. Було зроблено 16 пленарних і 18 усних презентацій та 51 постер було обговорено офлайн та онлайн. Мету конференції було досягнуто: обговорено нагальні проблеми, успіхи та перспективи розвитку сучасного наукового напрямку – нанобіофізики, яка охоплює досягнення молекулярної біофізики та нанотехнології. На відповідних сесіях було висвітлено питання фізичних аспектів бімолекулярних наносистем, властивостей біомолекул на наночастинках та наноструктурованих поверхонь, створення наногібридів біологічних об'єктів з 1-D та 2-D наноматеріалами, теорії та комп'ютерного моделювання нанобіосистем і практичних аспектів нанобіофізики. У рамках конференції було організовано кілька додаткових супутніх заходів: круглий стіл «Як біофізика та нано-науки відповідають на сучасні виклики: випадок COVID-19», спеціальна сесія Українського біофізичного товариства, SPIE & OSA майстерклас «Розвиток кар'єрних можливостей для молодих учених та студентів». Матеріали конференції NBP-2021 видано у збірці тез.
КЛЮЧОВІ СЛОВА: нанобіофізика; бімолекулярні наносистеми; біонаноматеріали; біонанокомпозити; наноструктуровані поверхні; міжмолекулярні взаємодії; комп'ютерне моделювання.