

IX International Conference

PLASMA PHYSICS
and
PLASMA TECHNOLOGY

PPPT-9

Minsk, Belarus
September 17 – 21, 2018

Program
and
Book of abstracts

Edited by
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TOPICS

1. Fundamentals and modeling of plasma processes, plasma dynamics, transport, optical, and thermodynamic properties of plasmas

2. Electrical discharges and other plasma sources, elementary and near-electrode processes (*arc, spark, barrier, surface, glow, and high-frequency discharges; microplasma discharges and plasma jets, plasma accelerators; electron and ion beam sources*)

3. Non-equilibrium effects and atmospheric pressure plasma processes, plasma in and in contact with liquid

4. Non-ideal and dusty plasmas, fusion and astrophysical plasmas

5. Laser and plasma interaction with surfaces

(laser ablation, modification of materials by laser and plasma treatment; reactions on a surface, sputtering and deposition)

6. Plasma spectroscopy and other diagnostic methods

7. Plasma applications

(plasma synthesis and processing of nanomaterials, plasma deposition of functional coatings, plasma in medicine and biology, plasma in agriculture, plasmas for environmental applications and resource recovery, plasma light sources; plasma in micro- and nanoelectronics, in spectrochemical analysis, plasma chemistry, plasma metallurgy, etc.)

Important dates

Registration	17-18.09.2018
PPPT-9 conference working days	17-21.09.2018
Conference dinner	18.09.2018
Ballet	19.09.2018
Excursion	20.09.2018

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GENERAL INFORMATION

Information for participants

The Conference program will include following types of presentations:

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

The conference language is English

The Conference halls are located in the building of the B.I. Stepanov Institute of Physics, NAS of Belarus.

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 the poster number. Participants can put their posters up at the beginning of the day of their poster session or just before it.

Short Poster presentations

All the poster presenters will have an opportunity to introduce their posters during the short poster presentation session (2 min, max 2 slides in PowerPoint format). The slides should summarize the poster and should not be a repeat of a poster.

Special issue

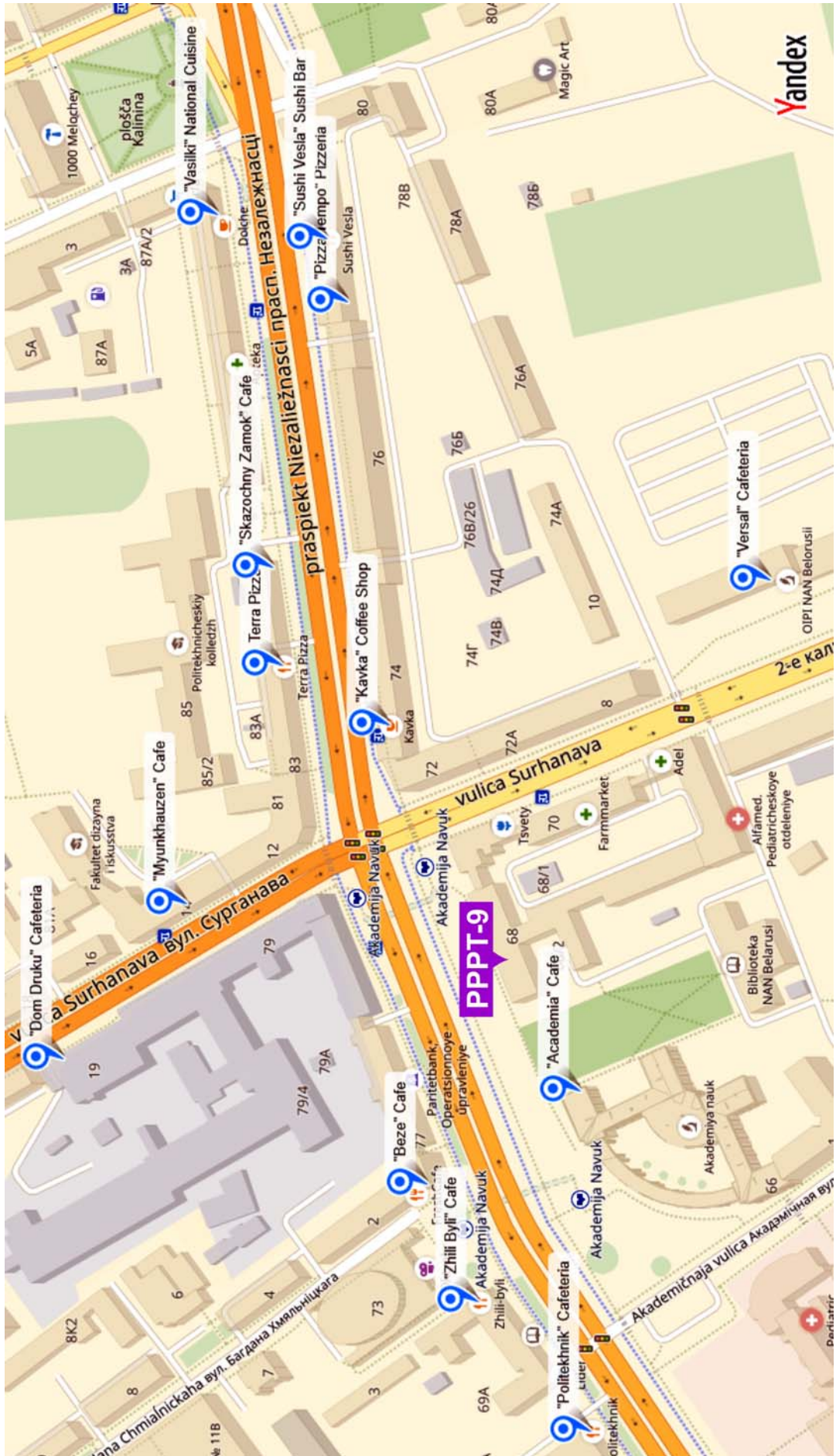
The selected conference contributions will be recommended by the Program Committee for publication in the special issues of the Journal of Applied Spectroscopy and High Temperature Materials and Processes. The decision of the Program Committee will be sent to the participants after the conference by 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 can organize the lunches in the café Akademija located at the Nezalezhnasti, 66. The cost of a 3 course meal is 3 euro. To find out more information about the menu and for booking a lunch, please, contact the registration desk.

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

GENERAL INFORMATION



GENERAL INFORMATION

Social program

Conference dinner – Tuesday, September, 18-18.30-22.00.

Conference dinner will take place in the "Arbat" restaurant located at the Nezalezhnasti 143, building 1. The program of the dinner includes degustation of the traditional Belarusian food and performance of Belarusian musicians.



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Theatre – Wednesday, September, 19 at 19.00



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All the participants are welcome to visit the ballet "Spartacus" in the National Academic Bolshoi Opera and Ballet Theatre of the Republic of Belarus that is located at the Parizhskaya Kommuna sq., 1. To get there from the conference venue you should take the metro from station "Akademija navuk" to "Niamiha" with the change at the "Kastryčnickaja"/"Kupalauskaia" station. The ballet duration is 2 hours 30 minutes with 2 intervals.

Excursion - Thursday, September, 20 - 11.00-21.00

We invite you to visit one of the most impressive sights of Belarus - the **National Historical and Cultural Museum-Reserve "Niasviž"**.

A guided tour includes a visit of the castle as well as of the the main sights of the **Niasviž** city. To get to the Niasviž the excursion bus will be organized from the conference venue. The duration of the excursion is 10 hours and includes the lunch.



If you have any questions, please contact organizers:
pppt9@ifanbel.bas-net.by

Monday – September 17, 2018**Hall I****11:00-12:40****11:00-11:20 Opening of the Conference****Chairman:** N.V. Tarasenko**11:20 Spectroscopic measurement of electric field in helium discharges**

T2-INV M. Kuraica

University of Belgrade, SERBIA

Theoretical (ab initio) foundations and experimental verification of the method for the measurement of the electric field strength in gas discharges in helium utilizing Stark polarization spectroscopy will be presented. The method is successfully applied for the diagnostics of dielectric barrier discharges and plasma jets. The high spectral, spatial and temporal resolution for the first time gave the complete picture about the dynamics of the electric field in the discharge. The obtained results are of highest interest for discharge modeling and optimization of plasma reactors.

12:00 Inductively coupled plasma – from spectroanalytical to technological applicationsT6-INV A. Gilmutdinov, M. Voronov, K. Nagulin, I. Tsivilskiy*Kazan National Research Technical University, RUSSIA*

This work presents results of modeling of 3D transient spectroanalytical ICP with mass-spectrometer interface (ICP-MS) and also a model of technological plasma (TICP) to produce powders for additive manufacturing. Experimental high-speed visualization of a plasma flow for both ICP-MS and TICP proves the results of numerical simulation. A model of ICP-MS shows that the rotation of a gas jet makes its injection to the interface asymmetrical. That is why the supersonic jet inside the interface is rapidly deflected by walls of sampler cone, forming a shockwave between the sampler and skimmer. Model of TICP reveals the formation of a toroidal vortex near the induction zone of TICPs. This vortex introduces some instability, mixes the downstream gas flow and prevents penetration of the powder particles into the plasma. Commonly the vortex is attributed to an influence of a radial component of Lorentz forces on the ionized gas. Phase-change and shape transformation of a powder particle in plasma have been modelled for variety of operating conditions.

12:40-14:00 Lunch

Hall I**14:00-17:00****Section 2 - Electrical discharges and other plasma sources, elementary and near-electrode processes****Chairman:** M. Kuraica**14:00 Demonstration of soliton stopping in acoustoplasma discharge**

T2-1 A.S.Abrahamyan

Institute of Applied Problems of Physics, NAS of Armenia, ARMENIA

The discharge tube is an acoustic resonator, in which non-axial modes and solitons can be excited. With an appropriate selection of frequency-amplitude relationships, the longitudinal components of the two opposing solitons are compensated, and the circular components are uncompensated. A standing soliton circular wave in the form of a single turn appears in the discharge tube in the contracted cord discharge. The report lists photographs and video clips of one, two and three stopped solitons.

14:20 Investigation of the glow and the dielectric-barrier discharge plasma jetsT2-2 A.M. Astafiev (1), A. V. Kazak (2), M.E. Pinchuk (1),
O.M. Stepanova (3), L.V. Simonchik (2)*(1) Institute for Electrophysics and Electric Power of RAS, RUSSIA**(2) Institute of Physics of NAS of Belarus, BELARUS**(3) Saint Petersburg State University, RUSSIA*

Sources of atmospheric pressure plasma jets have been becoming an object of intensive study, largely, due to the prospects for their use in biomedical applications. This report is devoted to comparison of the two types of low temperature plasma sources which based on the glow discharge and the barrier discharge. Particular attention is paid to plasma jet formation for different conditions (power, gas mixture, flow velocity).

14:40 Study of high-power beams of vacuum surface flashover of polymer dielectrics at voltages up to 100 kv: experiment and simulationT2-3 R.V. Emlin, P.A. Morozov, I.F. Punanov, E.N. Scherbakov*Institute of electrophysics of Ural Branch of RAS, RUSSIA*

We present a comparison of theoretical calculations with the measured parameters of plasma bunches generated by dielectric surface flashover in vacuum by high-voltage nanosecond pulses (95 kV, $t=20$ ns, $Z=25$ Ohm, $W=3$ J, current is 4 kA). It is a part of a development of repetitive pulsed plasma thruster based on generators with a stored energy less of 5 J and pulse rate of 100–400 Hz. The tested samples are PTFE, PMMA, polystyrene and polyethylene. We measured thrust, mass loss per discharge, ionic current. Total ionic charge was calculated using measured semispherical angular distribution diagram of the plasma bunch.

15:00 **New finding in low pressure gas discharges applications at MEPHI**

T2-4 V.A. Kurnaev, A. Kaziev
National Research Nuclear University MEPHI, RUSSIA

Recent results on application of new type of low pressure gas discharges investigated at MEPHI are reviewed. An auto oscillation secondary emission discharge occurring at plasma contact with oxidized collector allows generating high voltage pulses in broad (ten orders of magnitude) frequency range. New type of pulsed high current magnetron discharge with liquid cathode gives extra high deposition rates. The anomalous glow discharge is effectively used for nitriding of inner surfaces of tubes.

15:20 **Role of external factors in formation and development of dielectric barrier surface discharge in air (recent experimental data)**

T2-5 M.V. Sokolova, V.V. Voevodin, Ju.I. Malachov
National Research University "Moscow Power Engineering Institute", RUSSIA

Influence of a range of factors on the formation and development of dielectric barrier surface discharge in air is analyzed on the base of recent experimental results. The electrode arrangement, barrier characteristics, parameters of the applied impulse high voltage (its amplitude, pulse duration, front steepness) are analyzed using different experimental methods including electric measurements, photo and high speed camera registration, dust figure technique and microscopic scanning of the images.

15:40-16:00 Coffee Break

16:00-17:00 Short poster presentations

Hall III

17:00-18:40

Poster session 1

Hall II

14:00-15:40

Section 4 - Non-ideal and dusty plasmas, fusion and astrophysical plasmas

Chairman: L.V. Simonchik

14:00 **Brownian motion of macro particles in a two-dimensional dusty plasma under direct external impact. Simulation results**

T4-1

I.I. Fairushin, O.F. Petrov, M.M. Vasiliev

Joint Institute for High Temperatures of the RAS, RUSSIA

Moscow Institute of Physics and Technology, RUSSIA

We simulated the process of the impact of laser radiation on a two-dimensional system of dust particles interacting through the Yukawa potential and experiencing the action of the friction force and the Langevin random force from the ambient buffer gas. Trajectories of motion and particle velocity distributions are obtained. It is found that in the zone of impact of laser radiation the nature of the dependence of the self-diffusion coefficient the laser power is nonmonotonic.

14:20 **About magnetization of particles in dusty plasma**

T4-2

V.Yu. Karasev, E.S. Dзлиeva, S.I. Pavlov, L.A. Novikov,

S.A. Tarasov

Saint Petersburg State University, RUSSIA

The results of the studies of dust formations at the magnetization of the plasma components in the lightest inert gases are presented. The experiment with helium in standard magnetic coils under reduced pressure to 0.1 Torr in the trap near the narrowing of the current channel is carried out. In preliminary observations, the conditions of magnetization are technically achieved.

14:40 **Study of strongly coupled dusty plasmas by the time-averaged correlational analysis**

T4-3

E.A. Lisin (1,2), O.S. Vaulina (1,2), I.I. Lisina (1),

O.F. Petrov (1,2)

(1) *Joint Institute for High Temperatures of the RAS, RUSSIA*

(2) *Moscow Institute of Physics and Technology, RUSSIA*

We present here the results of theoretical analysis of the time-averaged correlation functions for displacements and velocities of interacting particles in strongly coupled systems. On the basis of the correlational approach, we developed a new contactless technique for studying the wake-mediated intergrain interactions in complex plasmas. An analytical model for description of the particle kinetic energy in systems with a nonreciprocal interparticle interaction was also developed.

15:00 ITER divertor plasma facing and nearby components during transient eventsT4-4 V. Sizyuk and A. Hassanein*Center for Materials under Extreme Environment, School of Nuclear Engineering Purdue University, USA*

A key obstacle to a successful magnetic fusion energy production in Tokamak reactors is performance during abnormal events. Advanced models and numerical tools were developed to efficiently couple major key processes during the disruptions and giant ELMs. Our results showed that unmitigated transient events could cause significant melting and vaporization damage to most interior and hidden components including the first wall that were not directly exposed to these events.

15:20 Nature and level of Hot Jupiter KOI 889 b atmosphere electrical conductivity at pressures 50-300 GPaT4-5 V.Ya. Ternovoi, D.N. Nikolaev, A.V. Shutov, A.V. Ostriak*Institute of Problems of Chemical Physics RAS, RUSSIA*

The intensity of optical radiation and resistance of a hydrogen-helium layer with He mass fraction $Y = m_{\text{He}}/(m_{\text{He}} + m_{\text{H}}) = 0.24$, which corresponds to the composition of the outer layers of Jupiter's atmosphere, were simultaneously measured under multiple shock compression up to 400 GPa in plane geometry. The initial pressure and temperature of the mixture were equal to 20 MPa and 30 MPa and 77.4 K, respectively, and the velocity of shock wave in sapphire bottom was equal to about 15 km/s. These conditions provided generation of final compressed curve close to the adiabatic states of Hot Jupiter's atmosphere (KOI889 b). The conditions for appearance of the high conducting phase in the compression process and the achieved level of electrical conductivity were determined. The experimental data were compared with the one-dimensional fluid-dynamic simulation of the compression process using the equation of state for the mixture.

15:40-16:00 Coffee Break**16:00-17:00 Short poster presentations****Hall III****17:00-18:40****Poster session 1**

Tuesday – September 18, 2018**Hall I****9:00-12:40****Section 1 - Fundamentals and modeling of plasma processes, plasma dynamics, transport, optical, and thermodynamic properties of plasmas****Chairman:** F. Krcma**9:00 Dynamical chemical model of laser induced plasma**

I. Gornuskin

T1-INV *BAM Federal Institute for Materials Research and Testing, GERMANY*

Laser induced plasma (LIP) is a highly dynamic, short living event which presents significant difficulty for both diagnostics and modeling. The former requires precise spatially- and time-resolved measurements on a micron-nanosecond scale while the latter needs numerous descriptive parameters; many of them can only be obtained from experiment. Diagnostics and modeling should always complement each other for obtaining a truthful picture of LIP.

In this presentation, a newly developed collisional-dominated model will be presented. The model is based on the coupled Navier-Stokes, state, radiative transfer, material transport, and chemical equations. The model incorporates plasma chemistry through the equilibrium approach that relies on atomic and molecular partition functions. Several chemical systems are modeled including Si-C-Cl-N and B-H-Cl systems.

9:40 Plasma power interruption; revealing mechanisms and processes

T1-1 J. van der Mullen

Université Libre de Bruxelles, BELGIUM

The response of plasmas to power interruption (PI) gives information on transport mechanisms and the role of elementary processes. This study deals with PI experiments on several low and atmospheric pressure Ar plasmas. It is interesting to see that after PI the electrons can remain high in temperature; although the electric field is absent! This post-heating is present in high pressure but absent in low pressure pure Ar plasmas. However, if a small percentage of CO₂ is added to low-p Ar plasmas it pops up again! The role of post-heating on CO₂ dissociation will be discussed as well.

10:00 Molecules in laser induced plasma: analytical application and evaluation of plasma temperature and electron densityT1-2 T.A. Labutin, S.M. Zaytsev, A.M. Popov*Lomonosov Moscow State University, RUSSIA*

Diatomic molecules present and emit in laser-induced plasma. And their emission is the most appropriate one for the halogens detection. At the same time temperature of nanosecond laser-induced plasma is close to those of plasma formed by the meteor entering the Earth's atmosphere. Thus, the laser ablation of a model object (iron oxide) can be useful for the determination of the mechanism of the ablation of astral bodies of natural and industrial origins.

10:20 Electrostatic cumulation of high-current electron beams for terahertz applications

T1-3 S.V. Anishchenko, V.G. Baryshevsky, N.A. Belous,
A.A. Gurinovich, E.A. Gurinovich, E.A. Gurnevich, P.V. Molchanov
Research Institute for Nuclear Problems, BELARUS

The electrostatic cumulation of current density in relativistic vacuum diodes with ring-type cathodes is described theoretically and confirmed experimentally. The distinctive feature of the suggested cumulation mechanism is a very low energy spread of electrons. As a result of electrostatic cumulation, a thin relativistic electron flow with a radial width of 1 mm and beam current density of 10-100 A/mm² is formed. Such a beam can be used as an active medium in high-power terahertz sources.

10:40 – 11:00 Coffee Break

Chairman: J. van der Mullen

11:00 Laser-induced plasma spectra modeling under local thermodynamic equilibrium conditions and its application to the standardless elemental analysis

T1-4 S.M. Zaytsev, I.N. Krylov, N.I. Sushkov, T.A. Labutin
Lomonosov Moscow State University, RUSSIA

The implemented model of laser plasma under LTE calculates a species densities and the wide-range spectrum for the set of parameters: temperature, electron density and relative mass fractions of the elements. A comparison of the uniform and non-uniform (2 zones) plasma models in terms of performance and accuracy has been done during multiparametric optimization of experimental spectra of steels and Al-alloys. The reported study was funded by RFBR according to the research project № 18-33-01297.

11:20 Experimental modelling of the parametric decay instability of O-wave into two upper-hybrid plasmons in plasma filament

T1-5 V. Arkhipenko (1), E. Gusakov (2), A. Popov (2),
L. Simonchik (1), M. Usachonak (1)
(1) *Institute of Physics NAS of Belarus, BELARUS*
(2) *Ioffe Institute, RUSSIA*

In this work the results of experimental modelling of the parametric decay instability (PDI) of O-wave into two UH plasmons are presented. The strong anomalous absorption effect was observed under conditions when the two-UH-plasmon decay is possible. The localization of the power deposition region is obtained and the instability threshold and growth rate are estimated in the experiment. The anomalous absorption over 0.6 is observed, which demonstrates the importance of this phenomenon consideration in the planning of microwave heating experiments on large installations.

11:40 Three kinds of ambipolar transport for gas discharge plasma

T1-6 A.E. Medvedev
Institute of Laser Physics SB RAS, RUSSIA

Three types of ambipolar transport are sufficient for describing the structure of direct-current atmospheric glow discharge. A detailed analysis of the results of an experimental investigation of atmospheric pressure discharges in various gases and a comparison with estimates based on three kinds of ambipolar transport of plasma have shown that the difference between the plasma pinch radii and the obtained estimates is not more than 20%.

12:00 Specific power of ultraviolet radiation from RF middle pressure discharge in a mixture of inert gas and chlorine

T1-7 A.P. Golovitskii, A.V. Pelli
Peter the Great St.Petersburg Polytechnic University, RUSSIA

The UV radiation from the capacitive RF (1-50 torr) discharge in electronegative gas mixture of inert gas and chlorine has been analyzed by a numerical modeling. The goal of the present work is the maximization of UV radiation power and efficiency by varying total pressure and partial pressures of the mixture components as well. It is shown that the maximal value of specific UV power can reach up to 0.6 W/cm^3 .

12:20 Equation of state for dense lead plasma at high energy densities

T1-8 K.V. Khishchenko
Joint Institute for High Temperatures RAS, RUSSIA

In this report a semiempirical equation-of-state model is presented. Wide-range equation of state for lead is constructed. Calculation results are compared with available data from experiments on shock compression as well as isentropic and isobaric expansion of the metal. The equation of state obtained can be used effectively in simulations of different processes in dense lead plasma at high energy densities. This research has been supported by the Russian Science Foundation, grant 14-50-00124.

12:40-14:00 Lunch

Hall I**14:00-17:00****Section 6 - Plasma spectroscopy and other diagnostic methods****Chairman:** I. Gornuskin**14:00 Fundamental aspects and application of nanoparticle enhanced Laser Induced Breakdown Spectroscopy**T6-INV A. De Giacomo(1,2), M. Dell'Aglio (2)*(1) University of Bari, ITALY**(2) CNR-NANOTEC, ITALY*

In this work, Nanoparticle - Enhanced LIBS (NELIBS) is described. The underlying mechanisms responsible for NELIBS are described as well as the most important applications. This is done by presenting both the properties of metallic particles interacting with high-energy laser radiation and the mechanisms of laser ablation enabled by the presence of nanoparticles. Finally NELIBS applications on different kinds of samples are described such as metals, transparent samples and liquids.

14:40 Laser-Induced Breakdown Spectroscopy (LIBS): New TrendsT6-INV M.S. Trtica (1), J. Savovic (1), M. Kuzmanovic (2),
M. Momcilovic (1), S. Zivkovic (1)*(1) VINCA Institute of Nuclear Sciences, University of Belgrade, SERBIA**(2) University of Belgrade, SERBIA*

Laser-Induced Breakdown Spectroscopy is a modern spectroscopic method that allows a multielement analysis of virtually all type of materials (solids, liquids, gas). Due to its unique advantages, such as speed of analysis with little or no sample preparation and relatively high sensitivity, the method has found numerous applications. LIBS can be used for process control in nuclear technology, in biomedicine, geology, etc. Examples of the LIBS applications developed at the Institute will be given.

15:20 Effect of ambient atmosphere on composition analysis of solids by LIBST6-1 E. Ershov-Pavlov, V. Kiris, L. Stanchits*Institute of Physics, NASB, BELARUS*

The effect of surrounding atmosphere on the results of chemical composition analysis of solid samples using laser induced breakdown spectroscopy is considered based on modeling and measurement data.

15:40-16:00 Coffee Break

Chairman: A. De Giacomo

16:00 **Calibration-free analysis of zooplankton by laser-induced breakdown spectroscopy (LIBS)**

T6-2 N.I. Sushkov (1), N.V. Lobus (2), S.M. Zaytsev (1),
A.M. Popov (1), T.A. Labutin (1)
(1) *Lomonosov Moscow State University, RUSSIA*
(2) *Shirshov Institute of Oceanology, RAS, RUSSIA*

Kara Sea copepods tend to accumulate trace elements. LIBS is well suited for their determination, but the lack of appropriate CRMs forces its application in a calibration-free mode. This study was focused on determination of ratios between Li, Na, K, Mg, Ca, Sr, and Al in zooplankton. This included plasma diagnostics and spectra modeling. The best results were obtained at early delays (0.5–0.75 μ s). The reported study was funded by RFBR according to the research project № 18-33-01297.

16:20 **Everything for plasma research and LIBS systems: diode- and lamp-pumped lasers, spectrometers, focusing and collecting optics**

T6-3 N. Didkovskaya, A. Gulevich
SOLAR Laser Systems, BELARUS

SOLAR LS as a high-tech manufacturing company presents its products intended for a wide range of plasma experiments:

- flash lamp pumped- and diode pumped lasers;
- double pulse lasers;
- ultrafast lasers;
- a choice of spectrographs ensuring perfect line quality and high-grade flat field;
- efficient light collecting optics adapted for your customized system.

16:40 **H₂ dissociation in Ar-H₂ discharge of moderate pressure**
S. Avtaeva

T6-4 *Institute of Laser Physics SB RAS, RUSSIA*

The optical actinometry technique for estimation of hydrogen-to-argon density ratio and hydrogen molecule dissociation degree in arc discharge in Ar-H₂ mixtures at moderate pressures (2-3 Torr) was applied. Using ratios of three Balmer series H lines to ArI 750 and ArI 811 nm lines the effect of argon fraction in the Ar-H₂ mixture on H₂ dissociation degree is studied. It is shown that H₂ dissociation degree strongly increases if Ar fraction in the mixture grows.

Hall III

17:00-18:40

Poster session 2

19:00-23:30 Conference dinner

Wednesday – September 19, 2018**Hall I****9:00-12:40****Section 7 - Plasma applications****Chairman:** V. Brüser

- 9:00 **Plasma application for catalyst preparation**
 N.A. Savastenko (1), I.I. Filatova (2), V.A. Lyushkevich (2),
T7-INV V. Brüser (3), S.A. Maskevich (1)
 (1) *Belorussian State University, BELARUS*
 (2) *B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS*
 (3) *Leibniz-Institute for Plasma Science and Technology, GERMANY*

The application of plasma techniques in the preparation of catalysts is discussed. There are three main trends in catalysts preparation using plasmas: synthesis of catalytically active nanoparticles, plasma assisted deposition of catalytically active materials on the support, and plasma modification of catalysts. The plasma prepared catalysts exhibit a higher activity compared to the catalysts prepared conventionally. In this work, we present our results on the preparation of automotive exhaust catalysts, electrocatalysts, as well as photocatalysts with plasma-assisted methods.

- 9:40 **The influence of the reflex discharge radial electric field on**
 the propagation of the plasma flow of substances modeling
T7-1 **the components of spent nuclear fuel**
 N.N. Antonov, G.D. Liziakin, R.A. Usmanov, Ya. A. Murzaev,
 A.V. Gavrikov, V.P. Smirnov
 Joint Institute for High Temperatures, RAS, RUSSIA

A generation of the electric potential spatial distribution in the buffer plasma and a study of motion of the ionized substance flows therein are the most important tasks for the method of plasma separation of spent nuclear fuel developing nowadays. The mutual influence of the radial electric field of the reflex discharge in argon ($P = 0.4$ Torr, $U = -1250$ V) and the low-energy lead plasma flow ($E < 20$ eV), directed along the magnetic field lines ($B = 1300$ G), was investigated in this paper.

- 10:00 **Inactivation components production mechanisms of an air**
 DC plasma jet
T7-2 V.I. Arkhipenko (1), A.V. Kazak (1), A.A. Kirillov (1),
 L.V. Simonchik (1), V.V. Shkurko (2)
 (1) *B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS*
 (2) *Graduate School of the National Academy of Sciences of Belarus, BELARUS*

The production mechanisms of the main inactivation components NO, NO₂ and HNO₂ of cold plasma jets generated by an atmospheric pressure glow discharge (APGD) are investigated. The main formation of nitrogen monoxide takes place in the nonequilibrium plasma of the ADGD, where N, O, and OH are produced in plasma-chemical reactions involving electrons. The growth of nitrogen dioxide and nitrous acid concentrations begins when the downstream temperature decreases.

- 10:20 **Plasma treatment as an approach to control biocompatibility of polylactide materials**
T7-3 T.S. Demina (1,2), A.B. Gilman (1), T.A. Akopova (1)
 (1) *Enikolopov Institute of Synthetic Polymer Materials, RAS, RUSSIA*
 (2) *Institute for Regenerative Medicine, Sechenov University, RUSSIA*

This research was aimed to investigate an effectiveness of DC discharge plasma treatment of polylactide materials as a direct approach to modify its surface properties or as a tool to preliminary activate it for further immobilization of various bioactive components, such as proteins and polysaccharides. The reported study was funded by RFBR according to the research project No– 18-32-00901.

10:40 – 11:00 Coffee Break

Chairman: N.A. Savastenko

- 11:00 **Plasma based immobilization of catalysts for chemical synthesis**
T7-4 V. Brüser (1), S. Peglow (1), Y. Hu (2), T. Werner (2),
 M. Beller(2), A. Kruth (1)
 (1) *Leibniz-Institute for Plasma Science and Technology, GERMANY*
 (2) *Leibniz Institute for Catalysis, GERMANY*

Plasma-based methods such as pyrolysis, surface activation or plasma polymer deposition for surface modification are suitable for immobilizing catalysts on supports. Immobilized catalysts play an important role in heterogeneous catalysis. Application examples are chemical processes, such as hydroformylation, hydrogenation, cyclization or photochemical water splitting. In this paper we present the applications of low pressure plasma methods in the preparation of heterogeneous catalysts.

- 11:20 **Deposition of double-layer coatings for preparing composite membranes with superhydrophobic properties**
T7-5 L.I. Kravets (1), M.A. Yarmolenko (2), A.A. Rogachev (2),
 R.V. Gainutdinov (3), N.E. Lizunov (1)
 (1) *Joint Institute for Nuclear Research, Flerov Laboratory of Nuclear Reactions, RUSSIA*
 (2) *Francisk Skorina Gomel State University, BELARUS*
 (3) *Shubnikov Institute of Crystallography of FSRC "Crystallography and Photonics", RAS, RUSSIA*

The present paper describes the possibility of double-layer superhydrophobic coating formation onto a porous substrate by the electron-beam sputtering of polymers. As a porous substrate a poly(ethylene terephthalate) track membrane with a pore diameter of 250 nm was used. Ultra-high molecular weight polyethylene was used for sputtering to form the first hydrophobic layer on the membrane surface and polytetrafluoroethylene was used for sputtering to form the second superhydrophobic layer.

- 11:40 **Experimental and theoretical study of plasma-based formation of free-standing N-graphene**
T7-6 D. Tsyganov (1), N. Bundaleska (1), A. M. Botelho do Rego (2), A. M. Ferraria (2), E. Tatarova (1)
(1) Instituto de Plasmas e Fusão Nuclear, Instituto de Plasmas e Fusão Nuclear, Instituto Superior Técnico, Universidade de Lisboa, PORTUGAL
(2) Centro de Química-Física Molecular and IN, Instituto Superior Técnico, Universidade de Lisboa, PORTUGAL

In situ direct synthesis of free-standing nitrogen-doped graphene structures was achieved in a single step method by employing microwave plasma at atmospheric pressure conditions. The technique is based on injection of nitrogen-containing precursor together with hydrocarbon in the reactive plasma environment. Nitrogen gas and ethanol were used as source of both nitrogen and carbon.

- 12:00 **Comparison of direct plasma gasification and combined thermolysis-plasma process**
T7-7 A. Liavonchyk, V. Sauchyn, S. Shabunya, D. Skamarokhau, N. Kurbanov
A.V. Luikov Heat and Mass Transfer Institute, BELARUS

Experimental research of direct and combined plasma gasification processes of organic waste was carried out. Direct process was studied when the material was fed into plasma jet. Combined technology consisted of two stages: thermal conversion with temperature 400-500°C and high temperature (1000-1200°C) processing of products from the first stage. Results showed that combined process provides more flexible approach for different gas media usage.

- 12:20 **Wettability and electret properties of plasma-treated polytetrafluoroethylene films**
T7-8 M.Yu. Yablokov (1), D.E. Temnov (2,3) S.M. Kulemina (2), A.A. Kuznetsov (1)
(1) Enikolopov Institute of Synthetic Polymer Materials, Russia
(2) Herzen State Pedagogical University of Russia, RUSSIA
(3) Saint Petersburg National Research University of Information Technologies, Mechanics and Optics ITMO University, RUSSIA

The action of direct current glow discharge on the surface characteristics of polytetrafluoroethylene (PTFE) films was investigated. It has been shown that the treatment of the films leads to a significant increase of their wettability. It was found that plasma modification of PTFE films results also in the appearance of stable surface effective electret charges. In this work we studied the relationship of the surface charging and wettability of direct current discharge-modified PTFE films.

12:40-14:00 Lunch

Section 7 - Plasma applications**Chairman:** D. Tsyganov

14:00 **Application of plasma and radio wave technologies in agriculture: protection of plants, improvement of plant growth and yield**
T7-INV

I.I. Filatova (1), V.A. Lyushkevich (1), S.V. Goncharik (1),
N.I. Chubrik (1), A.G. Zhukovsky (2), N.A. Krupenko (2),
N.G. Poplavskaya (2), J.N. Kalatskaja (3), V. Mildaziene (4),
G. Pauzaite (4)

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

(2) *RUE «Institute of Plant Protection», BELARUS*

(3) *V.F. Kuprevich Institute of Experimental Botany, NAS of Belarus, BELARUS*

(4) *Vytautas Magnus University, LITHUANIA*

The prospects of seed treatment with cold plasma and electromagnetic fields for effective cultivation of agricultural, ornamental, medicinal and woody plants are considered. The effect of treatment on seed germination, plant resistance to common diseases and accumulation of secondary metabolites is discussed. It is shown that seeds treatment with physical factors causes stable changes in metabolic processes at the subsequent stages of plant development, contributes to the height and increasing the biomass of seedlings of the second year of cultivation up to 50%, allows increasing the crop yield, stimulates the accumulation of some pharmaceutically important secondary metabolites in plant.

14:40 **Low-temperature plasma reactor for ozone generation based on dielectric barrier discharge**
T7-9

O.V. Shchebetun, V.V. Krasnyj, O. Chechelniczkiy, A.V. Taran,
A.S. Lozina

*Institute of Plasma Physics, NSC "Kharkiv Institute of Physics and Technology",
UKRAINE*

This article presents a device for ozonizing water based on a plasma reactor using a DBD. The design feature of this device is to obtain high ozone capacity with low air flow (0.2-0.3 ml/min) at atmospheric pressure. The concentration of ozone was 28-35 mg/l. When oxygen was supplied with a purity of 90-92%, the ozone concentration was 100-120 mg/l. Stabilization of the obtained parameters is achieved by cooling the ozone reactor with a thermoelectric module based on the Peltier element.

15:00 **The contact properties and chemical structure of poly(ethylene terephthalate) films modified by direct-current discharge**
T7-10

M.S. Piskarev, A.B. Gilman, A.A. Kuznetsov

Enikolopov Institute of Synthetic polymer materials, RAS, RUSSIA

This paper presents a comprehensive study of the surface modification of poly(ethylene terephthalate) films by direct-current discharge at the anode and cathode. The changes in the contact properties and the chemical structure of the film have been studied. It has been shown that the treatment imparts hydrophilicity of the films, which persists for a long time. X-ray photoelectron spectroscopy was used to study the effect of plasma treatment on the chemical structure of the modified films.

15:20 Laser ablation synthesis of metal oxide nanostructures for photovoltaic applicationsT7-11 A.V. Butsen (1), E.A. Shustava (1), N.V. Tarasenko (1), S. Pashayan (2)(1) *B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS*(2) *Institute for Physical Research, NAS of Armenia, ARMENIA*

By using double pulse laser ablation in a liquid (distilled water, ethanol) copper (CuO) and zinc (ZnO) oxides nanoparticles (NPs) promising for solar cells were synthesized. With the applying of absorption spectroscopy, transmission and scanning electron microscopy the optical and structural-morphological properties of the formed particles were studied. The possibility of film layers creating by depositing and assembling colloidal particles in organized structures on the surface of an indium-tin oxide (ITO) substrate was demonstrated.

15:40-16:00 Coffee Break**Chairman:** I.I. Filatova**16:00 Application of SiO₂ nano liquid glass on plasma cleaned surfaces**

T7-12 O. Doğan

Necmettin Erbakan University, TURKEY

In this study, hydrophobicity value of SiO₂ nano liquid glass was investigated on some coated surfaces cleaned with plasma technique and normal surfaces. SiO₂ nano liquid glass solution was produced with sol-gel method in a special reactor. Nano liquid glass SiO₂ solutions produced by silicon-based nanopowder is coated on the two kind of glass surfaces by using spray method. Surfaces were coated at room temperature in air with the different spray nozzles. Surface of the first glass is cleaned with plasma technique and other glass is not cleaned. Contact angle on the surface was measured by using DropShape Analysis System contact anglemeter. Scanning Electron Microscope (SEM) was used for investigating microstructure of the coated surfaces. Roughness of surfaces was investigated using Atomic Force Microscopy (AFM).

16:20 Oxidation and sintering of porous titanium surface under the action of a stationary plasma flow and laser irradiationT7-13 I.S. Nikonchuk (1), A.N. Chumakov (1), O.O. Kuznechik (2)(1) *B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS*(2) *Powder Metallurgy Institute, BELARUS*

The purpose of this study was to reveal an effective modes of oxidation and sintering of the surface layer of porous titanium material by laser and plasma action. It was found that stationary plasma action on the titanium samples initiates self-propagating high-temperature synthesis, which leads to effective oxidation and sintering of porous titanium surface. Analysis of laser action showed that nanosecond laser action is well suited for surface structuring and formation of oxides.

- 16:40 **Effect of interpulse delay on the intensity of the spectral lines of the main components of technological clays during two-pulse laser excitation**
T7-14

N.N. Kuryan (1), S.S. Anufrik (1), K.F. Znosko (1)
Grodno State University. Y. Kupaly, BELARUS

The dependence of the intensity of the spectral lines of Al I (309.4 nm), Al II (358.7 nm), Mg II (279.6 nm), Ti II (323.6 nm) from the laser ablation plasma under two-pulse excitation of technological clays on the time delay between the first and second laser pulse in the range of 1-10 μ s were studied. Time delays are established at which the intensities of the spectral lines reach the maximum values. It is shown that the optimal time delays depend on the energy of laser pulses.

- 17:00 **Non-catalyst desulfuration of oil-containing products in a plasma pulverizer**
T7-15

R.R. Saubanov (1), V.V. Zvezdin (1), F.G. Karih (1),
V.A. Pesoshin (2)

(1) Naberezhnye Chelny Institute Kazan federal university, RUSSIA

(2) Kazan National Research Technical University named after A. N. Tupolev - KAI, RUSSIA

On a basis of non-catalyst desulfuration of oil-containing products the effect of the fissile interaction of the atoms of sulfur with atoms of aluminum obtained in the reactor of a plasma pulverizer in the oil environment is used. It is rationally realized process of sulfur removal of oil-containing products.

19:00-21:00 Ballet

Thursday – September 20, 2018**Hall I****09:00-10:40****Section 3 - Non-equilibrium effects and atmospheric pressure plasma processes, plasma in and in contact with liquid****Chairman: A. Nevar****9:00 Pin hole based discharges in liquids: generation, properties and applications**T3-INV F. Krcma, Z. Kozakova
Brno University of Technology, CZECH REPUBLIC

The principle of pin-hole discharges generated in liquids is described. Physical and chemical properties of discharge are linked to various potential applications such as pollutants decomposition, surface treatment, and nanoparticles synthesis.

9:40 Plasmas in liquids: characteristic features and nanotechnological applicationsT3-1 V. Burakov, M. Nedelko, N. Tarasenko, A. Nevar, V. Kiris,
N. Tarasenko
B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS

Two types of plasma-liquid systems are discussed from the point of view of their capabilities for synthesis and surface engineering of nanomaterials. First, high-voltage discharge between two electrodes submerged into liquid is used for the synthesis of carbon and silicon nanoparticles. Second, gas-liquid interfacial discharge plasma is generated between a capillary (hollow needle) with flowing argon and liquid surface in ambient air under the normal pressure.

10:00 Density effects in the nonequilibrium arc helium plasma at atmospheric pressureT3-2 L.G. Dyachkov, D.I. Kavyrshin, O.V. Korshunov, V.F. Chinnov
Joint Institute for High Temperatures of RAS, RUSSIA

Radiation properties of arc helium plasma generated by a dc plasmatron at atmospheric pressure have been investigated. We have shown that the arc helium plasma is nonequilibrium with a predominance of ionization and the population of the ground state of HeI is two orders of magnitude higher than the Saha equilibrium one. However the populations of the levels with $n > 4$ are less than the equilibrium one and rapidly decrease as n grows. This is explained by the density effects.

10:20 **Strongly over-voltage open discharge in deuterium at low pressure as an intensive source of run-away electrons with energy up to 25 keV**
T3-3

Yu.S. Akishev (1,2), G.I. Aponin (1), V.B. Karalnik (1),

A.V. Petryakov (1), N.I. Trushkin (1)

(1) SRC RF TRINITY, RUSSIA

(2) NRNU MEPhI, RUSSIA

Strongly overvoltage open discharges in a narrow gap (2-3 mm) between the solid cathode and the grid anode are widely used for generation of the pulsed high-current beams of run-away electrons with energy up to 100 keV. Strongly overvoltage (SO) regime is unstable and the discharge tends to transit into low-voltage (LV) regime with a high-current. We studied experimentally this transition by example of the three-electrodes open discharge in deuterium (D_2) at low pressure (about 0.5-2 Torr) being powered by stepwise voltage with amplitude up to 25 kV.

10:40 – 11:00 Coffee Break

11:00-21:00 Excursion

Friday – September 21, 2018**Hall I****9:00-13:00****Section 5 - Laser and plasma interaction with surfaces****Chairman: M.S. Trtica**

9:00 Bimetallic nanocomposites formation by pulsed laser ablation

T5-INV R. Soni
Indian Institute of Technology Delhi, INDIA

Bimetallic nanocomposites are extensively used in catalytic reactions, surface enhanced Raman spectroscopy and sensing. Bimetallic nanocomposites of silver, gold, copper, palladium, aluminium and iron are prepared by different laser ablation methods in liquids to fabricate alloy and core-shell nanostructures. We will discuss the formation mechanism of composite nanoparticles, controlled synthesis of bimetallic alloy and core-shell nanostructures and their applications in plasmonic sensing.

9:40 Effective regimes of pulsed laser ablation of materials and generation of plasma flows with controlled parameters

T5-1 A.N.Chumakov, N.A. Bosak, P.I. Verenich, A.V. Panina
B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS

The ablation of a number of materials in air (Al, brass, graphite, silicon etc.) is experimentally studied when they are irradiated with a pulse-periodic laser radiation at the Nd:YAG-laser harmonics. New possibilities for increasing the efficiency of laser ablation of a number of materials and for controlling the parameters of near-surface laser plasma with the use of monochromatic and bichromatic laser radiation with variable repetition rate of laser pulses are revealed.

10:00 Architecture of CNC machines dedicated for laser machining/fabrication

T5-2 **plays main role in research or production**
A. Piščalov
STANDA UAB, LITHUANIA

Good architecture of high-end laser machines allows to reach high geometric quality of samples, perfect dynamics, short fabrication time and flexibility to perform rapid fabrication without putting additional effort to write machine code. Review on machine architecture will be presented on basis of Standa research in motion control and already finished projects.

10:20 Investigation of CZTS thin-film solar cells on perlite glass-crystal substratesT5-3 S.G. Petrosyan (1), A. S. Musayelyan (1), N.Yeranyan (1),
S.T. Pashayan (2)*(1) Institute of Radiophysics and Electronics, NAS of Armenia, ARMENIA**(2) Institute for Physical Research, NAS of Armenia, ARMENIA*

Thin $\text{Cu}_2\text{ZnSnSe}_4$ (CZTSe) films were synthesized by selenization of precursors Cu, Zn, Sn deposited by magnetron sputtering on Mo-coated perlite substrates. Synthesized films were used as the photoactive layer for Mo/CZTSe/CdS/ZnO/Al:ZnO solar cells. The surface morphology was studied with AFM; photoelectric measurements were performed using a Keithley-6340 setting. Conversion efficiency of solar cells is 4.9%, open-circuit voltage $\sim 0.6\text{V}$ is comparable with the results for more efficient solar cells on glass substrates.

10:40 – 11:00 Coffee Break**Chairman:** R. Soni**11:00 Formation of graphene structures in wood by laser irradiation**T5-4 R. Trusovas, K. Ratautas, G. Račiukaitis, G. Niaura*Center for Physical Sciences and Technology, LITHUANIA*

We present experimental results of laser-induced formation of graphene structures in pinewood. Experiments were conducted using nanosecond and picosecond lasers at the irradiation wavelength of 1064 nm in the hermetic chamber with a nitrogen atmosphere. Raman spectroscopy measurements showed the formation of high-quality few-layer graphene structures with $I(2D)/I(G)$ ratio of 1.10 obtained with nanosecond laser irradiation.

11:20 Laser ablation in liquids as a tool for preparation of binary alloy nanoparticlesT5-5 N.N. Tarasenko (1,2), V.V. Pankov (2)*(1) B.I. Stepanov Institute of Physics NAS of Belarus, BELARUS**(2) Belarusian State University, BELARUS*

Several approaches for synthesis of binary compounds nanoparticles have been developed based on plasma generation in liquid, in particular, successive laser ablation of targets, laser irradiation of a mixture of colloidal solutions, laser ablation of a target in a reactive liquid. The capabilities of each method have been evaluated with the view of the control over the NPs most important parameters such as composition, morphology and size distribution for their practical applications.

- 11:40 **Generation of gold nanoparticles on ITO glass using nanosecond laser and their potential application in electrochemistry**
T5-6
E. Stankevicius (1), M. Garliauskas (1), L. Laurinavicius (1),
R. Trusovas (1), N. Tarasenko (2), R. Pauliukaite (1)
(1) *Center for Physical Sciences and Technology, LITHUANIA*
(2) *B.I. Stepanov Institute of Physics NAS of Belarus, BELARUS*

Here, simple one-step generation of gold nanoparticles on ITO glass using nanosecond laser will be presented and the electrochemical properties of the gold modified ITO electrodes by the detection of the ascorbic acid will be analyzed.

12:00-13:00 Young Scientist Award and Closing

Section 1 - Fundamentals and modeling of plasma processes, plasma dynamics, transport, optical, and thermodynamic properties of plasmas

T1-P-1 Mathematical modeling of reactive ion-plasma etching

A.V. Abramov, E. A. Pankratova, E. V. Alekseeva
Voronezh state technical University, RUSSIA

Based on the results of experimental studies of reactive ion-plasma etching of silicon in SF₆ and CF₄ gases, a model is proposed and an analytical description of this process is performed. The analysis of results of mathematical modeling of the considered process at change of the area of etching which allowed to understand better mechanisms of its course and, in particular, a role of various components of plasma is carried out.

T1-P-2 Charged-particle stopping in a classical electron gas

Yu.V. Arkhipov (1), A.B. Ashikbayeva (1), S.A. Syzganbayeva (1),
D.Yu. Dubovtsev (1), I.M. Tkachenko (2)
(1) Al-Farabi Kazakh National University, KAZAKHSTAN
(2) Universitat Politècnica de València, SPAIN

The plasma stopping power problem, of great interest by itself, provides a reliable test of dynamic and transport properties of dense plasmas. A quantitative evaluation of polarizational energy losses of projectiles in an electron gas is achieved on the basis of the linear-rational approximation for the plasma dielectric function generated by the non-perturbative self-consistent method of moments. A comparison with available simulation data is carried out.

T1-P-3 Low pressure glow discharge in transverse supersonic gas flow in a limited region: plasma process modeling

D.I. Israphilov
Kazan Federal University, RUSSIA

Article presents model of a glow discharge at low pressures due to supersonic gas flow in a limited region of discharge chamber. A model of flow regime of a supersonic flow in a vacuum chamber is described. Results of experiments on realization of a glow discharge at low pressures due to the organization of a transverse supersonic gas flow are shown.

T1-P-4 The numerical simulation of a cathode spot motion in a tangential magnetic field

I. Ivanou
Belarusian National Technical University, BELARUS

The numerical algorithm for calculating of a single vacuum arc cathode spot trajectory in out tangential magnetic field with considering the stochastic nature of the spot motion is described in this report. This algorithm suggests a step-by-step calculation method of a random motion direction of the spot and coordinates of a new emission center. The time coordinate axis don't use. Arc failure conditions are discussed.

T1-P-5 The dynamics peculiarities of carbon erosion jet formed by action of nanosecond laser pulses in vacuumV.K. Goncharov, K.V. Kozadaev, M.V. Puzyrov*A.N. Sevchenko Scientific-Research Institute of Applied Physical Problems of BSU, BELARUS*

The article is devoted to the description of development and decay features arising in erosive jets of carbon under action of nanosecond laser pulses on graphite target in vacuum. A mathematical model of Anisimov-Lukyanchuk, based on the Zeldovich-Reiser theory of dynamic condensation, is used to calculate the spatiotemporal profiles of pressure and density inside the erosion jet. It is suggested that the moving second zone of illumination in the jet can be associated with the emission region.

T1-P-6 Parameters of the plasma stream generated by the coaxial discharge system at atmospheric pressureD. Kotov, S.A. Nikitiuk, Y.I. Shukevich, A.N. Osipov*Belarus State University of Informatics and Radioelectronics, BELARUS*

Experimental and computational studies of the influence of the plasma creation conditions and the discharge system geometric parameters on the length of the plasma stream being generated are carried out. The optimal geometric parameters of the gas channel were chosen by computer simulation and experimental research and modes of steady generation of the plasma stream suitable for surface treatment of materials were determined.

T1-P-7 Comparison of stationary and Navier-Stokes models of laser-induced plasma of aluminum alloys.T.A. Labutin (1), I.B. Gornushkin*(1) Lomonosov Moscow State University, Department of Chemistry, RUSSIA**(2) BAM Federal Institute for Materials Research and Testing, GERMANY*

A quantitative description of laser-induced plasma is very important for both fundamental study of this plasma source and development of a robust calibration-free method of laser-induced breakdown spectrometry. We have compared three models of laser-induced plasma of an aluminum alloy: (i) the homogeneous plasma at local thermodynamic equilibrium, (ii) the two-zone heterogeneous plasma approximated by the "hot" core and "cold" periphery, and (iii) the hydrodynamic model of expanding plasma.

T1-P-8 Electron capture in the dense nonideal plasma on the basis of the effective potentialE.O. Shalenov, M.M. Seisembayeva, K.N. Dzhumagulova, T.S. Ramazanov*IETP, Department of Physics, al-Farabi KazNU, al-Farabi 71, 050040 Almaty, Kazakhstan, KAZAKHSTAN*

Investigation of the interaction between particles and plasma properties is of great interest in many areas of physics such as atomic and plasma physics. It is important for the development of the plasma technologies. One of the elementary processes in plasma is the electron capture process. In this work the electron capture processes by the hydrogen atom and proton were investigated.

T1-P-9 Plasma as a working body

A.E. Medvedev

Institute of Laser Physics SB RAS, RUSSIA

In the present paper, conditions for changing from flows of individual components to transport of plasma as a continuum, with the parameters n , ρ , j , thermal energy density nT , and electric field energy $\rho\phi$, called ambipolar transport [1], are obtained. On the basis of the equations obtained, low-frequency polarization with the formation of charged layers at the boundaries that is typical for discharges is considered. 1. A.E. Medvedev // EPJ D 2016 Vol. 70 P. 37-47.

T1-P-10 Calculation of emission characteristics of XeCl excilamps of barrier dischargeS.S. Anufrick, A.P. Volodenkov, K.F. Znosko*Yanka Kupala State University of Grodno, BELARUS*

The results of modeling of XeCl excilamps with barrier discharge are considered. From the main results of modeling of XeCl-excilamps it is possible to draw the following conclusions. The basic channel of formation of XeCl-molecules is harpoon reaction. At the given total pressure the channel ion - ionic recombination can not be taken into account. The developed techniques of modeling allow to optimize more purposefully issue characteristics of pulse sources of radiation.

T1-P-11 Modeling of emission characteristics in a mixture of mercury vapor and argonS.S. Anufrick, A.P. Volodenkov, K.F. Znosko*Yanka Kupala State University of Grodno, BELARUS*

The model for studying of the emission characteristics of a mixture of Hg and Ar depending on the composition, total pressure, and the parameters of the power system when excited by a glow discharge was developed. A simplified four-level scheme of the energy transitions of the mercury atom was used, taking into account the ground level 6^1S_0 , the triplet levels $6^3P_{0,1,2}$. The model made it possible to determine the maximum obtainable power of radiation at a wavelength of 254 nm.

T1-P-12 Numerical simulation of the powder particles behaviour in a technological ICPM. Voronov, K. Nagulin, R. Nazarov, A. Gilmutdinov*Kazan National Research Technical University, RUSSIA*

A 2D model of the technological atmospheric pressure ICP is presented and has a good agreement with experimental data. The model includes both tangential and axial components of the electrical current flowing in the load coil. This allows simulation of electromagnetically-driven rotation of the plasma around the axis. Evolution of the particles of the powder (trajectories, heating and evaporation) is included in the model together with thermal and gas-dynamic load of the plasma by the particles.

- T1-P-13 Vortexes in a technological atmospheric pressure ICP produced by electromagnetic phenomena**
M. Voronov, K. Nagulin, O. Kudimov, A. Gilmutdinov
Kazan National Research Technical University, RUSSIA

Lorentz forces in a technological ICP were found to be dominant in the induction zone. This results in magnetically driven vortexes in the plasma. These phenomena were investigated through plasma modeling using an LTE-based two-dimensional (cylindrically symmetric) stationary model of ICP, comparison with experimental results and a similarity analysis.

Section 2 - Electrical discharges and other plasma sources, elementary and near-electrode processes

- T2-P-1 Features of the acoustoplasma operating mode of gas-discharge devices**
A.S.Abrahamyan
Institute of Applied Problems of Physics, NAS of Armenia, ARMENIA

The main results of 20-year studies in the Laboratory of Applied Problems of Physics of LTGDP, IAPP NAS RA of the acoustoplasma discharge are presented. The experimental results of the gas-discharge tube and devices based on it in the acoustoplasma mode and with a plasma without an acoustic perturbation are compared. In an acoustoplasma medium one can obtain topological phase transitions. The time of plasma relaxation to the unperturbed state after removal of the perturbation is given.

- T2-P-2 Numerical investigation of direct current arc plasma torch with self-conjugate heating of electrodes**
A.I.Saifutdinov (1,2)
(1) *Kazan Federal University, RUSSIA*
(2) *Saint Petersburg University, RUSSIA*

A self-consistent modeling of an arc plasma torch of a direct current with self-conjugate heating of electrodes was carried out in the work. All the main parameters of the plasma flow both inside the plasma torch and at its output were obtained. The binding of the arc to the anode was investigated.

- T2-P-3 Prebreakdown characteristics of weakly ionized gaseous media in the strongly nonuniform electric field**
M.S. Apfelbaum, R.A. Syrovatka and V.I. Vladimirov
Joint Institute for High Temperatures, RAS, RUSSIA

A theoretical model of electrohydrodynamic prebreakdown phenomena in slightly ionized media is proposed. The electric high voltage conduction of weakly conductive liquids and slightly ionized gases in intense electric fields using this model is considered. The formula for the calculations of volt-ampere characteristics under high voltage spherical capacitor field is analytically obtained. The experimental corona discharge volt-ampere characteristics of air are presented.

T2-P-4 Investigation of the switching arc in the hv gas-blast interrupters downstream region**S. Averyanova, E. Tonkonogov***Peter the Great St.Petersburg Polytechnic University, RUSSIA*

The interaction between the switching arc and the gas flow is an important factor for increasing of interrupting ability in the HV gas-blast interrupters. The different ways to accelerate arc decaying and to raising the interrupting ability exist. The purpose of this investigation is to study the influence of the downstream region on the interrupting ability through the electric field strength rising. In the paper, the interaction between the switching arc and stream in the region between the nozzle exit and downstream contact is discussed.

T2-P-5 Calculation of the electrostatic field of the corona discharge during the powder coating process**M. Fazlyyakhmatov, N. Kashapov***Kazan Federal University, RUSSIA*

The object of the study is the process of charging a polydisperse powder gas mixture in an electrostatic field of the corona discharge. The two-dimensional task of the distribution of the electrostatic field in a rectangular area 50*100 cm between the corona electrode and a grounded plate 50 cm long and 25 mm thick was solved. The results of modeling in the presence and absence of volumetric charges are presented. The distribution of the electrostatic potential is shown.

T2-P-6 Study of additional heating of helium arc plasma at atmospheric pressure by millisecond-long electric current pulse**D. I. Kavyrshin, M. A. Sargsyan, A. V. Efimov***Joint Institute for High Temperatures of the Russian Academy of Sciences, RUSSIA*

The need for impulse heating of helium arc plasma at 1 atm pressure to reach electron temperatures above 3.5 eV is related to its high transport coefficients which grow rapidly along with temperature making it necessary to input more power in the plasma. Optimization of pulse parameters, plasmatron geometry, gas flow regime let us achieve stable arc discharge for pulse currents with amplitude up to 2.5 kA. The reported study was funded by RFBR according to the research project № 18-32-00292.

T2-P-7 The effect of additional buffer capacity on the parameters of a glow discharge in tube**S.A. Fadeev (1), A.I. Saifutdinov (1), (2), N.F. Kashapov (1),
A.R. Akhmadullin (1)***(1) Kazan Federal University, RUSSIA**(2) St. Petersburg State University, RUSSIA*

The effect of additional buffer capacity on the current-voltage characteristic of a glow discharge is studied experimentally. The discharge was ignited between two plane parallel electrodes in a tube with inert gas at different pressures. It was found that the use of the buffer capacity can effectively control the concentration of neutral atoms and parameter E/N in the discharge. The presence of additional buffer capacity leads to more uniform diffuse glow discharge at medium and high pressure.

T2-P-8 Study of one-electrode breakdown in long discharge tube at low gas pressure

D. O. Ivanov, A.V. Meschanov, A.I. Shishpanov, Y. Z. Ionikh,
S.A. Kalinin

Saint Petersburg State University, RUSSIA

One-electrode breakdown excited by a long voltage pulse applied to one electrode while the opposite electrode remained free was studied in a long non-shielded tube in neon at 1 Torr. Only one ionization wave moved from the active electrode with no return strike and discharge ignition was observed. The tube wall non-compensated surface charge remained after IW propagation was found to be long-lived one and was measured. Potential associated with this charge was high enough to cause repeated break.

T2-P-9 The value of the temperature jump on the boundary of the primary zone of the heat sink of the electric arc

A.V. Gerasimov, A.P. Kirpichnikov, F.R. Sabirova

Kazan National Research Technological University, RUSSIA

The paper deals with the problem of the value of the temperature jump $T_e(R)$, $T(R)$ at the boundary of the main zone of the heat sink at $r=R$ where R is the radius of the limiting arc of a cylindrical tube whose walls are supported at a fixed, sufficiently low temperature $T(R)$. In this paper, this problem is solved in the framework of the well-known channel model of M. Steenbeck, as the most convenient for the analysis of a wide class of problems of maintaining the gas discharge plasma in electric and magnetic fields.

T2-P-10 Modelling the magnetic field of the acceleration channel of the End-Hall ion source

D.A. Kotov, M.A. Palmera, B.M Shandarovich

Belarusian State University of Informatics and Radioelectronics, BELARUS

End-Hall ion sources have been used for the last decades in the optical coating industry. This type of ion sources is based on magnetoplasma dynamic acceleration and Hall effects. In this research, the magnetic field was modeled near the anode to obtain a maximum magnitude of the field along the acceleration. The changes in the magnitude of the components of the magnetic field were determined: for the component B_x a decrease of 10% and for B_y an increase of 20% was observed.

T2-P-11 Numeric simulation for a single pulsed plasma jet-capillary discharge with an evaporating wall

V.V. Kuzenov (1,2,3), K.V. Polyakov (1), S.V. Ryzhkov (1)

(1) *Bauman Moscow State Technical University, RUSSIA*

(2) *Ishlinsky Institute for Problems in Mechanics RAS, RUSSIA*

(3) *Dukhov All-Russian Research, RUSSIA*

Numerical simulation for interaction of pulsed plasma jets generated by atmospheric capillary discharge is presented. The plasma source is based on a plasma jet established at the end of a capillary discharge at atmospheric pressure. Interaction between the pulsed plasma jets and the shock wave/contact boundary layer is analyzed. The plasma jet for magneto-inertial fusion must be created in a vacuum environment. Preliminary results on an array of pulsed capillary discharges are presented.

- T2-P-12 Nanosecond pulse DBD source for modification of polymers**
E.A. Shershunova, S.I. Moshkunov
Institute for Electrophysics and Electric Power RAS, RUSSIA

The DBD plasma source with a power supply from a home-made generator on a base of composite solid-state switches was developed for modification of polymers surface. The volume air plasma with regulated average power density from 100 mW/cm² to 2 W/cm² can be used for modification of PTFE films. The preliminary results showed that nanosecond pulse DBD plasma could uniformly treat the PTFE surface causing a significant reduction of the contact water angle.

- T2-P-13 Plasma decay in heated H₂O-containing gaseous mixtures and hydrocarbons after high-voltage nanosecond discharge**
M.A. Popov (1), A.Yu. Starikovskiy (2), I.V. Kochetov (3), N.L. Aleksandrov (1)
(1) Moscow Institute of Physics and Technology, RUSSIA
(2) Princeton University, USA
(3) Troitsk Institute of Innovative and Thermonuclear Research, RUSSIA

The results of the experimental study of high-voltage nanosecond discharge plasma decay in heated water vapor with nitrogen and oxygen and in gaseous hydrocarbons were presented. The gas temperature ranged from 300 to 700 K and the gas pressure ranged from 2 to 10 Torr. Effective electron-ion recombination coefficients were obtained. Recombination rates were greatly decreased with increasing gas temperature. Numerical calculations of electron density and ion composition were conducted.

- T2-P-14 Mode transition and electron heating in dual frequency dielectric barrier discharge at atmospheric pressure**
A.A. Saifutdinova (1), B.A. Timerkaev (1), A.I. Saifutdinov (2,3)
(1) A.N. Tupolev Kazan National Research Technical University, RUSSIA
(2) Kazan Federal University, RUSSIA
(3) Saint Petersburg University, RUSSIA

Plasma ionization, excitation, mode transitions and associated electron heating mechanisms in atmospheric pressure dielectric barrier discharges (DBD) driven by dual radio frequency sources are investigated in this work. The results have demonstrated that the independent control of plasma parameters via non-linear synergistic effect between the dual frequency sources can be achieved through reasonable selection of processing parameters.

- T2-P-15 Dynamics of one-electrode discharge in branched tube at low gas pressure**
A.I. Shishpanov, D.O. Ivanov, A.V. Meschanov, S.A. Kalinin
Saint Petersburg State University, RUSSIA

Splitting of ionization wave (IW) in two fronts was observed in branching (Y-shape) three-electrode tube filled with neon at 1 Torr. The source of IWs was one-electrode discharge excited by voltage pulses applied to one electrode while the opposite electrode remained free. It was observed that IW from one channel splits into two waves in branching point each propagating in other channels with lower speeds than origin wave. Collision of two waves in one channel results in their annihilation.

T2-P-16 Influence of a constant magnetic field on the uniformity of plasma generated by a planar ICP sourceA.A. Yasunas, D.A. Kotov*Belarusian State University of Informatics and Radioelectronics, BELARUS*

In this work a research of the influence of a constant magnetic field distribution in a plasma reactor on the basis of a planar ICP (inductively coupled plasma) source on plasma concentration distribution is introduced. The ICP source of 200 mm in diameter with a four-spiral helical antenna system has a discharge gap 55 cm in length. The magnetic trap configuration wherein plasma uniformity improves from $\pm 37\%$ to $\pm 24\%$ was found at a distance of 120 mm from a plasma source.

Section 5 - Laser and plasma interaction with surfaces**T5-P-1 Ablation treatment of dental tissue by ultraviolet radiation**S.S. Anufrick, A.P. Volodenkov, K.F. Znosko*Grodno State University, BELARUS*

Ablation influence of ultraviolet radiation on a surface of dental enamel and dental calcium was investigated. Ablation threshold of power density for formation of craters in dental enamel and calcium were determined. The dependence of the depth of a crater in dental enamel and calcium on density of power was investigated. Specific energies of evaporation of dental enamel and dental calcium for different power densities were determined.

T5-P-2 Generation of electric potential and magnetic field during bichromatic laser irradiation of titanium target in airA.N. Chumakov, N.A. Bosak, N.I. Chubrik, A.A. Ivanov*B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS*

A repetitively pulsed action of laser radiation (LR) makes it possible to vary the air plasma/erosion plasma relationship by increasing a pulse repetition rate to values higher than 5 kHz, which raises the efficiency of both the laser ablation of a target in air and the generation of a magnetic field. The aim of the paper is to elucidate the features of generating the electrical potentials and magnetic fields on exposure of a titanium target in air to paired LR pulses at the Nd:YAG laser harmonics.

T5-P-3 Nb-C-N-Fe surface layers synthesis in high speed steel by compression plasma impactN.N. Cherenda (1), V.V. Uglov (1), V.M. Astashynski (2),

A.M. Kuzmitski (2)

*(1) Belarusian State University, BELARUS**(2) A.V. Lykov Heat and Mass Transfer Institute, NAS of Belarus, BELARUS*

The phase and element composition of AISI T1 high-speed steel surface layers alloyed with niobium atoms were investigated in this work. Alloying was carried out by deposition of Nb coating on the steel surface and the following treatment with compression plasma flows. The findings showed that plasma impact resulted in the formation of two main sublayers in steel modified layer: Nb-C-N-Fe film containing Nb(N,C) phase and steel surface layer alloyed with Nb atoms.

T5-P-4 Nonequilibrium processes of intense laser radiation interaction with heterogeneous media containing of nanoparticles with plasma formation

V.K. Pustovalov (1), A.N. Chumakov (2)

(1) *Belarusian National Technical University, BELARUS*

(2) *B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS*

Nonequilibrium processes of intense laser radiation interaction with heterogeneous media containing of nanoparticles are very interesting for laser and plasma treatment and modification of different materials and media. Analysis of the parameters of mentioned processes and their temporal dependencies, taking into account the preceding optical, thermal and heating processes, allows to describe the final results. These processes can be used for the applications in the synthesis of new materials.

T5-P-5 Peculiarities of steam and plasma bubble evolution during treatment of a metal sample in liquid by laser pulses with different durations

A.Yu. Ivanov, A.V. Kapytski, S.V. Vasiliev

Grodno State University, BELARUS

It is shown experimentally that using radiation of GOR-100M laser operating in free oscillating regime (pulse duration 1.2 ms, laser radiation flux density $\sim 10^6$ W/cm²) for metal surface treatment we obtained the form of a crater on the irradiated target in water different from the topography of the crater developed on the analogical target surrounded by air at normal pressure (10^5 Pa). Using pulses with duration ~ 1 μ s and energy ~ 1.5 J we obtained craters with a form similar to the craters observed after treatment of the analogical target in air at normal pressure. It is pointed that the substantial difference of the forms of crater surfaces is determined by principally different character of plasma, steam and gas mixture flow in the mentioned cases.

T5-P-6 Plasma cleaning of steel products using a liquid electrode

A.T. Gabdrakhmanov, I.H. Israphilov, A.T. Galiakbarov

Kazan Federal University, RUSSIA

In this paper, we present a method for cleaning the surface of steel articles using a vapor-gas discharge, and also describe the results of surface investigations of samples after their cleaning.

T5-P-7 Features of target electrization and generation of magnetic field in process of bichromatic laser ablation of niobium in air

A.N. Chumakov, N.A. Bosak, M.G. Sugak

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

The aim of this work is to study laser ablation features of a metal with high melting and boiling points such as niobium when it is irradiated by double laser pulses at the first and second harmonics of the Nd:YAG laser and to reveal the features of generation of magnetic and electric field in such conditions.

T5-P-8 Structural and optical studies of copper oxide-based nanostructures

S. Pashayan

Institute for Physical Research, NAS of Armenia, ARMENIA

Nanostructured copper oxides thin films and nanoparticles were synthesized by magnetron sputtering and pulsed laser ablation (PLA). Effect of laser fluence, post annealing temperature, substrate material and temperature, film thickness and other parameters was studied. Micro- and crystal structure and optical properties of the samples were examined with SEM, EDX, XRD, UV-Vis, FTIR and Raman spectroscopy (RS). The identified RS and XRD pattern diffraction peaks can be assigned to Cu, CuO and Cu₂O.

T5-P-9 Metal coatings formation by compression erosion plasma flows interacting with surfacesP.A. Shoronov (1), V.I. Shymanski (2), V.M. Astashynski (1),
A.M. Kuzmitski (1), V.V. Uglov (2)*(1) A.V. Luikov Heat and Mass Transfer Institute, NAS of Belarus, BELARUS**(2) Belarusian State University, BELARUS*

In the present work the possibility of metal coatings deposition by erosion compression plasma flows is discussed. The erosion flows formation occurs due to erosion of the electrodes material in the discharge device. The products of the erosion are accelerated by dense compression plasma flows and achieve the surface of a sample displaced in the chamber. In the work the coatings of tungsten, nickel and copper deposited in the air residual atmosphere on the silicon surface are presented.

T5-P-10 Composite membranes with two hydrophobic layers obtained by plasma polymerizationL.I. Kravets (1), N.E. Lizunov (1), A.B. Gilman (2), V. Satulu (3),
B. Mitu (3), G. Dinescu (3)*(1) Joint Institute for Nuclear Research, Flerov Laboratory of Nuclear Reactions, RUSSIA**(2) Enikolopov Institute of Synthetic Polymer Materials, RAS, RUSSIA**(3) National Institute for Laser, Plasma and Radiation Physics, ROMANIA*

The chemical structure, surface and electrotransport properties of the composite membranes prepared by deposition of plasma-polymerized hexamethyldisilazane nanoscale films onto a polypropylene track-etched membrane surface have been studied. It is shown that the applying such layers results in bilayer composite membranes with both the layers having hydrophobic properties. It is established that composite membranes of such type featuring asymmetric conductivity in solutions of electrolytes.

T5-P-11 Laser ablation of sapphire on wavelength of 1040 nm

B.A. Shulenkova, A.V. Danil'chik, A.G. Vainilovich, E.V. Lutsenko

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

Laser ablation for sapphire wafers cutting was investigated using a Yb-laser (60 kHz, 300 fs). Two types of ablation, with and without laser spark, were studied. We showed that laser spark formed grooves with 25 μm width and 100 μm depth. However, wet etching of grooves showed that cracks occurred on the creases of cuts, due to high pressures of laser plasma. Decrease in intensity up to spark disappearance led to the decrease in the cut's width to 15 μm without cracks, which corresponded to waist.

T5-P-12 Mechanisms of polymethylmethacrylate laser destruction in different mediaA.Yu. Ivanov, S.V. Vasiliev*Grodno State University, BELARUS*

Laser treating of polymethylmethacrylate and the formation of a crater on the surface of a given dielectric and caverns in its volume under the action of a laser radiation are considered. The character of the change in the parameters of the crater and caverns was studied as a function of the energy of the laser pulse acting on the sample under study. Experiments were carried out during which the sample was located in the air and liquid. It is shown that in an aqueous medium a crater on the surface of the irradiated sample is formed only if a black spot is placed on the surface in the region of focusing of the laser radiation. It is also shown that the development of caverns located closer to the irradiated surface hinders the development of more remote caverns (screening). It is concluded that the main mechanism for the development of a crater on the surface of a sample of polymethylmethacrylate during its laser treatment is its burning.

T5-P-13 Comparative study of the laser induced helium gas plasma spectroscopy with single and double pulse LIBS

K.H. Kurniawan (1), A.N. Chumakov (2) and K. Kagawa (3)

*(1) Research Center of Maju Makmur Mandiri Foundation, INDONESIA**(2) B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS**(3) Fukui University, JAPAN*

Despite the well established advantages and popularity of the widely used LIBS for practical and rapid spectrochemical analysis, there are obviously rooms for its further improvements. The need to overcome the Stark broadening and time mismatching effects for achieving high resolution and highly sensitive detection as well as the demand for the linear calibration line with zero intercept required by reliable quantitative analysis remain the challenging problems for certain important application.

Hall III

17:00-18:40

Poster Session 2

Section 3 - Non-equilibrium effects and atmospheric pressure plasma processes, plasma in and in contact with liquid

T3-P-1 Plasma-electrolyte production of stainless steel powder for selective laser melting technology

L.N. Kashapov, R.N. Kashapov, N.F. Kashapov

Engineering institute, Kazan Federal University, 18 Kremlevskaya str., 420008, Kazan, Russia, RUSSIA

Search of new methods for obtaining metallic powders satisfying additive technologies requirements is an urgent task. In the work, studies have been carried out to obtain a 17-4 PH powder in a gas discharge plasma with a liquid electrode. Regularities characterizing the influence of input power, voltage and discharge current on the properties of the powder obtained are revealed. The combustion conditions of discharge are determined, at which minimum oxidation of powder particles is observed.

T3-P-2 The determination of the content of metal ions in water solutions by use of a dc-current discharge with a liquid cathode

N. Sirotkin, V. Titov

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

The emission-spectral analysis of water and aqueous solutions on the content of metal ions is one of the promising applications of plasma-solution systems. It is established that the composition of the electrolyte-cathode affects the emission intensities of the lines of metal atoms. We suggest adding an aliquot of a solution of a metal salt with a known concentration to the analyzed solution and further determining the number of atoms of the analyzed metal in the plasma by the actinometry method.

T3-P-3 Application of sliding discharge plasma for decomposition of liquid hydrocarbons and production of carbon nanomaterials

A.O. Sofronitskiy (1), B.A. Timerkaev (1), K.G. Sadikov (2),
M.S. Denisyuk (1)

(1) Kazan National Research Technical University named after A. N. Tupolev, RUSSIA

(2) Kazan Federal University, RUSSIA

The paper presents the results of experiments on the effect of sliding discharge plasma on liquid hydrocarbons. In this case, liquid hydrocarbons serve as a discharge dielectric. It was established that hydrocarbons were broken down into smaller fractions and carbon nanoparticles were formed in the course of the experiments.

Section 4 - Non-ideal and dusty plasmas, fusion and astrophysical plasmas

T4-P-1 **Plasma-dust structures in a DC discharge in magnetic field**

A. Abdirakhmanov, M.K. Dosbolayev, T.S. Ramazanov

Institute of Experimental and Theoretical Physics, Al-Farabi Kazakh National University, KAZAKHSTAN

In this work we investigated the properties of dust structures in a magnetic field, where influence of a narrowing current channel (the diaphragm in the form of a cone) can be neglected, since it is absent in the volume of the discharge tube. Experimental conditions: gas-argon, pressure $P = 0.1-0.25$ Torr, discharge current $i = 0.5-1.5$ mA, induction of external magnetic field $B = 0-400$ mT. As dust particles, polydisperse aluminum with a characteristic size of 1 to 10 μm was used.

T4-P-2 **Melamine-formaldehyde particles in complex plasma**

V.Yu. Karasev, E.S. Dzlieva, A. Gorbenko, S.I.Pavlov

St. Petersburg State University, RUSSIA

Melamine-formaldehyde spherical microparticles, falling into neon dc glow discharge, acquired an electric charge on their surface and hung in a dust trap, where the electric field strength was strong enough. Depending on the exposure time, the particle sizes and surface properties changed. Scanning electron microscopy provided insight in the particle morphology changing.

T4-P-3 **Forced vertical oscillation of a single dust particle in a stratified glow discharge**

A. A. Kartasheva, Yu. B. Golubovskii, V. Yu. Karasev

St. Petersburg State University, RUSSIA

Amplitude-frequency characteristics of a single dust particle oscillation are obtained in the range of pressures $p=0.06-0.66$ Torr. The main resonance peaks at the frequency close to the eigenfrequency of the dusty plasma system and the maxima at multiples of the resonant frequencies were observed at lowest pressures. The values of the vibrational characteristics of the dusty plasma system are determined. The calculation of the dust particle charge with the help of eigenfrequency is made.

T4-P-4 **Surface heating of dust in cryogenic plasma medium**

M.M. Muratov (1,2), T.S. Ramazanov (1), Zh.A. Moldabekov (1,3)

(1) *Institute for Experimental and Theoretical Physics, Al-Farabi Kazakh National University, KAZAKHSTAN*

(2) *National Nanotechnological Laboratory of Open Type, Al-Farabi Kazakh National University, KAZAKHSTAN*

(3) *Institute of Applied Sciences and IT, KAZAKHSTAN*

In this work we investigated the surface heating of dust in cryogenic plasma medium at low gas pressure. The surface temperature of dust grain at low pressure was calculated and it was shown that the temperature is significantly higher than that of the background gas. The temperature near the surface of the dust grain is a slowly decreasing function of distance.

T4-P-5 Dust plasma in the glow discharge in moderate magnetic field

S.I. Pavlov, V.Yu. Karasev, E.S. Dзлиeva, L.A. Novikov
Saint Petersburg State University, RUSSIA

In the present thesis we discuss in details the problems of the obtaining of steady dust structures in the trap in the glow discharge at a partial magnetizing of the plasma component. In the experiment the dusty plasma was created in glow discharge in the long discharge tube placed in the magnetic field created by a superconducting magnet. The dynamics of rotation of dust structure at the chosen discharge parameters depending on magnetic induction is measured.

T4-P-6 Density waves in a structure of charged particles in the electrodynamic trap

V.I. Vladimirov, L.V. Deputatova, V. S. Filinov, D.S. Lapitsky,
V.Ya. Pecherkin, R.A. Syrovatka, L.M. Vasilyak, O.F. Petrov
Joint Institute for High Temperatures, Russian Academy of Sciences, RUSSIA

For the first time the stable structures of microparticles in a dynamic linear trap with corona electrodes have been obtained. The possibility for capturing and confining of microparticles in a linear electrodynamic trap with corona electrodes at atmospheric pressure has been studied experimentally. The corona discharge on the electrodes of the trap was generated by an alternating electric field.

T4-P-7 Coulomb structures in a linear electrodynamic trap by an electric field

R.A. Syrovatka, L.V. Deputatova, V. S. Filinov, D.S. Lapitsky,
V.Ya. Pecherkin, L.M. Vasilyak, V.I. Vladimirov
Joint Institute for High Temperatures, Russian Academy of Sciences, RUSSIA

A method of the controlled effect by the electric fields on Coulomb structures in the linear electrodynamic trap for the controlled compression and stretching of these structures was proposed. The obtained images of the Coulomb structures at various frequencies by rectangular pulses of the electric field are presented. Such effects can be used to obtain the thermodynamic properties of the Coulomb structures by the statistical method.

T4-P-8 Production of spherical particles in stream of thermal plasma based on aluminosilicate raw materials

G. Volokitin, V. Shekhotsov, N. Skripnikova, O. Volokitin
Tomsk State University of Architecture and Building, RUSSIA

In order to obtain hollow microspheres based on refractory oxides and silicates, high-temperature carrier medium should be provided as the melting temperature of particles achieves more than 2000 K. Thermal plasma energy as a heating source for agglomerated particles can be used. This type of energy provides 3000÷5000 K temperatures allowing to use raw materials with high melting temperatures.

Section 6 - Plasma spectroscopy and other diagnostic methods

T6-P-1 **Relationship of spectral and temperature characteristics in an acoustoplasma gas discharge**

A.S. Abrahamyan, T.Zh. Bezhanyan, R.Yu. Chilingaryan
Institute of Applied Problems of Physics, NAS of Armenia, ARMENIA

The emission spectra (300-800 nm) of the gas discharges with a direct current and in the acoustoplasma mode were studied. We used spectrograph Ocean Optics PC-2000. The measurements were carried out on a discharge tube of a working CO₂ laser with a radiation power of several Watts and on specially developed discharge tubes.

T6-P-2 **Luminescence of silicon dioxide during reactive ion plasma etching**

A.V. Abramov, E.A. Pankratova, I.S. Surovtsev
Voronezh State Technical University, RUSSIA

The article presents the results of a study of luminescent glow of silicon dioxide in the process of its reactive ion-plasma etching, which has the highest intensity in the plasma of fluorinated gases. It is established that this emission is accompanied by the phenomenon of interference. Probable mechanisms of this phenomenon are considered. The possibility of using the phenomenon of luminescence to control the etching of SiO₂ film is shown, as well as the layers of other materials lying on it.

T6-P-3 **Diagnostics of pulsed plasma in accelerator IPU-30**

A.B. Tazhen, A.U. Utegenov, M.K. Dosbolayev, T.S. Ramazanov,
Zh. Raiymkhanov
IETP, Al-Farabi Kazakh National University, KAZAKHSTAN

In this work the results of the complex diagnostics of pulsed plasma in accelerator IPU-30 are presented. The energy of charged particles in the plasma flow and the energy density of the pulsed plasma, density of charged particles, and magnetic field distribution in the plasma at various parameters of the accelerator were investigated. Complex diagnostics was performed using a wire calorimeter, a Faraday cup and magnetic probe.

T6-P-4 **Determination of parameters of helium plasma jet with hydrocarbon admixtures by methods of emission spectroscopy**

R.Kh. Amirov, M.B. Shavelkina, D.I. Kavyrshin, M.A. Sargsyan
Joint Institute for High Temperatures, Russian Academy of Sciences, RUSSIA

This work presents spectroscopic study results of atmospheric pressure plasma jet generated by a direct current plasmatron. The plasma gas is a mixture of helium and hydrocarbon, that is being converted into nanostructures of various morphology from nanotubes and graphene to carbon nano-onions. The aim of the work is studying the composition and parameters of the plasma jet by methods of optical emission spectroscopy. The reported study was funded by RFBR according to the project № 18-08-00306.

T6-P-5 Software-hardware complex for experimental studies of characteristics of rocket engine installations during stand fire tests

S.A. Grishin (1), V.V. Klimentovski (1), N.S. Niadvetski (1),
D.A. Yagodnikov (2)

(1) SSPA "Optics, Optoelectronics and Laser Technology", BELARUS

(2) Bauman Moscow State Technical University, RUSSIA

The report presents the results of research aimed to create a high-speed sensor devices and software-hardware means for recording and processing of liquid-propellant rocket engines (LRE) status parameters using non-contact optical, thermal, electromagnetic, acoustic and other means of monitoring. The results of studies of combustion and destruction processes of LRE structural elements, time and amplitude-frequency characteristics of physical fields of LRE plasma flows are given.

T6-P-6 The evolution of intensity of FeO band, temperature and electron density of laser induced plasma on the iron oxide surface.

T.A. Labutin, S.M. Zaytsev, A.M. Popov

Lomonosov Moscow State University, RUSSIA

The systematic registration of emission spectra resulting from impact events in the Earth's atmosphere is currently being used for the determination of the mechanism of the ablation of astral bodies of natural and industrial origins. The temperature of plasma formed by the meteor entering the atmosphere is close to those one of nanosecond laser-induced plasma. The aim of this work is the investigation of evolution of the laser induced plasma on the surface of model object (iron oxide).

T6-P-7 Measurements of the OH concentration by optical absorption in a shock tube

O. Penyazkov (1), N. Miatselskaya (2), A. Skilandz (1)

(1) A.V. Luikov Heat and Mass Transfer Institute, BELARUS

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

The work is devoted to the measurement of OH concentration in a shock tube behind reflected shock waves by UV absorption spectroscopy. The radiation of xenon lamp was transmitted through a gas of interest and monitored using photomultiplier. Measurements were performed for A²Σ⁺-X²Π (0,0) band of the OH absorption spectrum. The characteristics of the OH absorption were calculated using HITRAN spectroscopic database. Time-resolved OH concentration was inferred from the measured absorption.

T6-P-8 Temperature measurement in anode spots on the metal surface by the spectral method

L.M. Simonyan, Ya.L. Kats

National University of Science and Technology "MISIS", RUSSIA

Spectral measurements of the anode spot temperature were done in the region of "transparency" of argon plasma using the continuous emission of metal without argon lines. A tungsten tube was used as a cathode. Fe, Ni, W, Zr and steel temperatures were measured. A temperature of the anode spots on the metals surface reaches its boiling point (besides W).

- T6-P-9 Optimisation of plasma parameters for bacteria decontamination**
 U. Cvelbar (1), M. Modic (1), N. Hojnik (1), A. Jurov (1,2),
 Z.Lj. Petrović (3), N. Škoro (3), K. Spasić (3), D. Vujošević (4),
 V. Vuksanović (4), M. Đurović (4)
 (1) *Jozef Stefan Institute, SLOVENIA*
 (2) *Jozef Stefan International Postgraduate School, SLOVENIA*
 (3) *Institute of Physics, University of Belgrade, SERBIA*
 (4) *Center for Medical Microbiology, MONTENEGRO*

Atmospheric pressure plasma jet (APPJ) was used as an alternative to conventional bacteria sterilisation techniques. The focus was on finding the most efficient parameters thus diverse input voltages and gas flows were tested. After obtaining the optimal parameters for the decontamination, plasma source was diagnosed with optical emission spectroscopy, ICCD imaging and electrical measurements.

- T6-P-10 Probe diagnostics of argon electron beam plasma**
V.O. Konstantinov, V.G. Shchukin, R.G. Sharafutdinov
Institute of Thermophysics SB RAS, RUSSIA

The results of probe measurements of secondary electrons temperature and density are presented in free argon jet activated in electron-beam plasma. The measurements were carried out using a double electrostatic Langmuir probe. On the cold plasmatron prototype at primary beam energy of 1 keV dense and cold plasma with a cross dimension of about 80 mm was obtained. Plasma with such parameters is favorable for the deposition of high-quality silicon layers in the forvacuum pressure range.

- T6-P-11 Investigation of C₂ and CN band emission as a tool for determining the temperature of an argon arc plasma**
D.P. Ranković (1), M.M. Kuzmanović (1), J.J. Savović (2)
 (1) *University of Belgrade, SERBIA*
 (2) *VINCA Institute of Nuclear Sciences, University of Belgrade, SERBIA*

Direct current (DC) argon arc with continual aerosol supply is suitable excitation source for spectrochemical analysis. The 20% alcohol-water solution was nebulized to obtain intensive emission of molecular bands. Well-resolved molecular bands of C₂ (Swan), and CN (violet system) were used to estimate molecule vibrational and rotational temperatures. The obtained rotational and vibrational temperature were practically the same, and varied from 3500 - 6000 K, depending on the observed radial position.

Section 7 - Plasma applications

- T7-P-1 Combined LIBS-spark discharge technique for analysis carbon in steel**
V. Kiris, N. Tarasenko
Institute of Physics, National Academy of Sciences of Belarus, BELARUS

In this work we investigated the possibilities of laser induced breakdown spectroscopy - spark discharge combination for the analysis of carbon in steel under air atmosphere using the spectral line in the near infrared spectral region.

- T7-P-2 Calculation of parameters and development of experimental setup for plasma synthesis of copper nanoparticles based on data of simulation**
I.I. Fayrushin (1,4), A.I. Saifutdinov (2,3), A.O. Sofronitsky (4), B.A. Timerkaev (4)
(1) *Joint Institute for High Temperatures, RUSSIA*
(2) *Kazan Federal University, RUSSIA*
(3) *St. Petersburg State University, RUSSIA*
(4) *Kazan National Research Technical University named after A.N. Tupolev, RUSSIA*

On the basis of the hybrid hydrodynamic model numerical experiments were performed. The main parameters of the electric discharge of a direct current with copper were obtained. The obtained data were used as the main conditions for molecular-dynamics simulations of the copper vapor nucleation process. The results of the simulation formed the basis for the development of an experimental setup for the plasma synthesis of copper nanoparticles.

- T7-P-3 Unified source for power supply of acoustoplasma devices**
A.S. Abrahamyan, T.Zh. Bezhanyan, R.Yu. Chilingaryan, H.T. Hovhannisyanyan
Institute of Applied Problems of Physics, NAS of Armenia, ARMENIA

The acoustoplasma discharge requires the development of a special power source. This requires a special design of the power source. The schematic diagram of the developed source and the design of the HV transformer are given. The source is tested with acoustoplasma lasers and magnetrons. The developed source has the following parameters: power is 400 W; the output voltage is 0-20 kV; the modulation frequency range is 0-4 kHz; the depth of modulation is 0-50%.

- T7-P-4 Plasma reactor for solution treatment**
A. Essiptchouk (1), G. Petraconi (2), F. Miranda (2), F. Caliarì (2), A. Marquesi (2), L. Charakhovski (3)
(1) *Instituto de Ciência e Tecnologia, UNESP – Univ Estadual Paulista, BRAZIL*
(2) *Technological Institute of Aeronautics, BRAZIL*
(3) *A.V.Luikov Heat and Mass Transfer Institute, NAS of Belarus, BELARUS*

The plasma-chemical reactor for the treatment of liquid waste contaminated with organic matter will be presented. The principal advantages of the reactor are: high local temperature of plasma jet and low temperature of treated liquid, which diminishes corrosion of the reactor wall; elevated quenching rate preserves high concentration of radicals produced in discharge to promote advanced oxidation processes; high turbulence, induced by plasma jet, contributes to mass transfer from plasma to liquid

- T7-P-5 50 watt pulsed plasma truster system**
L. Potabachniy (1), R. Emlin (2), F. Kazankin (1), L. Yashnov (1),
P. Morozov (2)
(1) *NII Mashinostroeniya, RUSSIA*
(2) *Institute of electrophysics, Ural Branch of RAS, RUSSIA*

The structure and measured parameters of the working prototype of small-size propulsion system (PS) using liquid propellant for cosmic devices of classes "mini" and "micro" is presented. Rotation of discharge chamber by 180° allows propulsion modules to realize the functions of orientation and extra acceleration. The dry solid weight of PS is 2,5 kg, propulsion impulse changes from 0,1 to 100 μN s depending on discharges frequency. Power consumption is below 50 watt from power source 12-36 V.

- T7-P-6 Effect of seeds treatment by low pressure and atmospheric pressure plasma on the infection level and length of winter wheat seedlings**
I.I. Filatova (1), V.A. Lyushkevich (1), S.V. Goncharik(1),
N.I. Chubrik (1), A.G. Zhukovsky (2), N.A. Krupenko (2),
N.G. Poplavskaya (2), Najeeb-ur-Rehman (3)
(1) *B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS*
(2) *RUE "Institute of Plant Protection", BELARUS*
(3) *COMSATS Institute of Information Technology, PAKISTAN*

It is shown that pre-sowing plasma treatment of artificially infected winter wheat seeds promotes the increase in germination energy and decrease in the infection of seeds with fungi *Fusarium* spp. and *Alternaria* spp. Treatment by low pressure plasma led to increase in the length of sprouts and roots of wheat by 19.5 and 13.4 mm, respectively. In case of treatment by atmospheric pressure plasma, the length of sprouts and roots of wheat increased by 43.7 and 27.9 mm, respectively.

- T7-P-7 Experimental investigation of electrical and magnetic field parameters of model liquid-propellant rocket engines plasma flows during stand fire tests**
S.A. Grishin (1), V.V. Klimentovski (1), N.S. Niadvetski (1),
D. A. Yagodnikov (2)
(1) *SSPA "Optics, Optoelectronics and Laser Technology", BELARUS*
(2) *Bauman Moscow State Technical University, RUSSIA*

Experimental investigations of electrical and magnetic fields parameters of liquid-propellant rocket engine plasma flow during fire tests using dedicated modules, optimized for operation in close proximity to rocket engine are discussed. Correlation between registered electrical and magnetic fields characteristics and engine operating modes and possibility of their utilization as diagnostic indicators for development of fast-responding monitoring, control and emergency shutdown systems is shown.

T7-P-8 Investigation of the developed acoustoplasma magnetron in the sputtering mode

A.S. Abrahamyan, T.Zh. Bezhanyan, R.Yu. Chilingaryan,
H.T. Hovhannisyan, A.S. Hakobyan, A.H. Mkrtchyan,
V.V. Nalbandyan

Institute of Applied Problems of Physics, NAS of Armenia, ARMENIA

Experimental results are presented for the developed cylindrical planar acoustoplasma magnetron. The characteristics are compared with DC power and in acoustoplasma mode. The rate of sputtering increases (by 2-3 times), the directional pattern narrows. The dependences of the electron and ion currents on the substrate on the parameters of the discharge are measured.

T7-P-9 Deposition of film coatings with titanium and silver nanoparticles by means of combined magnetron-laser plasma

A.P. Burmakou, O.R. Lyudchik, V.N. Kuleshov, A.V. Stoliarov
Belarusian State University, BELARUS

The technique of the combined magnetron-laser deposition of the coatings comprising nano- and micro-dimensional particles in the solid-state matrix is considered. The conditions for the deposition processes of the coatings with titanium and silver particles in the titanium oxide matrix are represented. The significant difference of the coefficients of the transmission and absorption, of the size and surface density of particles is presented for the structures with silver and titanium nanoparticles.

T7-P-10 Surface metallic nanostructures for photoacoustic fiber-optic transducers synthesized by laser plasma condensation

A.P. Mikitchuk, K.V. Kozadaev

Belarussian State University, 5 Kurchatov, 220045, Minsk, Belarus, BELARUS

Thin layers of silver or gold nanoparticles (NPs) on the surface of optical fiber synthesized by laser plasma condensation are studied for development of photoacoustic fiber-optic transducers. In this paper we present theoretical investigation of absorption of laser radiation within metallic NPs monolayer on the surface of the optical fiber. Designs of nanostructures on the edge of the optical fiber are proposed for effective photoacoustic transducers formatted by laser plasma condensation.

T7-P-11 Laser synthesis of colloidal nanoparticles for laser ablation propulsing thruster

V.V. Kiris, A.N. Chumakov, N.N. Tarasenko, M.I. Nedelko,
A.A. Nevar, N.V. Tarasenko

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

A method is proposed for the production of colloidal carbon nanoparticles in vacuum oil for the use as a liquid working medium of laser micromotors. Colloidal nanoparticles were synthesized by laser sputtering of a graphite target above the surface of the oil under reduced-pressure helium atmosphere.

T7-P-12 Influence of elemental composition on the optical properties of $Ti_{1-x}Al_xC_{1-y}N_y$ coatings prepared by reactive magnetron sputtering

I.M. Klimovich (1), V.A. Zaikov (1), L.V. Baran (1),
V.V. Vorob'ev (2), A.M. Rogov (2), F.F. Komarov (1,3)

(1) *Belarusian State University, BELARUS*

(2) *Kazan Physical-Technical Institute, RAS, RUSSIA*

(3) *Sevchenko Research Institute of Applied Physics Problems, BELARUS*

$Ti_{1-x}Al_xC_{1-y}N_y$ films were studied by energy dispersive X-ray analysis, scanning electron microscopy, atomic force microscopy, and optical spectroscopy. The results of investigation have been shown that solar absorptance coefficient $\alpha = 0.51$ and emittance $\varepsilon = 0.44$ correspond to the $Ti_{0.72}Al_{0.28}C_{0.34}N_{0.66}$ film, $\alpha = 0.59$ and $\varepsilon = 0.43$ correspond to the $Ti_{0.51}Al_{0.49}C_{0.37}N_{0.63}$ film, and $\alpha = 0.66$ and $\varepsilon = 0.31$ correspond to the $Ti_{0.51}Al_{0.49}C_{0.37}N_{0.63}$ film.

T7-P-13 Change in adhesion properties of the silicon surface under the influence of atmospheric plasma

D. Kotov (1), T.A. Kuznetsova (2), S.A. Nikitiuk (1),
V.A. Lapitskaya (2), G.B. Melnikova (2), S.A. Chizhik (2),
U. V. Zaporozhchenko (1), E.V. Yatsevich (1)

(1) *Belarusian State University of Informatics and Radioelectronics, BELARUS*

(2) *A.V. Luikov institute of Heat and Mass Transfer of National Academy of Science of Belarus, BELARUS*

The silicon wafer surface was processed by atmospheric pressure plasma. A significant increase in adhesion after a dielectric barrier discharge plasma treatment was found. Using the method of atomic force microscopy and the method of a contact angle of wetting, the dependence of the change in the adhesion of the silicon surface on the modes of its treatment was established. The use of the atmospheric discharge plasma made it possible to change the surface properties rapidly and at low cost without its destroying.

T7-P-14 Grafting of natural polymers onto polymer films activated by DC discharge

I.S. Melnikov (1,2), M.S. Piskarev (2), T.S. Demina (1,2,3), A.I. Shpichka (3), N.N. Veryasova (3), Yu.S. Sotnikova (1,2), D.A. Kulagina (1,2), E.V. Istranova (3), A.B. Gilman (2), P.S. Timashev (3), T.A. Akopova (2)

(1) *Moscow Aviation Institute (National Research University), RUSSIA*

(2) *Enikolopov Institute of Synthetic Polymer Materials, RAS, RUSSIA*

(3) *Institute for Regenerative Medicine, Sechenov University, RUSSIA*

Polymer materials are widely used for biomedical applications ranging from catheters, heart valves, stents to biodegradable scaffolds for tissue engineering. A control of materials surface properties is critical for medical application. This research aims to evaluate an effectiveness of direct current (DC) discharge treatment of polymer films such as poly(ethylene terephthalate) and poly(L,L-lactide) as surface activation method for immobilization of proteins and polysaccharides onto the film surfaces.

T7-P-15 Regulation of the phase composition and structure of carbon coatings by plasma metals doping methods

A.S. Rudenkov, A.V. Rogachev, D.G. Piliptsov, E.A. Kulesh
Francisk Skorina Gomel State University, BELARUS

Compared with single-component coatings in Raman spectra of metal-doped layers, irrespective of the method of generation of metal plasma fluxes, carbon coatings, the ratio I_D/I_G is observed to increase. It was found that doping with a magnetron more than in the case of electric arc evaporation contributes to an increase in the number and size of sp^2 clusters. It is shown that copper doping with carbon coatings leads to the maximum increase in the number of carbon atoms with sp^2 -conjugated bond.

T7-P-16 Detector based on a nonlocal plasma of a short glow discharge for gas chromatography

A.I. Saifutdinov, S.S. Sysoev, A.A. Kudryavtsev
Saint Petersburg University, RUSSIA

A microplasma detector based on a nonlocal plasma of a short glow discharge was developed under conditions of a buffer gas flow for modern microchromatographs. Experiments were conducted on the qualitative and quantitative analysis of various calibrated mixtures, which showed the operability of the presented microplasma detector.

T7-P-17 Stability of ZrSiN nanocomposite films at air annealing

I.A. Saladukhin (1), G. Abadias (2), V.V. Uglov (1),
S.V. Zlotski (1)

(1) *Belarusian State University, BELARUS*

(2) *Institut Pprime, CNRS, Université de Poitiers, ISAE-ENSMA, FRANCE*

The structural evolution of Zr-Si-N magnetron sputtered films during air annealing has been investigated using in situ X-ray diffraction (XRD) analysis in the temperature range from 400 to 950°C, as well as by scanning electron microscopy (SEM). While the reference ZrN film starts to oxidize at $T = 550^\circ\text{C}$, the oxidation starts at 700-780°C for ZrSiN nanocomposite films. Unlike the reference samples, ternary ZrSiN films retain a better surface integrity and there are no pronounced corrosion sites after air annealing at 950°C.

T7-P-18 DBD-plasma treatment of photocatalyst impregnated with silver nanoparticles

N.A. Savastenko (1), I.I. Filatova (2), V.A. Lyushkevich (2),
N.D. Strekal (3), A.A. Shcherbovich (1), S.A. Maskevich (1)

(1) *Belorussian State University, International Sakharov Environmental Institute BSU, BELARUS*

(2) *B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS*

(3) *Grodno State University, BELARUS*

In this paper, the effects of dielectric barrier discharge (DBD) plasma treatment on the performance of ZnO-based catalysts doped with silver nanoparticles (Ag-NPs) are reported. A diminished catalytic activity was observed after impregnation with Ag-NPs. A subsequent treatment by DBD-plasma leads to the enhancement of catalysts performance.

T7-P-19 Effect of electrical characteristics of DBD on the performance of DBD plasma treated ZnO-based photocatalysts

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N.I. Chubrik (2), S.A. Maskevich (1)

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(2) *B.I. Stepanov Institute of Physics, NAS of Belarus, BELARUS*

A dielectric barrier discharge (DBD) plasma was applied to treat commercially available photocatalytic active ZnO powders. The performance of untreated and DBD plasma treated ZnO-based photocatalysts is discussed in the light of their application for photodegradation of methyl orange (MO) in aqueous solution exposed to ultraviolet (UV) light. The effect of discharge parameters (supply voltage magnitude and frequency) on the performance of DBD plasma treated ZnO-based photocatalysts was studied.

T7-P-20 Plasma-assisted synthesis of polymer-capped dye-sensitised TiO₂-based photocatalysts for methyl orange photodecomposition

N.A. Savastenko (1), V. Brüser (2), S.A. Maskevich (1)

(1) *Belorussian State University, International Sakharov Environmental Institute BSU, BELARUS*

(2) *Leibniz-Institute for Plasma Science and Technology, GERMANY*

A pulsed microwave discharge plasma was applied to treat the Ru dye-sensitised TiO₂ nanopowders (anatase). The photocatalytic activities were characterized by UV-visible absorption measurements of methyl orange dye concentrations. The catalysts were characterized by photoluminescence (PL) spectroscopy.

T7-P-21 Electrolytic plasma polishing of titanium implants

S.I. Bahayeu, I.P. Smyaglikov

Physical and technical institute of NAS of Belarus, BELARUS

Investigation of the electrolyte-plasma polishing of implants made of titanium alloys has been carried out. The electrolyte composition is developed and treatment modes are found, which ensure low roughness, gloss and surface purity. It is established that electrolyte-plasma polishing of VT6 alloy leads to a decrease of aluminum and vanadium concentrations in the surface layer from 7.3 and 2.1 at. % to 3.5 and 0.1 at. %, respectively.

T7-P-22 Obtaining of C-metal nanoparticles in plasma of magnetron discharge

M. Silamiya, A.U. Utegenov, M.K. Dosbolayev, T.S. Ramazanov

IETP, Al-Farabi Kazakh National University, KAZAKHSTAN

On the 1st stage the metal nanoparticles were synthesized using Haberland type cluster source with magnetron. Furthermore, the dependences of nanoparticles size on pressure and discharge power were obtained. On the 2nd stage, combining the magnetron and RF discharges, the carbon-metal composite nanoparticles were obtained. Moreover, the dependence of the properties of carbon-metal materials on the power and time of discharge, gas pressure, and current of the magnetron was obtained.

T7-P-23 Formation of composite membranes with hydrophilic porous substrate and hydrophobic top layer

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(3) *Shubnikov Institute of Crystallography of FSRC "Crystallography and Photonics", RAS, RUSSIA*

Polymer composite membranes with hydrophilic porous substrate and hydrophobic top layer were studied. Composite membranes were prepared by synthesis of a fluorocarbon coating on poly(ethylene terephthalate) track-etched membrane. Hydrophobic fluorocarbon top layer was obtained by electron-beam dispersion of polytetrafluoroethylene powder in vacuum. Surface topography of the membranes and the chemical structure of deposited layers were investigated.

T7-P-24 Spectroscopic measurements of the electron temperature in the reactive magnetron plasma Ar/H₂/C₂H₂, used for the synthesis of TiAlCN structures

V.A. Zaikov, I.M. Klimovich, O.R. Lyudchik, I. A. Romanov, D.V. Serafimov

Belarusian State University, BELARUS

The method of optical emission spectroscopy was used to study the synthesis of TiAlCN coating by magnetron sputtering. Goal of this work is to calculate the electron temperature as a function of pressure, excitation power, and the content of nitrogen, acetylene, and argon. We used Boltzmann plot technique to derive the electron temperature. The results show that increasing the working pressure, the ratio of nitrogen to argon and acetylene to argon leads to a decrease in the electron temperature.

T7-P-25 The impact of an air plasma jet on isolates from human habitat objects

A.V. Kazak, O.A. Emeliyanova, L.V. Simonchik and N.V. Dudchick

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

(2) *Republican unitary enterprise «Scientific Practical Centre of Hygiene», BELARUS*

The dc atmospheric pressure air plasma jet is realized. Main bioactive components for air plasma jet are RONSs. The inactivated effectiveness of the air plasma jet being developed is demonstrated on epidemically significant microbiota of medical institutions, which includes both isolates from the human habitat and isolates from sick people. The effect of the plasma jet was evaluated by inhibition zones on Petri dishes and in the concentrations of surviving microorganisms determined by colony counting method.

LASER SYSTEMS

PULSED Nd:YAG LASERS

- Pulse energy up to 1.5 J
- Flat top beam profile
- PRR up to 100 Hz
- VIS and UV Harmonic generators
- MM, TEM₀₀, SLM operation modes

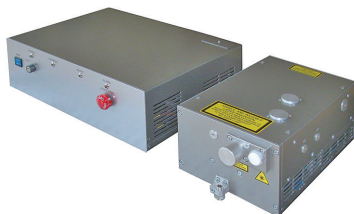
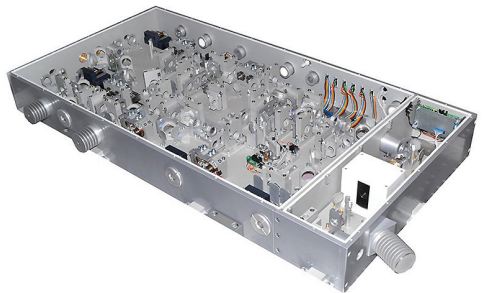


FEMTO- & PICOSECOND LASERS

- Pulsewidth from 120 fs to 10 ps
- Output power up to 10 W
- VIS and UV harmonic generators
- Laser diode pumping
- Tunable picosecond laser systems

TUNABLE LASERS

- Ti:Sapphire lasers, OPO and DFG systems
- Linewidth up to 0.1 cm⁻¹
- 0.2 ... 20 μm tuning range
- Pulse energy up to 100 mJ



DPSS LASERS

- Compact and dustproof design
- Air cooling
- Pulsed energy up to 200 mJ at 1064 nm/20 Hz
- Output power up to 3W at 355 nm/50 kHz
- VIS and UV Harmonic generators

SPECTRAL INSTRUMENTS

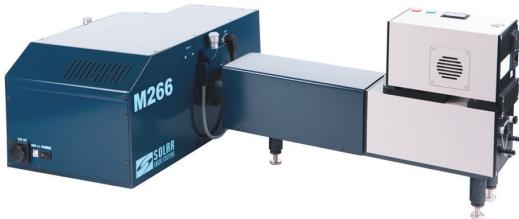
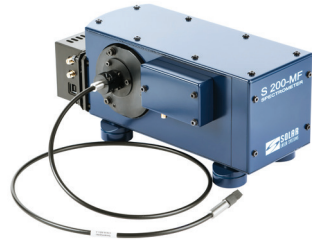


MONOCHROMATORS/SPECTROGRAPHS

- Single and double
- Focal length from 140 mm to 830 mm
- Wide range of detectors and accessories

COMPACT SPECTROMETERS

- Spectral range from 190 nm to 2600 nm
- High-sensitivity
- Multiple optical fibers imaging



POWERFUL XE LIGHT SOURCES

- Tunable from 250 nm to 2500 nm

WAVELENGTH METERS FOR LASERS AND DIODES

- Spectral range from 190 nm to 1800 nm
- High precision ± 3 pm
- Spectrum demonstration and analysis

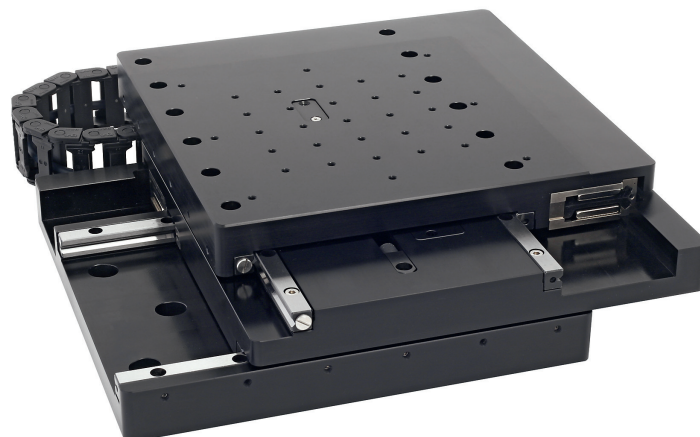


Planar XY Linear Stage

8MTL120XY

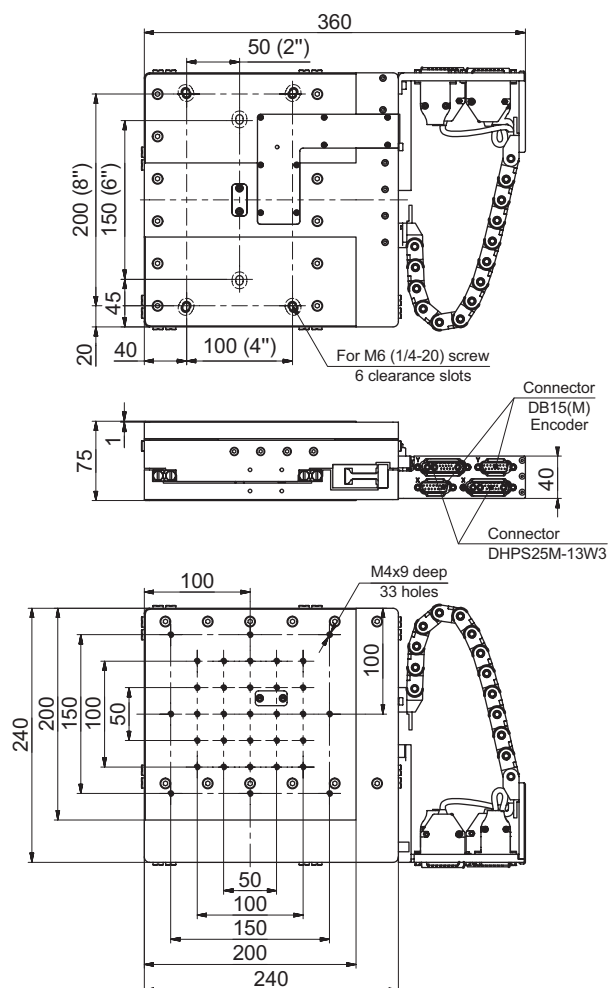
FEATURES

- Direct drive zero backlash system
- High resolution non-contact optical incremental encoder
- Integrated, low-profile, XY, linear motor stage
- High accuracy linear guide with crossed roller bearings, anti-creep
- Easy integration with metric/imperial opto-mechanical systems
- 5 arcsec orthogonality
- All measurement reports are included by default



SPECIFICATIONS

Parameter	Value
Travel range	120 × 120 mm
Motor	Linear Ironless BLDC
Encoder type	Optical
Encoder resolution	any of the range: 25 nm to 5 µm
Bi-directional repeatability	(peak to peak) ± 0.15 µm
Bi-directional repeatability (RMS)	± 0.10 µm
Absolute accuracy	
before calibration	± 4.00 µm
after calibration	± 0.5 µm
Maximum velocity (load 4kg)	< 1 000 mm/s
Maximum acceleration (load 4kg)	< 20 000 mm/s ²
Load capacity (centrally placed)	30.00 kg
Recommended controllers	8SMC5-USB series or ACS Products Line



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