XI International conference

Plasma Physics and Plasma Technology

Program & Book of Abstracts

Minsk, Belarus
September 15 – 19, 2025

B.I. Stepanov Institute of Physics
National Academy of Sciences of Belarus

LASERS & LASER SYSTEMS

PULSED Nd:YAG LASERS

- Pulse energy up to 2.5 J
- Flat top beam profile
- Pulse repetition rate up to 200 Hz
- All harmonics from 1064 to 213 nm
- Adjustable pulsewidth
- Adjustable pulse shape

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- Output energy up to 1 mJ
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- Pulse selectors

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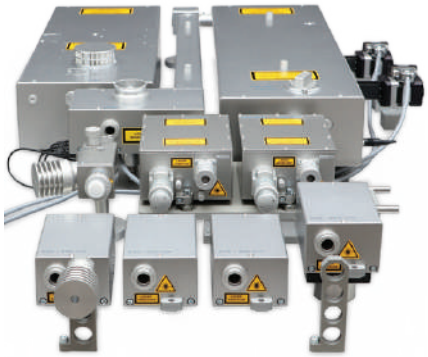
- Tuning range from 0.2 to 20 μm
- Linewidth up to 0.005 nm
- Pulse energy up to 100 mJ



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Solar Laser Systems

XI International Conference

PLASMA PHYSICS and PLASMA TECHNOLOGY

PPPT-11

Minsk, Belarus
September 15 – 19, 2025

Program and Book of abstracts

Edited by

Nikolai Tarasenko
Alena Nevar

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TOPICS

1. Modeling of plasma processes, plasma dynamics, optical and thermodynamic properties of plasmas

2. Electrical discharges and other plasma sources, novel plasma generation approaches

3. Atmospheric pressure plasmas, plasma in and in contact with liquid, plasma-liquid interactions

4. Non-ideal and dusty plasmas, extreme plasma regimes, fusion and astrophysical plasmas

5. Laser and plasma interactions with materials, laser ablation, modification of materials by plasma and laser treatment, sputtering and deposition

6. Plasma spectroscopy and other diagnostic methods, plasma chemistry

7. Plasma applications and advanced plasma technologies *(plasma for nanomaterials synthesis and processing, plasma in medicine and biology, plasma in agriculture, water treatment and decontamination, plasma in spectrochemical analysis, plasma in catalysis, plasma metallurgy, etc.)*

Important dates

Registration	15-16.09.2025
PPPT-11 conference working days	15-19.09.2025
Conference dinner	16.09.2025
Excursion	18.09.2025

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Information for participants

Conference venue. The Conference halls are located in the building of the B.I. Stepanov Institute of Physics, NAS of Belarus, at 68-2 Nezalezhnasti ave., 220072, Minsk, Belarus.

The Conference program will include following types of presentations:

1. invited (40 min or 20 min)
2. sectional reports (20 min)
3. poster presentations and discussions

The conference language is English

Oral presentations

Oral presenters will have overall 20 minutes to present their talks including the discussion. The recommended duration for the talk is 15 minutes, leaving 5 minutes for questions. Participants are welcome to use the provided computer with software for showing slides in PPT, PPTX and PDF formats. The presenters should upload their files and test their presentations before the start of the session.

Poster presentations

We recommend to prepare A1 size poster in portrait. All poster boards will be labeled with a poster number. Participants can put their posters up at the beginning of the day of their poster session or just before it.

Post-conference publications

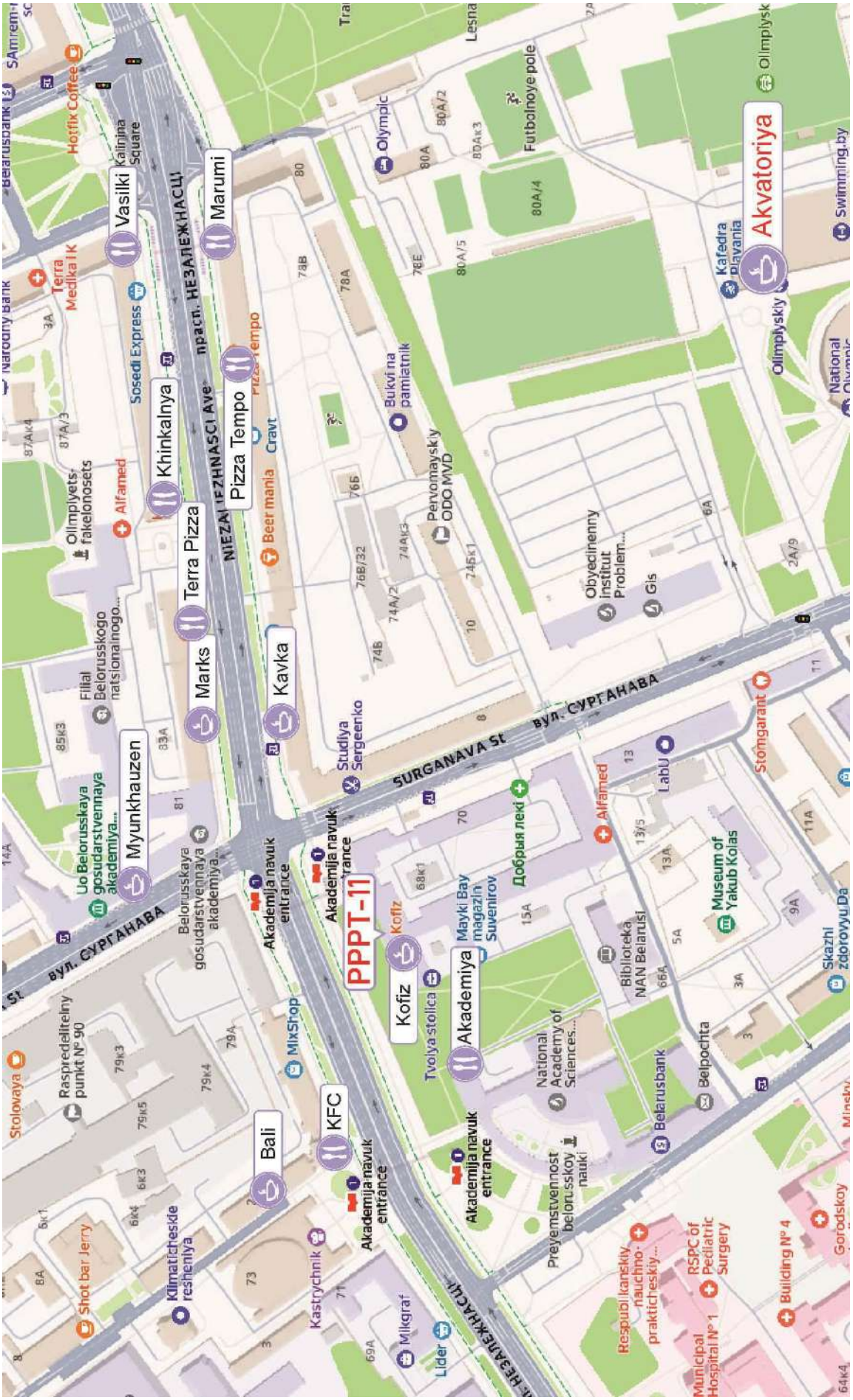
The selected conference contributions will be recommended by the Program Committee for publication in the Journal of Applied Spectroscopy and High Temperature Materials and Processes. The decision of the Program Committee will be sent to the participants after the conference by email. Note that the articles will be considered by the journals as regular papers and will go through the standard revision process established by the journal.

Lunches

The Organizing Committee will organize the lunches (included to the registration fee) in the café "Akvatoriya" located at the Surganova st., 2A.

Otherwise, you can have a meal in one of the cafes nearby marked on the following map:

GENERAL INFORMATION



Social program

Conference dinner – Tuesday, September, 16 – 18.30-22.30

The conference dinner will take place in the "The Seventh Heaven" ("Sed`moe nebo") restaurant located at 11 Nezavisimosti ave. The program of the dinner includes a degustation of the traditional Belarusian food and a performance of Belarusian musicians.

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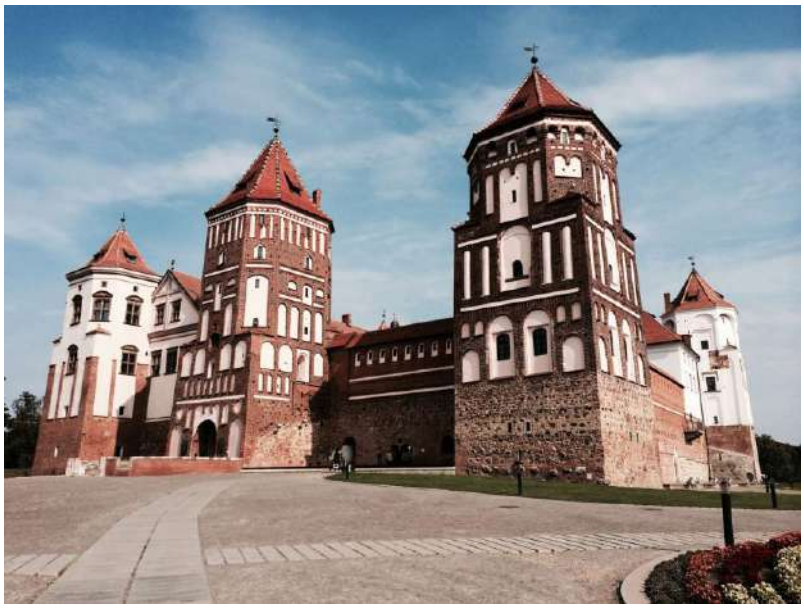
Excursion - Thursday, September, 18 – 11.00-21.00



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We invite you to visit one of the most impressive sights of Belarus - the majestic MIRSKY CASTLE. The castle was built at the beginning of the 16th century and it is part of the UNESCO World Heritage.

A guided tour includes a visit to the castle as well as the main sights of the Mir village. The history of the castle and the village are associated with the names of the Radziwills, Wittgensteins, Svyatopolk-Mirskys, who left a bright mark both in the history of the castle and in the history of the country. Next to the castle there is a church-tomb of the last titled owners of the castle, the princes Svyatopolk-Mirsky, built in the Art Nouveau style. To get to the Mirthe excursion bus will be organized from the conference venue. The duration of the excursion is 10 hours and includes a lunch.

Monday – September 15, 2025

Hall I 10:00-12:40

10:00-10:20 Conference Opening

Chairman: N.V. Tarasenko

10:20 T4-INV **Energetics and evolution of active Brownian motors in Coulomb systems in plasma, viscous liquid and superfield helium**

O.F. Petrov, M.M. Vasiliev
Joint Institute for High Temperatures, RAS, Russia

Active Brownian grains are able to obtain energy from external sources (laser radiation), store it and spend it on their own motion in the medium, which can lead to their self-organization and evolution. Such grains can be considered as active Brownian motors whose motion is controlled by radiation, and the mechanism of active Brownian motion itself is associated with photo- or thermophoresis (in plasma and viscous liquid), or with the occurrence of quantum turbulence (in superfluid helium).

11:00 T4-INV **Electromagnetic radiation in plasmas: Non-Plankovian thermal emission and asymptotic tunneling**

S.V. Gaponenko, D.V. Novitsky, L.V. Simonchik, M.S. Usachonak
B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

The genuine Planck formula is strictly valid for vacuum only since it includes the photon density of states (DOS) factor derived for the free space. Since plasma features dielectric permittivity $\varepsilon(\omega) < 1$ everywhere and $\varepsilon(\omega) < 0$ at $\omega < \omega_p$ where ω_p is plasma frequency, photon DOS in plasmas is always less than in vacuum tending to 0 for $\omega \leq \omega_p$. We derived the general formula for corrected thermal emission spectrum in plasmas and consider spectral ranges for a number of model systems where deviation from Planck formula should be expected. Electromagnetic (EM) radiation tunneling resembles a direct classical analog to quantum mechanical ones. We show that simple model of a lossless plasma gives Wigner time asymptotically tending to $2/\omega_p$ in the limit of low-transparent barriers and it was found to be generally valid for the more realistic problems including lossy plasma and time-dependent consideration. Since $1/\omega_p$ defines the extreme time of plasma reaction to an external perturbation we suggest that EM tunneling in the case of plasmas can be considered as a kind of prompt burst of a plasma layer thus enabling to avoid problems with a number of time-relevant conceptions which are tempted to describe the tunneling dynamics.

11:40 **Studies of error budget in CF-LIBS in connection with temperature behaviour of partition function**

T6-1 N.I. Sushkov, A.M. Popov
M.V. Lomonosov Moscow State University, Russia

Uncertainty of plasma temperature makes the largest contribution to the uncertainty of calibration-free analysis by laser-induced breakdown spectroscopy (CF-LIBS). An important part of this contribution is related to partition function (PF). In our study, we have shown that mathematical analysis of the temperature behaviour of PF and its derived quantities can indicate plasma conditions where CF-LIBS errors could be minimised.

12:00 **A comparison of parameters of Stark broadening obtained under different pressures in laser plasma**

T6-2 A.M. Popov, S.M. Zaytsev, B.S. Chilikin
Lomonosov Moscow State University, Russia

Stark broadening is the leading mechanism of spectral line broadening in laser plasma. Estimation of the parameters of this broadening is often complicated by the inhomogeneity of the laser plasma. At reduced pressure in Ar atmosphere, the plasma is believed to be more homogeneous than at atmospheric pressure. We compared the parameters of the sodium and potassium lines obtained at reduced pressure in an argon atmosphere and in air.

12:20 **Vacuum discharge with strip line current driver as EUV radiation source**

T6-3 L.V. Stepanov (1,2), P.S. Antsiferov (1,2), N.D. Matyukhin (1,3)
(1) Institute of Spectroscopy, RAS, Russia
(2) National Research University Higher School of Economics,Russia
(3) Moscow Institute of Physics and Technology (National Research University), Russia

This work describes a vacuum discharge operating in a special regime, in which radiation from multicharged ions arises at the moment when high voltage is applied to the plasma. At this stage, there is no pinching in the plasma, and its density remains relatively low. The electrical circuit of the setup is presented, enabling the generation of a 10kA current pulse with a duration of 500 ns. The discharge is able to produce spectral lines of multicharged Fe VII and Fe VIII ions, Sn lines near 13.5 nm, which are actively used for EUV lithography applications and other multicharged ions.

12:40-14:00 Lunch

Hall I **14:00-16:40**

Section 6 - Plasma spectroscopy and other diagnostic methods, plasma chemistry

Chairman: M. Kuzmanović

14:00 **Diagnostics of atmospheric pressure discharges via spectral line shape analysis**

T6-INV B. Obradović (1), G. Sretenović (1), N. Cvetanović (2), S. Ivković (1), V. Kovačević (1), I. Krstić (1) and M. Kuraica (1)
(1) University of Belgrade, Faculty of Physics, Serbia
(2) University of Belgrade, Faculty of Transport and Traffic Engineering, Serbia

The analysis of atomic line shape modifications, resulting from different physical broadening mechanisms, enables the determination of crucial plasma parameters, including gas temperature, electron number density, and electric field strength. The broadening mechanisms of the atomic line shapes are often mutually related and their influences strongly depend of the discharge condition. This lecture explores the application of spectral line shape analysis in diagnosing atmospheric-pressure discharges, including dielectric barrier discharges, RF discharges, free-expanding plasma jets, pulsed discharges with liquid electrodes, and pulsed discharges in liquid media.

14:40 **Application of spectral pyrometry to determine discharge temperature in the liquid anode method**

T6-4 YU.S. Baryshnikov, R.O. Kurakin, F.A. Orlov, S.A. Ponyaev
Ioffe Physical-Technical Institute, RAS, Russia

The method of spectral pyrometry for determining the discharge temperature of metals on a liquid anode was investigated. The obtained temperature data were correlated with a calibration lamp. Melting of galvanized iron cathodes during discharge on a liquid anode corresponded to the melting temperature of iron or when, with the same experimental parameters (electrical conductivity of the liquid anode, volt-ampere characteristics of the discharge), but a tungsten cathode was used, such a cathode did not melt in this case.

15:00 **Distribution of EUV radiation centers in laser plasma with a gas-jet target**

T6-5 V. E. Guseva, A. N. Nechay, A. A. Perekalov, N. I. Chkhalo
Institute for Physics of Microstructures, RAS, Russia

The paper presents the results of processing laser spark images obtained using an EUV microscope operating at a wavelength of 11.25 nm with excitation of various gases by Nd:YAG laser radiation (τpulse=4 ns, Epulse=0.8 J). The gas target was formed by the outflow of gas jets from a conical supersonic nozzle under a pressure of 3-10 bar. The paper describes a method for processing laser plasma images using the inverse Abel transform to obtain a radial distribution of radiation centers.

15:20 T6-6 **Spatial distribution of electric field strength in a glow discharge at atmospheric pressure in helium with non-planar electrodes**

P.A. Ivanova (1), A.V. Kazak (1), L.V. Simonchik (1), I. Rafatov (2), V.V. Shkurko (3)
(1) B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus
(2) Department of Physics, Middle East Technical University, Turkey
(3) University of the National Academy of Sciences of Belarus, Belarus

The method for calculating the HeI and Hβ line profiles in the cathode fall region when observed through the negative glow region was developed. The profiles of the HeI 492.2 nm and Hβ 486.13 nm lines formed by the Stark π- and σ -components in the cathode fall region were recorded. The spatial distribution of the electric field strength was obtained in the case of non-planar cathodes. The results was compared with the numerical discharge model.

15:40 T6-7 **Recombination mode of radiation of laser produced lithium (Li) plasma**

N. D. Matiukhin (1,2), M. S. Krivokorytov (1), V. M. Gubarev (1), V. V. Ivanov (1), L. V. Stepanov (1,3)
(1) Institute of Spectroscopy, RAS, Russia
(2) Moscow Institute of Physics and Technology (National Research University), Russia
(3) Higher School of Economics Research University, Russia

One of the various of optical inspection schemes for lithographic masks uses Fresnel zone plates. The operation of such schemes requires extreme ultraviolet (EUV) sources with narrow emission spectra around the operational wavelength. In this study, spectra of laser-induced lithium plasma were obtained in the wavelength range of 10–15 nm, corresponding to a resolving power 500. Based on the spectra, temperature and density of the emitting plasma were estimated ($N_e \sim 10^{19} cm^{-3}$, T~6 eV). Hypothesis was proposed that the radiation occurs in the recombination regime.

16:00 T6-8 **Features of the formation of erosive plasma in the two-pulse clay ablation mode**

N. Kurian, S. Anufrik
Yanka Kupala State University of Grodno, Belarus

It has been experimentally shown that the removal of material from the erosion crater and the increase in the intensity of clay spectral lines during nanosecond double-pulse laser action on the sample are due to the high temperature of the crater. When irradiating a heated surface (700–1300°C) with a focused laser beam, a more than twofold increase in the intensity of spectral lines of laser-induced plasma was observed.

16:20 T6-9 **Optical emission spectroscopy of coaxial DBD plasma at atmospheric pressure**

K.T. Logunov, D.A. Kotov, A.V. Aksiuchyts
Belarusian State University of Informatics and Radioelectronics, Belarus

In this study, optical emission spectroscopy (OES) was used to investigate the characteristics of the atmospheric dielectric barrier discharge. The analysis of the emission spectra of the plasma showed its non-equilibrium character and the presence of reactive particles, which is important for applications in physics, chemistry, biology and medicine.

16:40-17:00 Coffee Break

Hall III 17:00-19:00 Poster session

Tuesday – September 16, 2025

Hall I 9:00-10:40

Section 7 - Plasma applications and advanced plasma technologies

Chairman: B. Obradović

9:00 **Computational study of characteristics of atmospheric pressure glow discharge in helium**

T1-INV I. Rafatov
Middle East Technical University, Turkey

The results of numerical analysis of parameters of an atmospheric pressure glow discharge (APGD) in helium are presented. Numerical models are based on the drift and diffusion theory of gas discharges. The effect of the following factors on the APGD characteristics is considered: the temperature regime on the cathode surface, the value of the secondary electron emission coefficient, and the thermal diffusion. The transition of the discharge to an obstructed mode with gas heating is investigated. The spontaneous emergence of cathode spots is illustrated and discussed.

9:40 **Multifunctional setup for experiments on advanced applications of Electron-Beam Plasma**

T7-1 T.M. Vasilieva (1), A. Diaz Mesa (1), M.N. Vasiliev (2)
(1) Moscow Institute of Physics and Technology (National Research University), Russia
(2) Joint Institute for High Temperatures, RAS, Russia

The setup generating Electron-Beam Plasmas (EBP) with wide-range adjustable parameters at various conditions of experiments arrangement is described. The setup was used to study physical and chemical processes occurring in plasma volume formation and plasma-matter interaction in context of R&D on advanced plasma-based technologies. Effects of inorganic, organic and bioorganic materials treatment by the EBP resulting in their functionality and biocompatibility improvement are given as examples.

10:00 **Towards implementing atmospheric pressure plasma jet for paper document restoration**

T7-2 M.E. Pinchuk (1), E.A. Tileva (2), O.M. Stepanova (1), I.V. Tseveleva (2), D.G. Grudkin (1), V.N. Snetov (1)
(1) Institute for Electrophysics and Electric Power, RAS, Russia
(2) Library, RAS, Russia

Most historical documents are saved on paper and exposed to biological, organic, and inorganic contamination. The critical unresolved issue lies in safely eliminating such contaminants without damaging the documents. This makes the study of advanced cleaning techniques an urgent research priority. The scientific challenge of developing a novel, efficient, and safe method for removing contaminants from paper-based documents during their recovery or restoration is under consideration. Non-equilibrium atmospheric-pressure plasma jets are a promising solution. An experimental study is planned to assess the feasibility, efficiency, and safety of this approach and to examine its potential for practical application in document restoration.

10:20 **Synchronous purification of diesel engine exhaust gases from nitrogen oxides and soot using nanosecond corona**
T7-3 **discharge plasma systems**

A.Z. Ponizovsky, S.G. Gosteev, O.S. Kuzhel, S.P. Kryuchkov, V.A. Maevsky, A.S. Smirnov, I.G. Agrelov, S.N. Filippov
FMDB "Horizont", Russia

The results of experiments on the use of low-temperature plasma generated by nanosecond corona discharge (NSCR) for cleaning the exhaust gases of stationary and automotive diesel engines from soot and nitrogen oxides (NOx) are presented. The NSCR was generated at a combined constant (up to 20 kV) and pulsed (up to 60 kV) voltage, with pulses of ~50/300 ns, with a peak power of 15 MW, and a frequency ~1000 Hz. Chambers with an active catalyst and sorbent were used together with LTNP. The experiments have shown that it is possible to clean the exhaust up to 95% of NOx and soot at an energy level of ~25 J/L.

10:40 – 11:00 Coffee Break

Hall I **11:00-12:40**

Section 5 - Laser and plasma interactions with materials, laser ablation, modification of materials by plasma and laser treatment, sputtering and deposition

Chairman: I.S. Nikonchuk

11:00 **Optoplastic effect observed in metals as a result of damage to nanosecond ultraviolet laser pulses**
T5-INV

V.E. Rogalin, T.V. Malinskiy, S.I. Mikolutskiy, V.Yu. Khomich, V.A. Yamshchikov
Institute for Electrophysics and Electric Power, RAS, Russia

A series of studies of fast thermocyclic processes in samples of copper alloys is reported. Treatment was performed by UV laser pulses (355 nm, 10 ns, 100 Hz, with energy density Wp ~ 0.1-1.0 J/cm^2, slightly below the optical breakdown threshold). The surface was heated to a temperature close to melting; the processes under study occurred in a condensed state.

A microrising similar to the shape of the laser radiation distribution in the spot was formed on the surface. Profilometry showed residual traces of high-temperature deformation that is unobserved previously effect of uneven irreversible lifting of the surface in the irradiation zone. Slipping and cracking along grain boundaries were observed. The effect is called optoplastic. With an increase in energy density and the number of impact pulses, surface damage accumulates.

It has been established that:

- the main mechanism of relief development is dislocation relaxation of stresses associated with the anisotropy of thermal expansion of differently oriented grains;
- thermomechanical stresses exceed the yield strength of the material.

11:40 T5-1 **Synthesis of modified layers of tungsten and its alloys under the action of high-energy compression plasma flow generated by the gas-discharge magnetoplasma compressor**

V.M. Astashynski (1), N.N. Cherenda (2), G.M. Dzagnidze (1), R.S. Kudaktsin (1), A.M. Kuzmitski (1), D.A. Mikhailov (1), P.N. Shoronov (1), V.I. Shymanski (2), V.V. Uglov (2)
(1) A.V. Luikov Heat and Mass Transfer Institute, NAS Belarus, Belarus
(2) Belarusian State University, Belarus

The results of studies on modification of the surface properties of the tungsten sample with pre-applied thin work-hardening coatings (~ 1.5 μm) under the action of compression plasma flow are presented. Due to the high energy density of the compression plasma flow action, the surface layer melts to a depth up to 15 μm, depending on the impact conditions. After exposure, the ultrafast crystallization of the melt and its work-hardening is realized and, as a result, the surface operational properties of the tungsten modified layer are increased.

12:00 T5-2 **Effect of pulse bichromatic irradiation of oxigen-free copper surface**

S.I. Mikolutskiy (1), A.N. Chumakov (2), V.V. Lychkovsky (2), Yu.V. Khomich (1), V.E. Rogalin (1), V.Yu. Zheleznov (1)
(1) Institute for Electrophysics and Electric Power, RAS, Russia
(2) B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

The effect of laser-induced plasma generated by double bichromatic pulses with wavelengths of 355 nm and 532 nm on the surface of oxygen-free copper was investigated. The influence of the time delay between the pulses and their sequence on the characteristics of the resulting plasma and the morphology of the irradiated surface was studied. Experiments conducted at an energy density of approximately 200 J/cm² per pulse revealed that the greatest crater depth occurred when the pulse sequence was 532 nm followed by 355 nm.

12:20 T5-3 **Deposition and characterization of titanium nitride thin films as coatings for pacemaker electrode prototypes**

Yu.I. Rukina (1), O.I. Obrezkov (1), Yu.V. Martynenko (1), S.L. Shevchuk (1), M.Yu. Nagel (1, 2), S.N. Kochetov (1, 2)
(1) National Research Centre "Kurchatov Institute", Russia
(2) Moscow Institute of Physics and Technology, Russia

The influence of platinum on the functional properties of titanium nitride thin films, which are promising for use as coatings for pacemaker electrodes, was determined. Thin-film layers were deposited by reactive magnetron sputtering and modified by pulsed arc evaporation of platinum on substrates treated in various ways. A comparative analysis of these coatings was carried out based on impedance spectroscopy, electron microscopy, and resource testing of electrode prototypes.

12:40-14:00 Lunch

Hall I **14:40-16:40**

Section 2 - Electrical discharges and other plasma sources, novel plasma generation approaches

Chairman: Yu.A. Lebedev

14:00 T2-INV **Role of surface ionization waves in the formation of plasma structures in a coaxial barrier discharge in argon flow**

Yu.S. Akishev, M.A. Medvedev, A.V. Petryakov
State Research Center of Russian Federation Troitsk Institute for Innovative and Fusion Research, Russia

Results on time-spatial behavior of plasma structures formed in a barrier discharge will be presented. It was revealed the existence of diffuse and constricted plasma structures. The constricted plasma structures have a "memory", that is, they save their spatial pattern for a time much shorter compared to the gas residence time in the tube. The plasma structures were formed jointly by the diffuse and constricted surface ionization waves arising and disappearing each half-cycle of the periodical applied voltage.

14:40 T2-1 **Magneto-induced confinement of the spherical plasma formation developing during interaction of the two opposite direction high-energy compression plasma flows**

V.M. Astashynski, G.M. Dzagnidze, A.M. Kuzmitski, D.A. Mikhailov, P.N. Shoronov
A.V. Luikov Heat and Mass Transfer Institute, NAS Belarus, Belarus

The new approach to formation of the high-energy spherical plasma area developing during interaction of the two opposite direction compression plasma flows generated by the MPC have been proposed. It was shown that the deceleration of two opposite-directed current-carrying supersonic compression flows results to induce by self-consistent manner self-magnetic field without gaps which confinement the high-energy spherical plasma formation. In this case the transition of kinetic energy of colliding plasma flows into internal energy of spherical plasma takes place.

15:00 T2-2 **Patterns of emission plasma generation produced by non-self-sustained glow discharge in hollow cathodes of different volumes at low pressure**

A.O. Egorov, V.V. Yakovlev, V.V. Denisov, S.S. Kovalsky, E.V. Ostroverchov
Institute of High Current Electronics, SB RAS, Russia

A non-self-sustained glow discharge in a cylindrical hollow cathode was produced by using auxiliary electron injection from an external source in a pulse-periodic mode. Two different plasma systems with hollow cathode volumes of 0.34 and 0.007 m3 were investigated depending on pressures from 0.025 to 3 Pa with argon working gas. Glow discharge currents of 800 A at 350 V were obtained in a large volume system, and 250 A at 100 V in a small volume. The duration of current pulses reached 1 ms.

15:20 **Compact cold atmospheric plasma sources based on piezoelectric transformers: development and applications**

T2-3 N.N. Bogachev (1,2), E.M. Konchekov (1,3), L.V. Kolik (1), A.S. Bakshaev (2), D.V. Malakhov (1), V. P. Stepin (1), T.I. Pavlik (1,4), N.G. Gusein-zade (1,4), S.V. Gudkov (1)
(1) Prokhorov General Physics Institute, RAS, Russia
(2) MIREA – Russian Technological University, Russia
(3) RUDN University, Russia
(4) Pirogov Russian National Research Medical University, Russia

One of the promising approaches in the development of new plasma sources is the use of piezoelectric transducers as a key component of such devices. The paper presents a compact piezoelectric frequency-tunable plasma source that allows obtaining corona, spark, plasma jets and dielectric barrier discharges. For the developed source, electrical characteristics of discharges of various types were measured. The development of this technology opens up new opportunities for the development of portable and scalable plasma devices with high efficiency and a wide range of practical applications.

15:40 **Methods for increasing the stability of electron beam generation in a plasma cathode source based on a low-pressure arc**

T2-4 D.A. Gorkovskaia, M.S. Vorobyov, M.A. Mokeev, V.N. Devyatkov, A.A. Grishkov, S.Yu. Doroshkevich
Institute of High Current Electronics, Russian Academy of Sciences, Russia

In an electron source with a grid plasma emitter based on an arc discharge, studies have been conducted aimed at increasing the electrical strength of the accelerating gap by introducing feedback that compensates for the uncontrolled growth of the electron beam current. The organization of feedback is a necessary tool for self-consistent stabilization of the beam current and can be used for fine-tuning the irradiation modes of the surface of various materials and products.

16:00 **Competing types of electron emission in a low-pressure arc-based grid plasma emitter**

T2-5 R. A. Kartavtsov, M. A. Mokeev, M. S. Vorobyov, A. A. Grishkov, N. N. Koval, S. Y. Doroshkevich, P. V. Moskvin, D. A. Gorkovskaya, V. N. Devyatkov
Institute of High Current Electronics, SB RAS, Russia

An experimental study of emission processes was carried out in an electron source with a gridded plasma emitter (GPE) based on a low-pressure arc discharge and a plasma anode with an open boundary, over a wide range of operating parameters. It was found that when accelerated ions from the anode region enter the plasma emitter region, a competition arises between two mechanisms of electron emission from the surface of the GPE cathode electrodes. Experimental data show that an increase in the current through the acceleration gap leads to a redistribution of currents within the GPE.

16:20 **Extracted ion beam drift analysis in a Bernas-type source**

N.V. Mamedov (1,2), A.A. Avdienko (1), A.A. Starostenko (3),
T2-6 A.V. Sorokin (3)
(1) Research Institute for Precision Machine Manufacturing, Russia
(2) National Research Nuclear University MEPhI, Russia
(3) Budker Institute of Nuclear Physics, SB RAS, Russia

Bernas-type crossed-field ion sources are essential for ion implantation systems requiring stable, high-intensity beams. A major challenge, however, lies in mitigating the adverse effects of stray magnetic fields extending beyond the discharge chamber, which induce transverse beam drift and lead to significant ion losses at the extraction electrodes. This study utilized COMSOL Multiphysics simulations to analyze the motion of Ar^+ ions within the ion-optical system. Ion loss dynamics at the electrodes were investigated as functions of system geometry and source misalignment. The derived data will guide hexapod calibration prior to operational deployment.

18:30-22:30 Conference dinner

Hall II **14:40-16:40**

Section 4 - Non-ideal and dusty plasmas, extreme plasma regimes, fusion and astrophysical plasmas

Chairman: L.V. Simonchik

14:40 **Dynamics of an active coulomb engine in gas-discharge plasma**

T4-1 M.M. Vasiliev, R.A. Syrovatka, E.A. Kononov, R.V. Senoshenko, O.F. Petrov
Joint Institute for High Temperatures, Russian Academy of Sciences, Russia

In the present work, we experimentally studied the behavior of single active Brownian engines, small clusters and extended structures formed by them. It is shown that, as a result of absorption of laser radiation of different intensity, interacting active Brownian engines, small clusters and extended structures formed by them can store energy and use it for their own motion. Brownian engines show the formation of complex dynamics (from random, Brownian, to directed, in particular, vortex motion) and complication of structures.

15:00 **Ab initio pseudopotentials and Yukawa-like-screening in moderate density plasma, initial results**

T4-2 N. M. Sakan (1), Z. Simić (2), V. A. Srećković (1), M. Dechev (3), B. Stankov (1)
(1) University of Belgrade, Institute of Physics, Serbia
(2) Astronomical Observatory, Serbia
(3) Institute of Astronomy and National Astronomical Observatory, Bulgarian Academy of Sciences, Bulgaria

We present a computational approach for modeling collective phenomena in moderately dense plasmas using ab initio pseudopotentials with Yukawa-like screening. Our code calculates the influence of plasma environment on emitter pseudopotentials, enabling quantum-mechanical predictions of optical properties. Initial results demonstrate how ion-electron correlations and screening effects modify electronic states, providing a foundation for first-principles optical diagnostics in dense plasmas.

15:20 **Dusty plasma in a glow discharge in helium in strong magnetic fields**

T4-3 L.G. Dyachkov (1), E.S. Dzlieva (2), L.A. Novikov (2), S.I. Pavlov (2), V.Yu. Karasev (2)
(1) Joint Institute for High Temperatures, RAS, Russia
(2) Saint-Petersburg State University, Russia

Rotation dynamics of the plasma-dust structure in a glow discharge in helium in a magnetic field of up to B = 1.5 T is considered. The rotation velocity of the dust structure in the discharge inside the insert narrowing the current channel was measured as a function of B. Two significantly separated regions on the magnetic field scale were discovered, where the rotation velocity reaches 35 rad/s. A simple model of the dust structure rotation in a magnetic field under these conditions is proposed.

15:40 **Dynamics of an active Brownian particle with a centre-of-mass shift in a harmonic trap**

T4-4 E.A. Sametov, E.A. Lisin
Joint Institute for High Temperatures, Russian Academy of Sciences, Russia

A mathematical model has been developed to describe the dynamics of spherical active Brownian particles with inhomogeneous mass distribution due to the presence of a light-absorbing coating on one of the particle halves. The numerical modelling of the two-dimensional dynamics of such an active Brownian particle in a confinement force field is conducted. It is found that the displacement of the centre of mass significantly influences the motion of the active Brownian particle.

16:00 **On the dynamics and charge of a dust particle in a strong magnetic field**

T4-5 V.Yu. Karasev, E.S. Dzlieva, L.A. Novikov, M. A. Gasilov, S. I. Pavlov
Saint-Petersburg State University, Russia

The experimental dependence of the dust structure rotation in a DC discharge in the magnetic field of 2 T is presented. According to the probe theory, under experimental conditions one should expect a decrease in the charge of the dust particle and a change in the rotation speed. The analysis of the rotation dynamics shows an inverse trend, interpreted as the absence of a change in the dust particle charge. The obtained data are confirmed by independent experiments in a RF discharge in the field of 6 T.

16:20 **Multicomponent plasma composition under warm dense matter conditions: a generalized chemical model approach**

T4-6 A.E. Davletov (1), L.T. Yerimbetova (1), Ye.S. Mukhametkarimov (1), Yu.V. Arkhipov (1), I.M. Tkachenko (2)
(1) Al-Farabi Kazakh National University, Kazakhstan
(2) Universitat Politècnica de València, Spain

Over the past few decades, plasma physics has devoted significant attention to exploring warm dense matter (WDM), which exists at moderately high temperatures and densities. This ongoing interest is partly driven by the need to model the inner structures of astrophysical bodies, such as the cores of giant planets and stars, as well as the WDM generated in laboratory settings using high-power lasers or energetic ion beams that compress and heat matter to extreme conditions.

Understanding WDM is crucial for both theoretical insights and technological advancements, though it remains challenging to describe accurately. In this work we put forward a generalized chemical model, offering a practical approach to obtaining reliable physical predictions with reasonable computational effort. This model is applied to plasmas containing both charged and neutral components, capturing their intense interactions. and provides a unified method for examining effects like pressure ionization and molecular dissociation by mapping out their conditions across the density-temperature domain. Particular focus is placed on deriving analytical expressions for the lowering of ionization potentials and dissociation energies, which are defined through microscopic interaction potentials and tested over a broad range of plasma conditions.

18:30-22:30 Conference dinner

Wednesday – September 17, 2025

Hall I 9:00-10:40

Section 5 - Laser and plasma interactions with materials, laser ablation, modification of materials by plasma and laser treatment, sputtering and deposition

Chairman: I.S. Nikonchuk

9:00 T5-INV **Ultrathin transition metal-wrapped noble metal nanoparticles via laser ablation synthesis in solution**

R.Soni
Physics Department, Indian Institute of Technology Delhi, India

In this talk, we review the laser ablation synthesis in solution (LASIS) method for the controlled fabrication of ultrathin metal-wrapped noble metal nanoparticles. Robust physical-chemical stability and tunable plasmonic characteristics of the wrapped transition metal (TM)-gold core-shell nanoparticles make them very attractive colloidal particle systems for ultralow concentration chemical sensing applications. We will discuss the formation mechanism of wrapped TM-Gold NPs, through colloidal electrostatic attraction and self-assembly of the TM hydroxide colloids and ablated gold core, and plasmonic properties. A series of ultra-thin shells of TM-Au structure can favorably modulate the local electric field and plasmon resonance wavelength. We also present results on their utilization as SERS platforms for highly sensitive and reproducible performance for the detection of a variety of bio and chemical molecules.

9:40 T5-4 **Low-pressure glow discharge in a gas flow for biomaterials modification and coating deposition**

D.A. Zuza (1), V.O. Nekhoroshev (1), A.G. Korzhova (2), A. A. Bryuzgina (2)
(1) Institute of High Current Electronics, SB RAS, Russia
(2) Tomsk State University, Russia

The work investigates the potential of low-pressure glow discharge in a gas flow for materials processing. The key advantage of treatment using discharge in a gas flow is the significant reduction of thermal and plasma-induced damage to processed surfaces. This enables modification of materials that cannot withstand high-temperature or plasma exposure. There are the results of polysiloxane-based films deposition for protection of printed circuit boards. Also, the work focuses on the treatment of biopolymers with low melting temperatures — polylactic acid and polycaprolactone.

10:00 T5-5 **Preparation and characterization of laser nano-hydroxyapatite cladded on Ti-6Al-4V substrates for biomedical applications**

Man.Ganjali (1), Mo.Ganjali (2), A. Rasouli Azad (3)
(1) NoureZoha Materials Engineering Research Group, Iran
(2) Bioengineering Research Group, Nanotechnology and Advanced Materials Department, Materials and Energy Research Center, Iran
(3) Department of material Science and Engineering, Science and Research Branch, Islamic Azad University of Sirjan, Iran

This study fabricates nano-hydroxyapatite (HA) coatings on Ti-6Al-4V via laser cladding method, analysing the impact of process parameters on microstructure and properties. SEM/EDS and microhardness tests confirmed optimal Ca/P ratios and mechanical performance. Apatite formation after SBF immersion suggests strong bioactivity, supporting potential use in dental and orthopedic implants.

10:20 T5-6 **Enhancement of Ti-6Al-4V surface properties through graphene-reinforced hydroxyapatite coatings: hardness and wear resistance evaluation**

A.Sohrabi (1), Mo. Ganjali (1), F. Torknik (1), Man. Ganjali (2)
(1) Materials and Energy Reasearch Center, Iran
(2) Nour zoha materials engineering research group, Iran

The Ti-6Al-4V alloy, while widely used in medical implants, suffers from poor wear resistance. This study enhanced its properties through laser cladding with a hydroxyapatite/graphene nanocomposite coating. The results of the hardness test show that due to the presence of graphene, the hardness of the samples has increased by 9, 15 and 27 percent, respectively, for the samples with 1, 3 and 5 percent graphene compared to the sample without graphene. Also, the abrasion properties of the coating have improved by 6, 29 and 36 percent for the samples with 1, 3 and 5 percent graphene due to the presence of graphene.

10:40 – 11:00 Coffee Break

Hall I **11:00-12:40**

Section 7 - Plasma applications and advanced plasma technologies

Chairman: Yu.A. Lebedev

11:00 T7-INV **Plasma-chemical synthesis of micro- and nanosized materials in chain reactions initiated by microwave pulses of a powerful gyrotron in powders**

N.N. Skvortsova (1,5), N.S. Akhmadullina (1,2), V.D. Borzosekov (1), N.G. Gusein-zade (1), E.M. Кончеков1, D.V. Malakhov (1), E.A. Obraztsovaa (3), V.D. Stepakhin (1), N.K. Kharchev (1), O.N. Shishilov (1,4)
(1) Prokhorov General Physics Institute, RAS, Russia
(2) A.A. Baikov Institute of Metallurgy and Material Science, RAS, Russia
(3) Moscow Institute of Physics and Technology, Russia
(4) MIREA – Russian Technological University, Institute of Fine Chemical Technologies, Russia

The report presents the synthesis of micro- and nano-sized ceramic materials with specified composition, structure, morphology in the plasma-gas-microwave media. The synthesis was made in chain plasma-chemical reactions initiated by gyrotron radiation in powders. The report presents the creation of regolith coatings on metal plates and solar batteries for testing space technology materials, synthesis heterogeneous catalysts micro-particles with deposited nanoparticles (Pt, Pd, etc.) and luminescent materials with alloying additives of rare earth metals (Eu, Ce, etc.)

11:40 **Synthesis of metal oxide nanoparticles in liquid-phase plasma discharges under the effect of intensive ultrasound**

T7-4 N.A. Bulychev
Moscow Aviation Institute (National Research University), Russia

The work is aimed toward the study of plasma-chemical processes in liquid-phase media affected by the combination of thermally nonequilibrium low-temperature plasma and intensive ultrasonic vibrations in the regime of cavitation. The proposed method of plasma-chemical reactions is of significant interest and advantages for the creation of new nano-sized materials with special properties, because it allows for targeted variation of the electrophysical and acoustic characteristics of the process when carrying out plasma-chemical reactions.

12:00 **Plasma-chemical process of restoring the properties of metal powders after their use in additive manufacturing**

T7-5 A.A. Fadeev, A.V. Samokhin, N.V. Alekseev, M.A. Sinaisky, D.E. Kirpichev , A.A. Dorofeev, I.V. Kulbakin
Institute of Metallurgy and Materials Science of the Russian Academy of Sciences, Russia

Experimental studies of the process of regeneration of metal powders in thermal plasma of an electric arc discharge in order to restore their quality after repeated use in additive technologies were performed on the plasma spheroidization plant of powder materials of the IMET RAS. The objects of the study were powders of alloys of various size fractions in the range from 10 to 150 μm based on metals of the Fe, Ni, Co, W, Mo, Re group. The influence of design and technological parameters of the plasma regeneration process of precursor powders on the degree of restoration of their particle morphology and the content of gas impurities (oxygen, nitrogen) was experimentally determined. In the process of plasma regeneration, complete restoration of the particle morphology of the processed powders is achieved, their fluidity is improved, and the values of bulk density are increased.

12:20 **Plasma-chemical microwave method for one-stage synthesis of heterogeneous catalysts**

T7-6 N.K. Kharchev (1), N.N. Skvortsova (1), N.S. Akhmadullina (1,2), V.D. Borzosekov (1), N.G. Gusein-zade (1), E.M. Konchekov (1), D.V. Malakhov (1), E.A. Obraztsova (3), V.D. Stepakhin (1), O.N. Shishilov (1,4)
(1) Prokhorov General Physics Institute, RAS, Russia
(2) A.A. Baikov Institute of Metallurgy and Material Science, RAS, Russia
(3) Moscow Institute of Physics and Technology, Russia
(4) MIREA – Russian Technological University, Institute of Fine Chemical Technologies, Russia

Modern chemical industry and environmental technologies require the development of efficient and cost-effective catalysts. One promising direction is the creation of heterogeneous catalysts composed of microparticles coated with nanoscale metal particles. The Plasma Physics Department of GPI RAS has developed an innovative one-step synthesis method for such materials, opening new possibilities for catalytic processes. Heterogeneous catalysts based on dielectric materials with metallic nanoparticles (Pt, Pd, Ag) exhibit high activity, selectivity, and stability.

12:40-14:00 Lunch

Hall I **14:00-16:40**

Section 5 - Laser and plasma interactions with materials, laser ablation, modification of materials by plasma and laser treatment, sputtering and deposition

Chairman: V.E. Rogalin

14:00 **Role of charges in wettability of plasma-treated polytetrafluoroethylene**

T5-7 M. Yu. Yablokov, A. A. Kuznetsov
Enikolopov Institute of Synthetic Polymeric Materials, Russia

It is known that the treatment of polytetrafluoroethylene (PTFE) by low-temperature plasma leads to a decrease in the wetting angle, which is usually explained by an increase of the concentration of oxygen-containing polar groups. When stored in air, an increase of the wetting angle is observed. We experimentally showed that treatment of PTFE films by direct current glow discharge leads to accumulation of electric charges in the surface layer. During storage, the electret potential of PTFE decreases. This suggests that electrical charges significantly affect the wetting of polymer surface through the charge-dipole interaction mechanism.

14:20 **Measurement of optical nonlinearity coefficients of integrated silicon nitride microresonators**

T5-8 D.V. Morozov (1,2), A.K. Vorobyev (1,2), V.I. Pavlov (1), I.I. Stapanov (1), D.A. Chermoshentsev (1,2), I.A. Bilenko (1,3)
(1) Russian Quantum Center, Skolkovo Innovation Center, Russia
(2)Moscow institute of physics and technology, Russia
(3) Faculty of Physics, Lomonosov Moscow State University, Russia

We experimentally measure Kerr and thermal nonlinearity coefficients for optical integrated silicon nitride (Si_3N_4) microresonators. It is revealed that thermal nonlinearity coefficient may be several times higher than Kerr nonlinearity coefficient.

14:40 **Effect of Plasma and Ion-Beam Treatment on Glass Surface Morphology**

T5-9 K.T. Logunov, D.A. Kotov, A.V. Aksiuchyts
Belarusian State University of Informatics and Radioelectronics, Belarus

The influence of ion-beam cleaning, inductively coupled high-density plasma cleaning at reduced pressure, and dielectric barrier discharge plasma cleaning at atmospheric pressure on the surface morphology of glass substrates is investigated. The obtained results are important for optimization of the processes of substrate pretreatment before the application of functional coatings, as they determine the adhesion properties and quality of the formed layers.

15:00 T5-10 **Surface morphology, optical and electrophysical properties of films $La_{0.82}Sr_{0.18}Co_{0.9}Ni_{0.1}O_{3-d}$**

N.A. Bosak (1), M.V. Bushinsky (2), L.V. Baran (3), V.V. Malyutina-Bronskaya (4), O.S. Mantytskaya (2), A.S. Kuzmitskaya (4), N.V. Podvitsky (1)
(1) B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus
(2)SSPA "Scientific and Practical Center of the National Academy of Sciences of Belarus for Materials Science", Belarus
(3) Belarusian State University, Belarus
(4) SSPA "Optics, Optoelectronics and Laser Technology", Belarus

Currently, cobaltite-based materials are gaining popularity in the field of materials science due to their exceptional optical, magnetic and electrical properties. Thin films of $La_{0.82}Sr_{0.18}Co_{0.9}Ni_{0.1}O_{3-d}$ on a silicon substrate were deposited by high-frequency laser sputtering of ceramic targets in vacuum (p = 1.7 Pa). Deposition of macroscopically homogeneous films was achieved at a laser power density of q = 21.4 MW/cm^2 at a wavelength of λ = 1.06 μm, a laser pulse duration at half-maximum τ ~ 85 ns and a laser pulse repetition rate of f ~ 10-12 kHz. The morphology of the obtained thin films was studied using atomic force microscopy, the features of the transmission spectra in the near and middle IR region and the reflection spectra in the visible and near IR region were revealed, and the current-voltage (CVC) and capacitance-voltage (CV) characteristics were investigated.

15:20 T5-11 **Non-linear calibration for low-alloy steels characterisation by multivariative analysis of laser induced breakdown spectroscopy data from Er-glass compact laser based setup**

M.V. Belkov, K.Yu. Catsalap, M.A. Khodasevich
B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

In this paper we present the results for multivariative analysis comprising non-linear calibration algorithms for LIBS characterization of low alloy steel. We tested the model on laser spectral analyzer and spectral dataset from 65 standards of low alloy steel. To excite the plasma the compact diode–pumped Er-doped glass laser was used. The erosion plasma emission for low alloy steel standards were recorded by a compact FireFly 4000 spectrometer.
Our results show the non-linear calibration algorithms successfully counters the non-linearity and expands the concentration range.

15:40 T5-12 **Impact of laser radiation and transition metals doping on the photo-activated conductivity of copper oxide-based nanostructures**

S.T. Pashayan (1), V.G. Kornev (2), N.V. Tarasenko (2), S.V. Zlotski (3), S.V. Husakova (3), V.M. Anishchik (3)
(1)Institute for physical research, NAS of Armenia, Armenia
(2) B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus
(3) Belarusian State University, Belarus

The interest in transition metal oxide nanomaterials such as copper and zinc oxides is mainly associated with the possibilities of their practical application, in particular, for the creation of various types of detectors, photo- and optoelectronic devices. In this work, properties of CuO, Cu2O and ZnO nanoparticles (NPs) and thin films prepared by laser ablation in liquid and pulsed laser deposition (PLD) are studied and discussed. The main attention is focused on the influence of laser irradiation conditions and transition metal doping on the properties of the produced NPs and thin films which can be obtained more stable and with improved photo-activated conductivity.

16:00 **Surface modification of Cr-VN coatings on silicon by low intensity nanosecond mono- and bichromatic laser**
T5-13 **irradiation**

V. Lychkovsky, A. Chumakov, I. Nikonchuk, V. Aniskevich
B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

Changes of morphology due to action of series from 1 to 30 laser pulses of low intensity (~ tens MW/cm^2) and wavelengths 355 and 532 nm on Cr-VN coatings on silicon substrate was carried out. Cracking of coating surface that with increasing number of pulses transformed into grain like microstructure was revealed, as well as forming of "raise" in ring area surrounding irradiated spot. Action of bichromatic laser pulses lead to irradiated spots morphology changes on investigated coating, as well as visual look and change in atomic composition of surrounding aureole surface, depending on interpulse time interval and order in which bichromatic pulses follow. Significant change of aureoles coloring was observed for different regimes of laser bichromatic irradiation with change in atomic composition of O, N and C of approximately several weight %.

16:20 **Laser modification of Cr-VN coating on steel in liquid**

V. Lychkovsky, A. Chumakov, I. Nikonchuk, V. Aniskevich
T5-14 *B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus*

Laser action of paired nanosecond laser pulses (λ = 355 and 532 nm) on Cr-VN coating on steel substrate in 20% alcohol solution was investigated in comparison with laser action in air. Established change in visual look of modified area and their atomic composition after switching from air to liquid medium. Spots irradiated by series of 10 pulses showed absence of oxygen atoms and up to 1.5 times more carbon (in weight %), while aureole demonstrate significant presence of oxygen after same laser irradiation.

16:40-17:00 Coffee Break

Hall I **17:00-18:40**

Section 2 - Electrical discharges and other plasma sources, novel plasma generation approaches

Chairman: Yu. S. Akishev

17:00 **Modulation of the beam current in an electron source with a multi-arc two-grid plasma emitter**

T2-7 M.A. Mokeev, V.N. Devyatkov, D.A. Gorkovskaia, M.S. Vorobyov, N.N. Koval, P.V. Moskvin
Joint Institute for High Temperatures, RAS, Russia

The paper presents the design and principle of operation of an electron source with a multi-arc grid plasma emitter, as well as its power supply system, which allows modulating the arc discharge current during a submillisecond pulse. By introducing an additional grid overlapping the end of the hollow anode, grid control of the emission current has been implemented, for which a power supply system has been developed that allows for the modulation of the beam current, expanding the range of its power to more than two orders of magnitude.

17:20 **Experiments on ionization waves collisions in long discharge tubes**

T2-8 A.I. Shishpanov, V.V. Zaletov
Saint Petersburg State University

The interaction of two ionization waves (IW) excited synchronously from opposite internal and external electrodes of a long tube was experimentally investigated. Unipolar and bipolar ionization waves collided. Plasma potential dynamics were measured by a movable capacitive probe. We observed that a positive-polarity IW passed through an electrodeless-initiated negative-polarity wave, which resulted in the formation of a sharpened front with increased velocity, generating a discharge current peak.

17:40 **Surface streamer development in barrier discharge in transverse magnetic field**

T2-9 Yu. S. Akishev, A. V. Petryakov
State Research Center of Russian Federation Troitsk Institute for Innovative and Fusion Research, Russia

The work is dedicated to investigation of the development of surface streamers in dielectric barrier discharge in transverse magnetic field.

18:00 **Turbulent decay of the thermal cavern of the HF corona discharge**

T2-10 I.A. Moralev, I.V. Selivonin
Joint Institute for High Temperatures, RAS, Russia

The paper studies the evolution of a single-electrode high-frequency corona discharge operating in a pulsed mode in air at a pressure of 1-4~atm. The main attention is given to the dynamics of a heated cavity formed during discharge operation. Analysis of the shadow images shows that the cavern suffers from the sinuous instability with the wavelength of 2-3 cavern diameters, developing on the timescale of tens of microseconds. The following sub harmonic generation forms the turbulent region with macroscopic eddies, determining the shape of the discharge. Deformation of the discharge channel leads to the branching of the main filament, similar to the "apocamp" formation in the pulsed-periodic nanosecond discharges. The quantitative characterization of the instability is performed, and the possible mechanism driving the flow are discussed.

18:20 **Theoretical and experimental study of neutron sources and plasma generators**

T2-11 A.G. Polyanskiy, S.V. Ryzhkov
Bauman Moscow State Technical University, Russia

The description of the current state, methods and methods for obtaining fluxes of neutral and charged particles, as well as physical processes occurring in neutron tubes and large-sized neutron sources during their operation is carried out. The results of experimental and theoretical studies of deuteron acceleration in small-sized sources, in plasma ion diodes with magnetic isolation, generators based on plasma focus and laser exposure, and high-efficiency neutron accelerator tubes are presented. Estimates of the prospects for the creation of large-sized neutron generators are given.

Hall II **14:40-16:40**

Section 1 - Modeling of plasma processes, plasma dynamics, optical and thermodynamic properties of plasmas

Chairman: F.M. Trukhachev

14:00 **The calculations of equation of state and electronic transport coefficients of low-temperature tin plasma**

T1-1 E. M. Apfelbaum
Joint Institute for High Temperatures, RAS, Russia

A model is developed to calculate the thermodynamics (pressure, internal energy etc.) and electronic transport coefficients for the low-temperature tin (Sn) plasma within the temperature range 10 -100 kK. Our model is based on the chemical approach and the relaxation time approximation. The data for the properties under study in the considered range for Sn plasma have been absent up to now, so the results of calculations were approximated by polynomials for further use in applications.

14:20 **Equilibrium composition of transient graphite plasma**

T1-2 M. Ristić (1), M. Marković (1), A. Šajić (1), D. Ranković (2), M. Kuzmanović (1)
(1) University of Belgrade, Faculty of Physical Chemistry, Serbia
(2). University of Belgrade, Vinča Institute of Nuclear Sciences, Serbia

The goal of this work was to discuss the influence of pressure change and air mixing of ablated material on the equilibrium composition of plasma obtained on a graphite target with impurities. Special care is devoted to the influence of pressure and mixing on the equilibrium relationship between temperature T and electron number density Ne, which is important for plasma diagnostics. The obtained results show that the concept of local thermodynamic equilibrium (LTE) can be used for plasma diagnostics and optimization of spectrochemical analysis parameters.

14:40 **Numerical modeling of streamer discharge using adaptive mesh and mass correction**

T1-3 O.I. Korzhova, S. Kirillov, V.V. Voevodin, V.A. Yamschikov, Ya.E. Zharkov
Institute for Electrophysics and Electric Power, RAS, Russia

A numerical model of streamer discharge with adaptive remeshing is proposed, ensuring strictly conservative transfer of charged particle mass at the level of individual finite elements. The correction problem is formulated as local Karush–Kuhn–Tucker optimality conditions with an active set strategy. Computational efficiency is improved through sequential application of the active set and multilevel k-way graph partitioning of the nodal connectivity graph.

15:00 T1-4 **Ion flux spatial distribution in an end-Hall source**

V.U.Shakialeuski, D.A.Kotov
Belarusian State University of Informatics and Radioelectronics, Belarus

Despite the widespread use of end-Hall source in the surface processing industry, there is a limited number of studies on their modeling, which are mostly empirical in nature. Therefore, this paper considers the application of numerical methods based on Monte Carlo for charged particles in estimating the spatial distribution of the ion flux leaving the discharge region of the end-Hall source. A brief description of the methodology used is provided, along with verification against experimental data.

15:20 T1-5 **Model-based approach to characterize plasma composition and etching/polymerization kinetics in various flyorocarbon gases mixed with argon and/or oxygen**

A.M. Efremov (1), K.H. Kwon (2)
(1) Molecular Electronics Research Institute, Russia
(2) Korea University, Korea

The work summarizes results of our previous studies related to reactive-ion etching of silicon and silicon-based materials in multi-component fluorocarbon gas mixtures. Models for both plasma chemistry and etching kinetics were developed, verified and applied to analyze effects of various gas mixing regimes on steady-state plasma parameters and fluxes of active species responsible for etching/polymerization balance. Interpretations of etching mechanisms in terms of effective reaction probability were provided.

15:40 T1-6 **4D Vysikaylo's equation for describing the transport of non-uniform profiles of ambipolar quasi-neutral plasma with current**

P.I. Vysikaylo
Moscow Institute of Physics and Technology, Russia

We draw attention to the solution and visualization of this solution of the non-stationary nonlinear 3D equation of the Navier-Stokes type. A more complete classification of 3D processes of ambipolar transport in plasma with current and a classification of non-uniform 3D profiles of plasma parameters are given. We verify the theoretical models by experiments on the study of non-uniform plasma, locally perturbed by a beam of fast electrons. This leads to self-formation of: 1) shock waves of the electric field (layer of positive volume charge), stopped for photography by pumping gas, and 2) transition 3D profiles and plasma 3D Vysikaylo's nozzles already in quasi-neutral inhomogeneous plasma.

16:00 T1-7 **Fissile plasma gas dynamics**

S.K. Kunakov (1), A. Shapieyva (2)
(1) Suleyman Demirel University, Kazakhstan
(2) International Information Technology University, Kazakhstan

A fissile gas is a radioactive gaseous medium where atoms undergo nuclear fission. Classical hydrodynamics fails to capture its internal coupling of fission and gas dynamics. This study derives hydrodynamic equations from self-consistent Boltzmann equations for fission fragments, electrons, and neutrals. The model shows how high-energy fission products reshape both chemical kinetics and the overall gas-dynamic structure.

16:20 **Numerical modeling of counter-streaming magnetized plasma flows in arch configuration**

T1-8 A. V. Korzhimanov, S.A. Koryagin, A.D. Sladkov, M. E. Viktorov
A. V. Gaponov-Grekhov Institute of Applied Physics, RAS, Russia

The work is devoted to kinetic modeling of the interaction process of two counter-streaming magnetized plasma flows in an arched configuration under experimental conditions conducted at the Institute of Applied Physics RAS [arXiv:2412.06065]. The flows are generated by an arc discharge and thrown into a magnetic field created by a system of two coils located at an angle of 90 degrees to each other. The experimental conditions are such that the magnetic Mach number is close to unity and can be decreased or increased by changing the magnetic field strength. Numerical modeling has shown that a change in the interaction dynamics is observed during the transition from the sub-Alfvenic regime to the super-Alfvenic one, accompanied by intensification of the plasma ejection process from the arc top, plasma turbulization, increased magnetic reconnection rate, generation of fast particles and intense radiation.

16:40-17:00 Coffee Break

Thursday – September 18, 2025

Hall I 09:00-10:40

Section 3 - Atmospheric pressure plasmas, plasma in and in contact with liquid, plasma-liquid interactions

Chairman: M.S. Usachonak

9:00 T3-INV **Microwave discharges in liquids: physics and application**

Yu.A. Lebedev (1), T.S. Batukaev (1), G.V. Krashevskaya (1, 2), I.L. Epstein (1), A.V. Tatarinov (1)

(1) Topchiev Institute of Petrochemical Synthesis, RAS, Russia

(2) National Research Nuclear University MEPhI, Russia

Microwave discharges in dielectric liquids are relatively new area of plasma physics and plasma application. This review accumulates recent results on microwave discharges in wide classes of liquids (alkanes, cyclic and aromatic hydrocarbons, alcohols, water). Methods of microwave plasma generation are described. Physical characteristics of discharge are analysed and differences with conventional gas discharges are discussed. Examples of using microwave discharges in liquids to obtain hydrogen, decompose carbon dioxide, and obtain nanomaterials are considered.

9:40 T7-INV **Support of the experiment in the Laboratory of plasma aerodynamics using numerical modeling: gas dynamics, combustion, electrical discharges**

A.A. Firsov

Joint Institute for High Temperatures, RAS, Russia

The review of several research in the area of plasma aerodynamics, plasma-assisted mixing and combustion in the supersonic flow performed by the Laboratory of plasma aerodynamics of JIHT RAS is presented. The high complexity of the experiments is due to the combination of several phenomena that are difficult to organize and study in themselves, such as high-speed (including supersonic) flow, high-voltage electrical discharges, combustion of air-fuel mixtures. Combining them in one experiment makes the study even more complex and labour-intensive. Therefore, laboratory research is accompanied by numerical modeling using the CFD software FlowVision, which is used both to prepare the experiment, for example, to select the most interesting configurations, and to obtain an expanded volume of three-dimensional non-steady data on the distribution of gas-dynamic, chemical and electrical quantities in the model under study.

10:00 **Long-lived reactive oxigen and nitrogen species in liquids treated with capillary discharge**

T3-1 V.V. Gudkova (1,2), A.V. Davydov (1,2), K.V. Artem'ev (1,2), M.A. Zimina (1,2), V.D. Borzosekov (1,2), I.K. Naumova (3), N.G. Gusein-zade (1), V.A. Titov (4)

(1) Prokhorov General Physics Institute, RAS, Russia

(2) RUDN University, Russia

(3) Ivanovo State University, Russia

(4) G.A. Krestov Institute of Solution Chemistry, RAS, Russia

This study presents measurements of hydrogen peroxide as well as nitrite- and nitrate ions produced in liquids treated with a pulsed microwave capillary discharge in atmospheric pressure Ar/air flow at varying exposure times. This technique can be used for obtaining chitosan based biologically active solutions which are relevant for agricultural applications due to their antibacterial and plant-growth-promoting properties.

10:20 **Plasma-liquid synthesis of MXenes and their photocatalytic properties**

T3-2 N. A. Sirotkin, A.V. Khlyustova

G.A. Krestov Institute of Solution Chemistry, RAS, Russia

This study demontrates the one-step synthesis of MXenes containing titanium, molybdenum, and titanium-molybdenum composites through pulsed discharges in carbon tetrachloride. By employing titanium and molybdenum electrodes in various configurations, three MXenes samples were synthesized: Ti_2CT_x, Mo_2CT_x, and $Mo_2TiC_2T_x$. Characterization techniques, including UV-Vis spectroscopy, X-ray diffraction, Raman spectroscopy, scanning electron microscopy, and energy-dispersive X-ray spectroscopy, confirmed the successful synthesis of high-purity MXenes with distinct structural and optical properties. The photocatalytic perfor-mance of the synthesized MXenes was evaluated, showing a removal efficiency of 65 % to 98 % for dye mixtures, with methylene blue showing the highest degradation rate.

10:40 – 11:00 Coffee Break

11:00-21:00 Excursion

Friday – September 19, 2025

Hall I 9:00-12:40

Section 7 - Plasma applications and advanced plasma technologies

Chairman: N. Sakan

9:00 T1-INV **Soliton transport of charged particles, review**

F.M. Trukhachev (1,2), N.V. Gerasimenko (1), M.M. Vasiliev (1), O.F. Petrov (1)
(1) Joint Institute for High Temperatures, RAS, Russia
(2) Belarusian-Russian University, Belarus

The data on the studies of transport phenomena induced by solitary waves in plasma are summarized. Compressive and rarefactive solitons solitons of the following types are considered: ion-acoustic, electron-acoustic, dust-acoustic, magneto-sound. The influence of external magnetic fields is analyzed. Solitons on shallow water and in crystal lattices are also considered.

9:40 T7-7 **Diffusion flux enhancement in deposition process**

D.A. Butniakov (1), I.A. Sorokin (1,2), D.V. Kolodko(1,2)
(1) National Research Nuclear University MEPhI, Russia
(2) Kotel'nikov Institute of Radio Engineering and Electronics (Fryazino Branch), RAS, Russia.

The steady-state diffusion equation with a finite-element model that reproduces the full geometry of a planar asymmetric hollow cathode discharge (50 mm aperture) together with chamber walls and substrate holder has been solved. Experimental validation using an asymmetric hollow cathode system involved tungsten coating deposition on copper substrates. Film thickness profiles revealed significant increase in deposition rate at substrate edges, consistent across high-pressure conditions.

10:00 T7-8 **Synthesis of complex oxides under the influence of air plasma of pulsed high-voltage discharge on the mechanical mixture of simple oxides and on metal electrodes**

V.G. Kuryavyi, I.A. Tkachenko, A.V. Gerasimenko
Institute of Chemistry, FEB RAS, Russia

By direct action of pulsed high-voltage discharge plasma on the powder mixture of Y_2O_3, BaO_2 and CuO the composite $CuO/Cu_2O/Y_2O_3/Y_2BaCuO/YBa_2Cu_3O_{6.32}$ was obtained, which included complex oxides in its composition. By annealing this composite at 1173 K, $CuO/YBa_2Cu_3O_{6.91}$ was obtained, which included the known high-temperature superconductor $YBa_2Cu_3O_{6.91}$. The presence of superconducting phase in the obtained composite at T < 87 K is confirmed by SQUID magnetometry data. $NiCr_2O_4/NiO/Ni$ composite was obtained by plasma treatment of nichrome wire electrodes. The synthesized sample exhibits the effect of exchange bias of magnetic hysteresis loop indicating alternation of FM and AFM regions in it. The monolithic sample containing a Cu2O core covered with a CuO shell was obtained by plasma treatment of copper wire. The dependence of the sample magnetization on temperature has the form characteristic of cases of high-temperature superconductivity. The plasma-chemical methods used are promising for exploratory work on the synthesis of new functional materials.

10:20 **Control of the instabilities in shear flows using plasma actuators**

T7-9 I.Moralev
Joint Institute for High Temperatures, RAS, Russia

Plasma actuators based on barrier dicsharges are widely considered as a lab-grade devices for the flow control studies. The talk summarizes the author experience in building the control systems with plasma actuators for the problems of aeroacoustics and aerodynamics of unstable flows. Two problems will be considered: manipulation of the instability waves in the M=0.8 turbulent jet, aiming the jet noise reduction, and the control of the laminar-turbulent transition in the subsonic boundary layer on a swept wing. The talk will cover the problems of the actuator noise, forcing amplitude and relative role of heat release in the actuator operation.

10:40 – 11:00 Coffee Break

Chairman: I.I. Filatova

11:00 **Atmospheric pressure air plasma jets: potential application in plasma medicine**

T7-INV A.V. Kazak, L.V.Simonchik
B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

The report will consider modern devices for generating atmospheric pressure plasma jets and their main characteristics. Particular attention will be paid to plasma jets in the air. A definition of the dose for this type of impact on various objects is proposed. The ALOE device will be discussed, which we have already used to inactivate microorganisms and their consortia, heal wounds in animals and treat psoriasis, and which is in the process of certification.

11:40 **Innovative approaches in agricultural and biomedical applications of plasma-activated media**

T7-10 E.M. Konchekov (1, 2), N.G. Gusein-zade (1), S.V. Gudkov (1)
(1) Prokhorov General Physics Institute, RAS, Russia
(2) RUDN University, Russia

This presentation reviews low temperature plasma generation systems developed at the Prokhorov General Physics Institute. These technologies have been employed in both direct plasma treatment of biological specimens and indirect methods utilizing plasma-treated solutions. Key findings from recent interdisciplinary studies addressing agricultural engineering and biomedical challenges are summarized, demonstrating the versatility of plasma-based approaches in optimizing crop performance and advancing therapeutic strategies.

12:00 **PLASMA TECHNOLOGY FOR SEWAGE SLUDGE PROCESSING**

T7-11 V. Sauchyn, U. Skavysh, A. Liavonchyk, I. Khvedchyn, Hr. Dalholenka, N. Kurbanov
A.V. Luikov Heat and Mass Transfer Institute, NAS Belarus, Belarus

Two variants for sewage sludge processing is proposed. The first one is one stage high temperature processing with plasma torch as a source of high energy. The second one is multistage processing: combination of pyrolysis and high temperature gasification. Simulation of both processes was done. As a result multi-stage plasma gasification of dewatered wastewater sludge has significant advantages over the single-stage process.

12:20 **Effects of plasma treatment on the some physicochemical properties of technogenic saline soil**

T7-12 V. A. Lyushkevich (1), I. I. Filatova (1), S. V. Goncharik (1), J.N. Kalatskaja (2), I.A.Ovchinnikov (2), D.A. Kotov (3), A.V. Aksiuchyts (3)

(1) B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

(2) V. F. Kuprevich Institute of Experimental Botany NAS of Belarus, Belarus

(3) Belarusian State University of Informatics and Radioelectronics, Belarus

Changes in the physical and chemical properties of technogenically saline soil as a result of treatment with air and argon plasma jets were studied in order to develop a new method for remediation of the ecological functions of contaminated soils. The aggregate state of the soil changes towards an increase in its dispersity (an increase in the content of small particles). The total moisture capacity and electrical conductivity of the soil decrease by 11–12%, while the cation exchange capacity remains at the control level. Soil pH slightly decreased to a value close to neutral.

12:40-14:00 Lunch

Hall I **14:00-17:00**

Section 7 - Plasma applications and advanced plasma technologies

Chairman: A. Nevar

14:00 **On the influence of electron velocity spread on the operation of Compton FELs driven by laser plasma accelerators**

T7-13 S.V. Anishchenko

Institute for Nuclear Problems, Belarusian State University, Belarus

For the field amplitude, a nonlinear integro-differential equation is derived that describes the operation of a free-electron laser in the presence of electron angular and energy spread typical for modern facilities driven by laser plasma accelerators. Numerical solutions of the equation are in good agreement with particle simulations for the bunching factor less than 0.6, reproduce the frequency detuning spectrum near its maximum, and describe the amplification process up to saturation.

14:20 **Ammonia conversion in the plasmachemical reactor with a DC glow discharge at atmospheric pressure**

T7-14 A.V. Kazak, A.A. Kirillov, L.V. Simonchik, M.U. Tomkavich

B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

The ammonia reforming into a hydrogen in the plasmachemical reactor with a dc glow discharge depending on both gas flow rate and applied electrical power was investigated. The gas temperature along the discharge gap was determined. IR spectra of decomposition products were registered and the degree of conversion was determined. The conversion degree of NH3 was reached about 99%. It is increased with an increase in the residence time of the ammonia in the reactor plasma core and with an increase in the applied electrical power.

14:40 **Optimization of plasma furnace design for radioactive waste processing**

T7-15 V. Sauchyn (1), A. Liavonchyk (1), I. Khvedchyn (1), U. Skavysh(1), Hr. Dalholenka (1), M. Polkanov (2), I. Kadyrov (2)
(1) A.V. Luikov Heat and Mass Transfer Institute, NAS Belarus, Belarus
(2) RADON FSUE, State Atomic Energy Corporation Rosatom, the Russian Federation

For processing radioactive waste plasma technology has been developed. It allows processing of solid radioactive waste of complex morphological composition, containing both flammable and non-flammable components. The product of plasma processing of radioactive waste is molten slag, which has high chemical resistance. On the basis of experimental and calculation research options for changing the organization of the internal space of the melter of the "Pluton" installation are proposed.

15:00 **Anomalous absorption of O-mode microwave pump in plasma filament**

T7-16 M.S. Usachonak (1), L.V. Simonchik (1), E.Z. Gusakov (2), A.Yu. Popov (2)
(1) Institute of Physics of NAS of Belarus, Minsk, Belarus
(2) Ioffe Physical-Technical Institute, RAS, Russia

The O-mode microwave pump anomalous absorption in plasma filament is under investigation.

15:20 **Formation of submicron titanium carbide particles by electrical discharge treatment of titanium TC4 micropowders**

T7-17 A. Shumeijko (1), A. Nevar (1), V. Aniskevich (1), N. Tarasenko (1), M. Nedelko (1), Y. Song (2)
(1) B.I. Stepanov Institute of Physics of the NAS of Belarus, Belarus
(2) International Center of Future Science, Jilin University, China

Submicron titanium carbide particles are a promising material for additive technologies with a wide range of applications due to their unique properties, such as high hardness, wear and high heat resistance. In this study, we offer/consider the possibility of obtaining submicron titanium carbide particles by high-voltage electric discharge treatment of TC4 micropowders dispersed in ethanol. The results of the studies of the morphology, composition and structure of the synthesized material are presented.

15:40 **Tantalum diboride surface after treatment with compression plasma flows**

T7-18 V.V. Uglov (1), I.V. Kondrus (1), M.O. Kovalenko (1), A.Ya. Pak (2), A.A. Svinukhova (2)
(1) Belarusian State University, Belarus
(2) National Research Tomsk Polytechnic University, Russia

In this work, tantalum diboride TaB2 samples obtained by vacuum-free electric arc synthesis were subjected to compression plasma flow (CPF) treatment. The use of X-ray diffractometry (XRD), scanning electron microscopy (SEM), atomic force microscopy (AFM) and Energy-dispersive X-ray spectroscopy (EDX) allowed us to establish the modifying property of plasma treatment. As a result of treatment with compression-plasma flows, the density and homogeneity of the sample surface increased, and the modifying effect of the treatment on the phase composition of the samples was established.

16:00 **Capabilities of liquid assisted laser and plasma methods for synthesis of composite nanostructures**

T7-INV N.V. Tarasenko

B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

In this paper, a possibility of using a number of combined laser-discharge approaches to increase the production efficiency and enabling the control over the composition, structure and morphology of the composite nanomaterials is discussed. The relationship between the NPs structure and experimental parameters revealed allowed proposing plasma and laser assisted schemes suitable for the synthesis of NPs of alloys (Si-Sn, Ag-Cu) and compounds (SiC, ZnO, CuO), doped (ZnO:Co, ZnO:Nd) nanocrystals and hybrid (ZnO/C) structures. In addition, the influence of an external electric field on the morphology of the synthesized nanomaterials has been discussed that allowed development of a new method for the synthesis and assembly of anisotropic ZnO/C nanocomposites by laser ablation in a liquid.

16:20-17:00 Young Scientist Award and Closing

Poster Session

Hall III **17:00-19:00**

Section 1 - Modeling of plasma processes, plasma dynamics, optical and thermodynamic properties of plasmas

T1-P-1 **Simulation the gas dynamics in the flat reactor with rectangular cross-section for thin film deposition by CVD**

V.U.Shakialeuski, N.V. Leonovich, D.A. Kotov
Belarusian State University of Informatics and Radioelectronics, Belarus

This study presents numerical modeling of gas dynamics in a planar reactor designed for thin film formation using the chemical vapor deposition (CVD) method. The objective of the modeling is to analyze the distribution of gas flows and reactant concentrations within the reactor chamber in order to minimize non-uniformity in the deposition of iron oxide films. A 3D geometric model of the reactor was developed, including substrates, a substrate holder, and a gas distribution system operating under sub-atmospheric pressure. The results are important for the development of masking coatings for photomasks.

T1-P-2 **Influence of initial composition of the Cl_2/HBr/Ar mixture on plasma characteristics and etching profile evolution**

F. V. Oksanichenko (1, 2), A. M. Efremov (2)
(1) Moscow Institute of Physics and Technology, Russia
(2) Molecular Electronics Research Institute, Russia

A complex model of the plasma etching process, which describes the physico-chemical properties of plasma and the kinetics of processes on the surface was proposed. Plasma parameters using a global model were determined. The resulting etching profile using cellular automaton model that takes into account spontaneous chemical reaction, product redeposition, physical sputtering and ion-stimulated chemical reaction was calculated. This allowed to determine such etching charasteristics as etching rate and anisotropy. The process of polysilicon etching in HBr/Cl_2/Ar plasma was analyzed and the dependence of the above-described characteristics on the control parameters of plasma etching was investigated.

T1-P-3 **On the influence of control paramenters in plasma chemical etching on the spatial uniformity of plasma in a reactor**

Y.A.Zakharov (1), (2), A.M.Efremov (2)
(1) Moscow Institute of Physics and Technology, Russia
(2) Molecular Electronics Research Institute, Russia

This study presents a two-dimensional model for self-consistent description of electrophysical parameters and composition in inductively coupled Ar/Cl_2 plasma. The model investigates the effects of gas flow rate, pressure, input power, and initial gas mixture on electron temperature, charged particle concentrations, and chlorine atom distributions. Results demonstrate good agreement with experimental data, highlighting key trends: increased pressure and gas flow reduce plasma uniformity, while higher power raises electron temperature and concentration. The model's validity is confirmed by comparison with independent studies, supporting its use for reactor optimization in plasma etching applications.

T1-P-4 **Electrical conductivity of dense aluminum plasma: analysis via the continuous Kubo-Greenwood formula**

D.V. Knyazev, P.R. Levashov
Joint Institute for High Temperatures, RAS, Russia

Generally, this work is about calculation of transport and optical properties via quantum molecular dynamics (QMD) and the Kubo-Greenwood formula. We advance this approach and introduce the continuous Kubo-Greenwood (CKG) formula. It includes smooth functions and, thereby, provides better understanding of how final results are formed. We implement CKG formula in the ConGrUbo code. As example, we analyze electrical conductivity of dense aluminum plasma at normal density and temperature 3000 K.

T1-P-5 **Application of open foam package for modeling high-frequency discharge with liquid jet electrodes**

F.K. Khairullin, A.F. Gaisin, V.S. Zheltukhin
A.N. Tupolev's Kazan National Research Technical University, Russia

A simplified mathematical model of high-frequency discharge with liquid electrodes, one of which is a jet, has been developed. The model is implemented in the Open Foam package. The breakdown condition in the jet-drop discharge form has been obtained.

T1-P-6 **Taking into account the vibrational excitation effects of nitrogen and oxygen particles to simulate ozone production in dielectric barrier discharge plasma-chemical reactor**

I.A. Ruchkin (1,2), M.E. Pinchuk (1), V.N. Snetov (1), A.A. Dyachenko (1), O.M. Stepanova (1)
(1) Institute for Electrophysics and Electric Power, RAS, Russia
(2) Ioffe Physical-Technical Institute, RAS, Russia

The ozone production in a plasma-chemical reactor based on a coaxial dielctric-barrier discharge has been simulated using the ZDPlaskin software module [S. Pancheshnyi, et. al., Computer code ZDPlasKin, http://www.zdplaskin.laplace.univ-tlse.fr]. The relevancy in accounting the vibrational excitation of nitrogen and oxygen molecules when modeling the kinetics of plasma-chemical reactions is discussed. The two sets of reactions are considered: with and without taking into account the vibrationally excited molecules $N_2(v)$ and $O_2(v)$. Experimentally, data on the gas temperature were obtained from the profile of the N_2 0-0 spectral band (337.13 nm). In the case of excluding $N_2(v)$ and $O_2(v)$ states, the calculated ozone concentrations exceed the experimental values by approximately two times.

The study has been supported by a grant from the Russian Science Foundation № 24-29-00816, https://rscf.ru/en/project/24-29-00816/.

Section 2 - Electrical discharges and other plasma sources, novel plasma generation approaches

T2-P-1 **Impedance Matching in Dual-Frequency Capacitive Discharge Systems for Microelectronics Equipment**

P.A. Gvozdov, A.A. Yasunas
Freegy LLC, Belarus

The paper presents the principle of constructing dual-frequency capacitive discharge power supply systems used in plasma etching and deposition technologies in microelectronics. The matching circuits for such systems and the main requirements for these circuits are described.

T2-P-2 **Current-voltage characteristics of an incandescent and hollow cathode arc discharge**

I. I. Azhazha, V. V. Shugurov, Yu. Kh. Akhmadeev
Institute of high current electronics SB RAS

In this paper, the characteristics of an incandescent and hollow cathode arc discharge (PINK) are investigated in a system with a "hot" anode, the current-voltage characteristics of the discharge are plotted, and the probe characteristics of the plasma are measured. The research was carried out on the surface electron-ion-plasma engineering installation "COMPLEX", developed in the laboratory of plasma-emission electronics of the IHCE SB RAS, included in the register of unique scientific installations of Russia "UNIKUUM".
The system with a "hot" anode is a PINK plasma generator, the anode of which is a crucible with boron-containing powder (B). All the current-voltage characteristics were recorded both for the PINK discharge itself in its usual design, when the discharge anode is a chamber, and for the case when the discharge anode is a powder crucible (a system with a "hot" anode).

T2-P-3 **Faraday probe system for measuring the density and energy spectrum of compensated ion and ion-plasma beams used in thin-film deposition technology.**

R.I. Dubin, D.V. Ksenzov, A.A. Yasunas
Freegy LLC, Belarus

The paper presents a probe-based methodology for measuring ion currents in the range from nanoamperes to milliamperes, as well as for constructing the energy spectrum of compensated ion and ion-plasma beams used in thin-film deposition technology. The work provides a detailed description of the constituent modules of the probe measurement system and analyzes its operational principles. Key circuit design challenges arising during current measurements in this range are discussed, and a solution involving the use of a transimpedance amplifier is proposed.

T2-P-4 **The ALOE – device for plasma medicine**

A.V.Kazak, L.V.Simonchik
B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

The paper presents a device for generating an air plasma jet ALOE, which is designed for biomedical applications. The characteristics of ALOE and its uses are described. A definition of the dose for this type of impact on various objects is proposed, which is formed from the quantity (i.e. concentration) of biologically active molecules per unit time of impact on the treated object. The device can be used for effective sterilization and disinfection of surfaces, including heat-sensitive ones, such as living tissues, and also serve as the prototype in the development of various physiotherapeutic devices.

T2-P-5 **A method for determining the erosion of a metal cathode during the combustion of a high-current vacuum discharge based on the interaction of two co-directional plasma jets**

A.M. Kuzminykh (1), A.G. Rousskikh (1), A.S. Zhigalin (1), V.I. Oreshkin (1), V.A. Gasilov (2)
(1) Institute of High Current Electronics, SB RAS, Russia
(2) Federal Research Center Keldysh Institute of Applied Mathematics, RAS, Russia

This paper presents a new method for determining the ion erosion coefficient of a metal cathode in a vacuum high-current arc. During the experiments, two co-directional current-carrying plasma jets were formed. Describing the trajectory of the interaction of such jets, their linear mass, concentration, and ion erosion coefficient were estimated. The experiment was carried out on an IMRI-5 pulse power generator (250 kA, 600 ns in load). A 4-frame HSFC-Pro camera was used as optical diagnostics.

T2-P-6 **On the charge extracted from a microhollow cathode plasma reactor**

K.I. Romanov, E.A. Shershunova, S.V. Nebogatkin
Institute for Electrophysics and Electric Power, RAS, Russia

In this study, there was conducted an experimental estimation of the charge extracted from a plasma reactor with a micro-hole cathode at different supply voltage. The results of the influence of the distance to the target and the rate of argon pumping through the reactor on the amount of extracted charge were obtained. Differences in the amount of charge transferred depending on the form of the supply voltage and the gas pumping rate were experimentally established. The optical radiation spectra of the plasma of a gas discharge with a micro-hollow cathode were taken.

T2-P-7 **Self-oscillatory secondary emission discharge and its applications**

I.A. Sorokin (1,2)
(1) National Research Nuclear University MEPhI, Russia
(2) Kotel'nikov Institute of Radio Engineering and Electronics (Fryazino Branch), RAS, Russia

The work describes the mechanisms underlying high-frequency secondary emission instability arising from the interaction of highly nonequilibrium plasma with a high-emission surface. The physical foundations of the self-oscillatory secondary emission discharge (SOSED) are presented. The applicability of two SOSED regimes for implementing a plasma source for electric propulsion thrusters and a generator of periodic high-voltage relaxation pulses (e.g., neutron generation) is considered.

T2-P-8 **Development and optimization of a stationary high-frequency plasma heating system**

Q.V. Tran, V.P. Budaev, S.D. Fedorovich, D.I. Kavyrshin, M.V. Lukashevsky, A.V. Karpov
National Research University "Moscow Power Engineering Institute", Russia

A high-frequency helicon discharge is considered one of the most efficient solutions for the development of electrodeless plasma thrusters. At the National Research University "MPEI", based on the PLM-M facility, a high-frequency helicon discharge generation system has been developed for testing components of a stationary plasma flow accelerator. This study presents the initial results of the investigation of this discharge.

T2-P-9 **Comparison of the achieved values of pressure on the wall of the gas discharge chamber obtained by numerical method and experiment**

J.V. Triaskin (1), A.V. Budin (1), M.E. Pinchuk (1), N.V. Triaskin (1,2), A.A. Bogomaz (1)
(1) Institute for Electrophysics and Electric Power, RAS, Russia
(2) State Marine Technical University, Russia

The results of the shock wave force on the wall of a gas-discharge cylindrical chamber filled with hydrogen at high pressure (up to 32 MPa) are presented. The source of perturbation (shock wave) is an interelectrode breakdown by a megaampere-class current on the chamber axis. The comparison of the achieved pressure on the chamber wall between the numerical calculation and the experimental result is made.

T2-P-10 **Ionization waves forming a capacitive discharge at low and moderate gas pressures**

A.I. Shishpanov, V.V. Zaletov
Saint Petersburg State University, Russia

The parameters of ionization waves during pulse-periodic breakdown in gases: He, Ne, Ar, Kr, Xe at pressure p = 1 Torr and in Ne at p from 0.5 up to 50 Torr have been experimentally investigated. Ionization waves were excited at a quasi-constant voltage using a single-electrode and electrodeless method. The potential attenuation, the dynamics of the field strength behind the front, and the concentration of electrons generated by the wave have been studied.

T2-P-11 **Characteristics of the pulsed plasma accelerator depending on energy input**

V. E. Zavalova, A. V. Kozlov, Yu. V. Karpushin, V. P. Polishchuk
Joint Institute for High Temperatures, RAS, Russia

The characteristics of hydrogen plasma in an accelerator with multi-channel injector were studied. Plasma was created in an arc discharge with a current of up to 0.5 MA and a duration of ~0.1 ms; the initial hydrogen density was ~3·1016 cm-3. The source of discharge energy was a capacitive storage of electrical energy up to 60 kJ.

T2-P-12 **Plasma source of UV radiation with excitation by combined discharge**

K. F. Znosko
Yanka Kupala State University of Grodno, Belarus

A plasma source of UV radiation with excitation by pulsed combined discharge of the working medium based on inert gas halides has been developed. Its feature is the combined use of a capacitive discharge and a pulsed longitudinal discharge to create plasma. It is shown that the discharge is characterized by high visual radial homogeneity and high intensity of ultraviolet radiation. Experimental dependences of the source output parameters on the conditions of its excitation and the composition of the working medium have been established.

Section 3 - Atmospheric pressure plasmas, plasma in and in contact with liquid, plasma-liquid interactions

T3-P-1 **Effect of the plasma-forming gas on the generation of long-lived reactive oxygen and nitrogen species in liquid in the presence of cupper electrode erosion**

M.A. Zimina (1,2), V.V. Gudkova (1,2), I.V. Moryakov (1), V.D. Borzosekov (1,2)
(1) Prokhorov General Physics Institute, RAS, Russia
(2) RUDN University, Russia

The work considers the effect of a multi-spark high voltage pulse-periodic ring discharge with gas injection into the interelectrode gaps on deionized water. The concentrations of hydrogen peroxide, nitrite and nitrate ions were determined as a function of the plasma gas species and exposure time in the presence of copper electrode erosion. The results of the mass content of copper II ions in liquids were obtained and electrode erosion was gravimetrically characterized. The composition of nano- and microparticles of copper was determined by XRD method.

T3-P-2 **Modification of the surface of electrodes in a barrier discharge in air**

I. Selivonin (1), A. Lazukin (2), I. Moralev (1)
(1) Joint Institute for High Temperatures, RAS, Russia
(2) National Research University «Moscow Power Engineering Institute», Russia

An experimental study of the modification of the surface of metal samples made of aluminum, copper, titanium and molybdenum in a barrier discharge in air at atmospheric and reduced pressure was carried out. The dynamics of electrical characteristics, operation mode and structure of the discharge during its long-term operation were studied. The surface morphology was analyzed and an elemental analysis of the surface layers of the electrodes after their modification at various discharge parameters was performed.

T3-P-3 **Size properties of nanoparticles formed in plasma of electric explosion in distilled water**

A.V. Zelianko
Yanka Kupala State University of Grodno, Ozheshko str., 22, 230023, Grodno, Belarus

The size distributions of copper and aluminum nanoparticles deposited on glass slides, formed in plasma of electric explosion of materials in water, were studied using AFM microscopy methods. It was shown that the maxima of the size distributions of nanoparticles shift toward larger sizes with an increase in the number of conductors exploded in the same volume of water. In this case, an increase in both the "arithmetic mean" and "volume average" sizes of nanoparticles is observed.

Section 4 - Non-ideal and dusty plasmas, extreme plasma regimes, fusion and astrophysical plasmas

T4-P-1 **Features of plasma formation during the explosion of flat conductors in megagauss magnetic fields**

I. Datsko (1), V. Van'kevich (1), S. Chaikovsky (2), N. Labetskaya (1), V. Oreshkin (1)
(1) Institute of High Current Electronics, SB RAS, Russia
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Features of plasma formation and its expansion during the nanosecond explosion of flat conductors in strong magnetic fields were studied on a terawatt generator MIG (2.5 MA, 100 ns). Flat conductors with a thickness of 100 μm and a width of 5 mm were used in the experiments. The formation of plasma on the surface of the conductor was recorded by its glow in the optical range using a four-frame camera with an exposure time of 3 ns for each frame. The emission spectra of such plasma with a time resolution in the optical range were obtained.

T4-P-2 **Sagdeev's ion-acoustic soliton with trapped electrons**

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Based on the Vlasov equation for describing the electron component, the nonlinear motion of a collisionless nonisothermal plasma corresponding in Sagdeev's formulation to an ion-acoustic soliton with a Boltzmann electron energy distribution is investigated. It is found that in the kinetic approach, along with the motion of ions and the flow of trapped electrons, there is a current of passing electrons, which is opposite to the current of trapped electrons and comparable to it in magnitude.

T4-P-3 **Features of rotation of plasma-dust structures in different phases of a striation in a uniform and non-uniform magnetic field**

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Saint Petersburg State University, Russia

The work is devoted to the study of the behavior of plasma-dust structures, simultaneously levitating in different phases of the glow discharge striation. The dynamics of the structures in the case of superposition of both a uniform and non-uniform magnetic field on the discharge is studied. The dependence of the angular velocity of rotation for each of the structures on the magnetic field induction is obtained. The spatial characteristics of dust structures such as longitudinal and radial interparticle distances, the position of structures in the strata phases are determined.

T4-P-4 **Electric currents in Vysikaylo's cumulative-dissipative structures of the Universe**

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Magnetic fields are important for navigation. It is believed that magnetic storms on the Sun affect people's well-being. The influx of a huge number of protons (during magnetic storms) on negatively charged leukocytes is ignored by representatives of this paradigm. Scientists have not yet been able to determine the cause of solar and cosmic winds. The author divides and explores the second paradigm. In this paradigm, electric fields acting on charged particles cause their flows, and currents, according to Maxwell's equations, form magnetic fields. In this paradigm, it is believed that Coulomb's law is valid for any objects with an electric charge, from electrons to galaxies (with characteristic sizes from 10^{-15} to 10^{26} m).

Section 5 - Laser and plasma interactions with materials, laser ablation, modification of materials by plasma and laser treatment, sputtering and deposition

T5-P-1 **Structure and high-temperature oxidation resistance of austenitic stainless steel surface layer alloyed by compression plasma flows impact**

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The structure, phase composition, mechanical and corrosion properties of austenitic stainless steel (18% Cr, 10% Ni) surface layer alloyed with Ti and Al atoms during annealing in air at 600°C were investigated in this work. Alloying was carried out by deposition of Ti-Al coating on the steel surface and the following treatment with compression plasma flows. The findings showed that alloying led to the formation of surface layer with the thickness of ~ 10 micrometers containing solid solution on the basis of ferrite. Interaction with atoms of plasma forming gas resulted in TiN film growth at the surface of the alloyed layer. It was found that alloying and following annealing allow increasing microhardness of the surface layer. Structure changes during alloying and following annealing were analyzed. Surface of the alloyed layer demonstrated acceptable level of corrosion resistance to high-temperature oxidation.

T5-P-2 **Laser ablation in liquid for preparation of multielement nanoparticles: stoichiometry preservation.**

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Nanosized particles of metals and their alloys were synthesized using the method of laser ablation of a metal target in liquid. The composition of the formed particles was determined using transmission electron spectroscopy, absorption spectroscopy and XRD analysis. The factors determining the composition of the generated nanoparticles were analyzed.

T5-P-3 **Optimizing the operation mode of capacitively coupled RF plasma cleaning of mirror in B-field for ITER optical diagnostics**

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In-situ cleaning of the collecting mirror-electrode, contaminated by material of the first wall erosion and/or oxidized after an accidental steam ingress, is performed by bombardment with ions from plasma of a local RF discharge in a B-field of >3T. Increasing the driving frequency improves cleaning selectivity but decreases RF power deposition efficiency. The findings of an experiment to determine the frequency for the highest cleaning rate while minimizing damage are presented.

T5-P-4 **Plasma linear multicusp magnetic trap for material testing and plasma physics applications**

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The Plasma Linear Multicusp (PLM) installation is a linear magnetic trap utilizing a multicusp magnetic field configuration. It serves as a testing platform for heat-shielding lining of the in-vessel components of thermonuclear reactors, simulating conditions of the near-wall and divertor plasma of a tokamak. A distinguishing feature of this installation is its long-term steady state operation. When supplemented with additional induction heating, we consider the device as a plasma accelerator.

T5-P-5 **Synthesis of Si1-xSnx nanoparticles by laser ablation of tin covered silicon in a liquid**

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In this work, we have adopted a laser ablation method for the formation of Si1-xSnx nanoparticles (NPs) by scanning a laser beam in the ablation mode over the surface of a Si substrate coated with a Sn thin film submerged under ethanol. It has been demonstrated that the formation of composite silicon-tin NPs is observed in the solution above the processed substrate in the multiple scanning mode with complete removal of the tin film from the substrate. A correlation between the properties of the NPs and the laser irradiation conditions has been found.

T5-P-6 **Composite material based on natural high molecular weight compound filled with acrylic emulsions modified by low energy ion flow**

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Acrylic polymers are used to increase the operational performance indicators of capillary-porous material, which includes leather tissue of fur. Acrylic emulsions were modified by low energy ions flow generated in the plasma of radio-frequency coupled capacitive and coupled inductive discharges at reduced pressure to ensure uniformity of diffusion and distribution in the bulk of material. Additional structure formation of capillary-porous material filled with modified emulsions is confirmed by a increase in physical and mechanical and heat resistance indicators.

T5-P-7 **The effect of the low-energy ion flux of a low-pressure RF plasma of argon with an admixture of nitrogen and oxygen on the characteristic of residual stresses of metals and alloys**

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Studies of changes in the physical and mechanical characteristics like residual stress of samples from materials have been carried out BT-1, BT-3, BT-6, BT-8, BT-9, 20X13, 40X13, 12X18H9T, 08X18, steel 45, steel 30.

T5-P-8 **The influence of plasma assistance in the application of titanium dioxide by the vacuum arc method**

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The experiments were conducted on a vacuum ion-plasma installation "QUINTA". For plasma assistance, a gas plasma generator based on a non-self-sustaining arc discharge of low pressure with a hot and hollow cathode "PINK-P" was used. The parameters of gas-metal plasma were studied during separate and combined operation of the arc evaporator and plasma generator. Distributions of the ion current density obtained in different operating modes of plasma generators were constructed.

T5-P-9 **Finish cleaning of the substrate surface due to secondary emission in a laser erosion plasma ion source for the formation of nanostructures**

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It has been experimentally determined that during the deposition of nanostructures using ion flows, obtained from laser erosion plasma, there is a regime of secondary emission of ions of the substrate material due to the bombardment of the laser target material by ions. This effect can be used for the final cleaning of the substrate surface before deposition the laser target material.

T5-P-10 **Fabrication of of lead zirconate titanate films by combined laser ablation/ laser modification technique**

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A novel approach based on laser ablation in liquid in combination with additional laser modification has been developed for PZT films fabrication. First metal plates of Pb, Zr and Ti were subjected to laser ablation in ethanol, then the obtained colloidal solutions were mixed and irradiated with the forth harmonic of the Nd:YAG laser. The colloidal solution obtained after laser treatment was deposited on a copper plate to form a film on its surface. The results of studies of the morphology, structure as well as composition of the formed nanocomposites have been discussed.

T5-P-11 **Vortex motion in a system of active Brownian particles under laser irradiation**

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The results of the study of the dynamics of the active Brownian particle system in liquid media under the laser radiation are presented. The particles were monodispersed spherical plastic microparticles partially coated with copper. Upon exposure to laser radiation of constant intensity, collective vortex motion and its evolution were observed in the system. The absorption of laser radiation by the Janus particles resulted in the observed their active Brownian motion. The laser radiation caused heating of the metal coating of particles, resulting in the thermophoresis effect.

T5-P-12 **Development of vapor-plasma formation under laser action on a sample located in a liquid**

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The process of formation of a vapor-gas formation at the surface of the irradiated metal was experimentally studied. The features of the change in the shape and size of the vapor-gas "bubble" at different stages of the process were studied. It was found that when using the radiation of the GOR-100M laser operating in the free generation mode, the shape of the surface of the crater formed on the sample placed in water is fundamentally different from the topography of the crater formed as a result of the action of a laser pulse with the same parameters on a similar sample surrounded by air at normal pressure.

T5-P-13 **Laser polishing of natural leather**

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(4)Tashkent Institute of Textile and Light Industry, Uzbekistan

For the first time, laser polishing of genuine lambskin was studied during laser action on its surface from the front and back sides using a laser generating in a two-pulse mode. It was found that laser action from the front and back sides leads to polishing of the skin. It was shown that laser polishing of the skin from the front and back sides begins at different input energies and has a threshold character (from the front side 30 J, from the back side 40 J), which is possibly due to the looser structure of the skin from the back side and its lower absorption of radiation.

T5-P-14 **Digital upgrade of analog optical devices in laser surface processing applications**

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The measurement process for laser pulse–material interaction parameters has been improved, including refined measurements of the laser spot size. As part of an import substitution initiative, analog energy meter data (using the ILD-2M as an example) have been digitized, enabling real-time data processing. A practical implementation is demonstrated through measurements of the reflectance of Ge and Si as a function of laser pulse energy density at a wavelength of 355 nm.

T5-P-15 **Synthesis of nanoparticles by laser ablation of copper target in a surfactant solution following photoinduced coalescence**

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Laser-induced morphology changes of copper-based nanoparticles prepared via pulsed laser ablation in liquid approach have been investigated. Copper-based nanoparticles were produced by laser ablation at 1064 nm of a metal copper plate in an aqueous solution of sodium dodecyl sulfate (SDS). Synthesized material was subjected to laser-induced modification. The as-prepared specimens consisted of spherical particles of 8–10 nm in diameter. Irradiation of nanoparticles in SDS solution by a pulsed Nd:YAG laser at 532 nm was found to cause the coalescence of nanoparticles.

Section 6 - Plasma spectroscopy and other diagnostic methods, plasma chemistry

T6-P-1 **Dynamics of spectral line intensity along the axis of the erosion plasma torch on an aluminum target**

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The distribution of the intensity of aluminum spectral lines along the axis of the erosion plasma torch formed under the action of intense laser radiation on an aluminum alloy target was studied. It was shown that the intensity of ion lines reaches a maximum value at a distance of 0.5–1.0 mm from the target surface, and the intensity of atomic lines reaches a maximum value at a distance of 0.5–2.5 mm from the target surface.

T6-P-2 **Experimental parameters of Stark broadening of Lu and Y**

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Lomonosov Moscow State University Department of Chemistry, Russia

Experimental parameters of Stark broadening for Lu I-II, Y I-II were estimated in laser-induced plasma under Ar low-pressure conditions. Self-absorption and the impact of other possible broadening mechanisms were estimated also.

T6-P-3 **Using the TM110 mode of a cylindrical cavity to diagnostic the plasma density in a gas discharge tube**

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The study proposes the use of the TM110 mode of a cylindrical cavity, in contrast to the commonly used TM010 and TE011 modes. For plasma generated by a surface wave discharge in a gas-discharge tube, an experimental comparison was conducted using the cylindrical cavity's TM110 and TM010 modes, as well as the waveguide method. It was experimentally demonstrated that the TM110 mode enables measurements at higher plasma densities for the same cavity model. The features of the field distribution in the cavity for the TM110 mode are described.

T6-P-4 **Experimental determination of the Stark broadening parameters of the Na I and K I lines in laser plasma**

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The Stark broadening parameters are an important characteristic of plasma radiation and are widely used for plasma diagnostics, even without LTE. At present, a large theoretical base of Stark line parameters has been collected, but sometimes has low trust factor and the lack of experimental data is still a problem. The work is devoted to the experimental determination of the widths and shifts of lines caused by the quadratic Stark effect for the spectral series 3p-nd/ns Na I and 4p-nd/ns K I.

T6-P-5 **Plasma velocity in MPK-A40 for different energies**

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Research has been initiated on a variation of the magnetoplasma compressor (MPC) device. The modified version, MPC-A40, is more compact than conventional MPC, but retains the same capability to generate a compressed plasma flow. The MPC-A40 is placed in a dielectric cylindrical chamber, which allows side-on plasma diagnostics. Plasma flow velocity was measured using four capacitive probes positioned in the axial direction, at equal distances. Measurements were conducted over a wide range of energies.

T6-P-6 **Plasma diagnostics during skin explosion of conductors in megagauss magnetic fields**

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Plasma studies during nanosecond explosion of conductors on a terawatt MIG generator (2.0 MA, 100 ns) were conducted using a diagnostics complex in the optical and X-ray ranges. To obtain images of conductors at different moments in time, a four-frame optical camera HSFC-Pro with a minimum frame exposure of 3 ns was used. Integral and time resolved spectra measurements of plasma radiation in the ranges of 200-1100 nm were carried out. The distribution of plasma density along the radius of the conductors was studied using a radiograph by probing with X-ray radiation generated at the hot stop of the X-pinch.

T6-P-7 **Application of holographic laser scanning to determine the electron concentration in the plasma forming the apokamp**

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Streamer discharges that do not transit to a spark channel are now widely investigated. One of the varieties of such discharges is the apokamp discharge, in which streamers start from a diffuse spark channel having a curved shape at high repetition rate of voltage pulses. In this work, to estimate the electron concentration in the plasma forming the apokamp, a digital holographic laser scanning method is applied for the first time. The method is based on the comparison of the phases of two optical wavefronts, registered at different time moments in the form of digital holograms. The result of the phase comparison between the wavefronts is presented in the form of a numerically calculated map of the phase difference of the reconstructed wavefronts. Gas-discharge plasma is a phase (transparent) object, and the interference fringes are formed as a result of the change in the refractive index introduced by the plasma with respect to the original unperturbed medium. The obtained value of the refractive index allowed estimating the concentration of electrons in the spark channel plasma. It is shown that at the growth of the voltage pulse repetition rate from 5 to 50 kHz the concentration of electrons in the plasma forming the apokamp decreases by estimate 4 times.

Section 7 - Plasma applications and advanced plasma technologies

T7-P-1 **Optically pumped rare gas (OPRGL)**

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We present the results of experiments on the study of a laser on a mixture of inert gases with optical pumping (LONIG). Dependence of generation power on repetition frequency of discharge pulses and on gas mixture flow rate for medium 2% Ar + 98% He is presented. The results of second harmonic generation experiments are presented.

T7-P-2 **Simultaneous generation at three wavelengths in optically pumped He-Ar-Kr medium**

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The paper presents laser generation of optically pumped rare gas laser (OPRGL) simultaneously at wavelengths 912.3 nm and 893.1 nm using a gas mixture consisting of 98% He (buffer gas), 1.5% Ar and 0,5% Kr. Dependence of generation power and ratio of intensities of separate lines in overall generation on flow rate of gas mixture, pressure in cavity and repetition rate of discharge pulses is experimentally investigated. In the experiments carried out, the ratio of laser generation intensities on argon and krypton atoms was practically equal at the repetition rate of discharge pulses - from 80 to 100 kHz, mixture flow rate - from 8 to 9 l/min, mixture pressure - from $1.2 \cdot 10^5$ to $1.4 \cdot 10^5$ Pa. The maximum achieved laser power level (total at all wavelengths) was about 8 mW.

T7-P-3 **X-ray radiography of substance structure of aluminum tube during explosion on the GIT-12 facility**

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The results of experiments on X-ray radiography (spectral range 1.3÷5 keV) of the process of electric explosion of an aluminum tube with an external diameter of 10 mm (internal diameter was 8 mm) on the GIT-12 facility (5 MA, 2 μs) are presented. The pulse radiograph was another compact pulse power generator (240 kA, 240 ns) with an X-pinch load. The method of determination of the plasma substance density is presented. Dependences of substance density on the tube radius is obtained.

T7-P-4 **Accounting for the Marangoni effect during electromagnetic mixing in an electric arc liquid metal melt**

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Mixing processes of liquid metal components to obtain homogeneous alloys is considered. A mathematical model of the processes of electromagnetic mixing of the alloys produced in an electric arc furnace, taking into account the Marangoni effect, has been developed. A numerical method is proposed to solve the problem. A special experiment is planned to test the proposed model.

T7-P-5 **Experimental study of combined cooling system using EHD streams**

A.S. Kirillov, V.Yu. Khomich, O.I. Korzhova, S.I. Moshkunov, V.V. Voevodin, Ya.E. Zharkov
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An experimental study of the combined cooling of two aluminum plates heated to 100 °C in a rectangular channel was carried out. Cathode wires were positioned equidistantly between the plates. Thermocouple temperature measurements at different corona discharges and a fan power supplies showed the plate surface temperature decreasing by tens of degrees under both combined cooling and when cooled only by electric wind with a significant dependence on the interelectrode distance. The research results are applicable to the standard «heat sink-fan» cooling systems modernization.

T7-P-6 **Comparison of partial least squares (PLS) and the original multiparametric calibration for the analysis of steels with high compositional variability using laser-induced breakdown spectroscopy (LIBS)**

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This study compares partial least squares (PLS) with a novel multiparametric calibration (MPC) for quantifying elements in highly variable steels via laser-induced breakdown spectroscopy (LIBS). Quantitative LIBS analysis, particularly for highly alloyed steels, is challenging due to complex non-linearities and matrix effects. Both methods, validated on LIBS 2022 contest data, account for inter-element influences and spectral shifts. Results show MPC significantly improves accuracy over PLS calibration, especially for highly alloyed steels, achieving lower RMSE values.

T7-P-7 **Application of plasma and microwave techniques for fabrication of advanced luminescent carbon nanodots**

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Carbon nanodots (CNDs) were synthesized by electrical discharge between two graphite electrodes immersed into distilled water. The obtained CNDs with dimensions of 2-8 nm were modified with organic dye perylene using the microwave method. It was found that an effectively luminescent in the wavelength range of 450-580 nm hybrid organic-inorganic complex is formed. The high absorption capacity of the obtained material in the UV region of a spectrum, photostability, and quantum efficiency indicate the prospects for its use as UV converters, as well as for recording ionizing radiation.

T7-P-8 **The study of the oscillations structure of a flow interacting with a secondary gas transverse jet in the presence of a spark discharge**

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This work is devoted to the study of the influence of periodic spark discharges of different frequencies on the formation of disturbances in the shear layer at the boundary of the secondary transverse jet within a freestream. Two cases of flow structure were considered: the case of a subsonic jet injected into a subsonic flow and the case of a transonic jet injected into a supersonic flow with M = 1.6. The discharges are localized in the separation zone on the windward side of the injector. For both subsonic and supersonic cases the experiments were carried out in the absence and in the presence of a pulsed-periodic local energy release formed by a spark discharge on the windward side of the injector. Also, for supersonic case the computer simulation of the flow was performed by the URANS method using the FlowVision software package. It was shown that spark discharges are capable of initiating the formation of disturbances in the shear layer at the windward side of the jet and influencing their frequency.

T7-P-9 **LIBS analysis of carbon-containing samples based on molecular spectra registration**

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Spatial and temporal resolved spectroscopic studies of the carbon and steel laser ablation plasmas in nitrogen were performed. The contribution of the emission of carbon-nitrogen diatomic molecules to the spatial-temporal characteristics of the whole plasma glow was determined. The spatial-temporal plasma regions suitable for the detection of molecular emission spectra in the LIBS analysis were established.

T7-P-10 **Using of the Plasma Arc Ejector for waste treatment**

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Pyrogenesis Company has developed the Plasma Arc Waste Destruction System aboard ships. The key process has two-stage grinding of waste with further disposal of latter in Plasma-Fired Eductor. This process shows the difficulty of implementing and maintaining of the equipment, and high cost. Inspired by this study, this article presents a concept of the system based on a Plasma-Arc Ejector for liquid or granular solid waste processing; the results of CFD modeling of this system are included.

T7-P-11 **Copper–iron contacts in high current protection devices**

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The prospects of use a copper and iron pseudo-alloy (CuFe) material obtained by layer-by-layer laser sintering in contacts of high-current protective devices are considered. A huge energy flow on the contact surface in the area of the arc attachment causes erosion wear, while interacting with heated gas flows in the switching and lightning protection devices. Electric erosion of the material is compared with the erosion of CuW and CuFe produced by the traditional powder metallurgy methods. The erosion of the electrodes was measured for arcs in the range of current amplitudes up to 150 kA at an air and nitrogen pressure from 20 Pa to 2 MPa with different gas-puff system and contact opening scheme. The dependences of the specific erosion on the magnitude of the current and gas pressure are obtained. The new material has a specific erosion of ~1 mg/C at the level of materials produced using the traditional powder process in studied conditions.

T7-P-12 **Structure of TNTZ titanium alloy with Zn nanoparticles treated with CPF**

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On the surface of the titanium alloy TNTZ a micro-nanostructured layer is formed by the combined effect of friction stirring treatment for the introduction of zinc particles and subsequent treatment with compression plasma flows to effectively reduce surface roughness and increase surface strength. The patterns of change in the elemental and phase composition, the microstructure of the surface of the modified layer from the modes of treatment with compression plasma flows are revealed.

T7-P-13 **Metal-puff Z-pinch based on foil evaporation and ionization**

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The compression dynamics and the large-scale instabilities developed during compression of a metal-puff, experiments were studied. The liner plasma shell was formed by metal foil evaporation in an arc discharge. The arc discharge was formed by discharging a capacitor of 30 μF charged to a voltage of 25 kV. The experiments were carried out on a GIT-12 pulse power generator. The development of large-scale instabilities in this design was not observed.

T7-P-14 **Ozone-hydroxyl mixture generators for water purification and disinfection**

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On the basis of the corona electric discharge, an ozone-hydroxyl mixture generator of the flow-circulation type was created, in which the lifetime of OH• radicals is 0.12 s. Ozone is consumed to maintain the life time of radicals. With the help of the generator the purification of water from tetracycline was studied. A decrease in the concentration of tetracycline to 0.001 mg/L was obtained. The energy costs of reducing the concentracion of bacteria by a factor of 10 are compared.

T7-P-15 **Optimization of the electrolytic plasma polishing process of TC4 alloy using Taguchi method**

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The electrolytic plasma polishing (EPP) process of TC4 alloy using the Taguchi statistical method was investigated. The influence of the operating voltage (U), solution temperature (T), processing time (t) and ammonium fluoride concentration (C) on the combined ΔRa-h criterion (achieving the maximum ΔRa value at minimum h) was established: T–50%, t–22%, U–18%, C–10%. The EPP conditions for TC4 alloy were optimized taking into account the ΔRa-h criterion: T–90°C, t–4 min, U–340 V, C–0.15 mol/l.

T7-P-16 **Modeling of the formation of bactericidal components of air glow discharge plasma jets**

A.V. Kazak, A.A. Kirillov, L.V. Simonchik
B.I. Stepanov Institute of Physics, NAS of Belarus, Belarus

Air plasma jets of atmospheric pressure glow discharge (APGD) are a promising tool for biomedical applications due to the generation of reactive oxygen- and nitrogen-containing compounds (RONS), including NO, OH, HNO_2. The mathematical formulation of the study of the formation of bactericidal components of the plasma jet is based on a system of chemical kinetics equations in the form of ordinary differential equations (ODE). It is shown that NO is formed in the nonequilibrium plasma of the APGD, where N, O, and OH are generated in plasma-chemical reactions involving electrons. Due to the thermal dissociation of NO_2 and HNO_2 molecules in the discharge zone, an increase in their concentrations begins with a decrease in temperature downstream.

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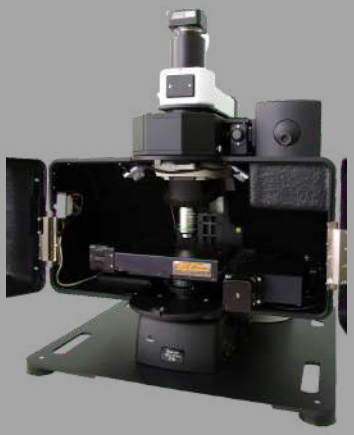

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PPPT-11 SCHEDULE																				
	Mon, September 15th		Tue, September 16th				Wed, September 17th				Thu, September 18th		Fri, September 19th	
	8:00-18:00 Registration													
	Hall I		Hall I		Hall II		Hall I		Hall II		Hall I		Hall I	
9:00-9:20			T1	Rafatov			T5	Soni			T3	Lebedev	T1	Trukhachev
9:20-9:40														
9:40-10:00			T7-1	Vasilieva			T5-4	Zuza			T7	Firsov	T7-7	Butniakov
10:00-10:20	Opening		T7-2	Pinchuk			T5-5	Ganjali			T3-1	Gudkova	T7-8	Kuryavyi
10:20-10:40	T4	Vasiliev	T7-3	Ponizovsky			T5-6	Ganjali			T3-2	Sirotkin	T7-9	Moralev
10:40-11:00			10:40-11:00 Coffee break											
11:00-11:20	T4	Gaponenko	T5	Rogalin			T7	Skvortsova			11:00-21:00 Excursion		T7	Kazak
11:20-11:40														
11:40-12:00	T6-1	Sushkov	T5-1	Kudaktsin			T7-4	Bulychev					T7-10	Konchekov
12:00-12:20	T6-2	Popov	T5-2	Mikolutskiy			T7-5	Fadeev					T7-11	Sauchyn
12:20 -12:40	T6-3	Stepanov	T5-3	Rukina			T7-6	Kharchev					T7-12	Lyushkevich
12:40-14:00	12:40-14:00 Lunch												Lunch	
14:00-14:20	T5	Obradović	T2	Akishev			T5-7	Yablokov	T1-1	Apfelbaum			T7-13	Anishchenko
14:20-14:40							T5-8	Morozov	T1-2	Kuzmanović			T7-14	Tomkavich
14:40-15:00	T6-4	Baryshnikov	T2-1	Astashynski	T4-1	Vasiliev	T5-9	Logunov	T1-3	Zharkov			T7-15	Sauchyn
15:00-15:20	T6-5	Guseva	T2-2	Egorov	T4-2	Sakan	T5-10	Bosak	T1-4	Shakialeuski			T7-16	Usachonak
15:20-15:40	T6-6	Ivanova	T2-3	Bogachev	T4-3	Dyachkov	T5-11	Catsalap	T1-5	Efremov			T7-17	Shumejko
15:40-16:00	T6-7	Matiukhin	T2-4	Gorkovskaia	T4-4	Sametov	T5-12	Pashayan	T1-6	Vysikaylo			T7-18	Uglov
16:00-16:20	T6-8	Kuryan	T2-5	Kartavtsov	T4-5	Karasev	T5-13	Lychkouski	T1-7	Kunakov			T7	Tarasenko
16:20-16:40	T6-9	Logunov	T2-6	Mamedov	T4-6	Davletov	T5-14	Lychkouski	T1-8	Korzhimanov			16:20-17:00 Closing ceremony	
16:40-17:00	16:40-17:00 Coffee break													
17:00-17:20	17:00-19:00 Poster session Hall III						T2-7	Mokeev						
17:20-17:40							T2-8	Shishpanov						
17:40-18:00							T2-9	Petryakov						
18:00-18:20			18:30-22:30 Conference Dinner				T2-10	Moralev						
18:20-18:40							T2-11	Ryzhkov						