# International Conference on the Physics of Low Temperature Plasma (PLTP-2017)

Journal of Physics: Conference Series Volume 927

Kazan, Russia 5 – 9 June 2017

ISBN: 978-1-5108-5311-9

ISSN: 1742-6588

# Printed from e-media with permission by:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2017) by the Institute of Physics All rights reserved. The material featured in this book is subject to IOP copyright protection, unless otherwise indicated.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact the Institute of Physics at the address below.

Institute of Physics Dirac House, Temple Back Bristol BS1 6BE UK

Phone: 44 1 17 929 7481 Fax: 44 1 17 920 0979

techtracking@iop.org

# Additional copies of this publication are available from:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571 USA

Phone: 845-758-0400 Fax: 845-758-2633

Email: curran@proceedings.com Web: www.proceedings.com

# **Table of contents**

# **Volume 927**

The International Conference "The Physics of Low Temperature Plasma" (PLTP-2017)

5-9 June 2017, Kazan University, Kazan, Russian Federation

Accepted papers received: 6 November 2017

Published online: 23 November 2017

# Preface

The International Conference "The Physics of Low Temperature Plasma" (PLTP-2017)

Peer review statement

# **Papers**

Effect of anode material on the breakdown in low-pressure helium gas

S F Adams, V I Demidov, A A Kudryavtsev, I P Kurlyandskaya, J A Miles and B A Tolson.....1

Influence of composition of electrolyte on electric discharge in liquid

M F Akhatov, F M Gaisin, F R Iskhakov, R R Kayumov, A I Kuputdinova, R A Mukhametov and A I Shpilev.....5

Combined method of stabilization of the glow discharge in gas flow

T Ya Asadullin and I G Galeey.....9

Į	Jsing	two-ch	namber	: photo	olasma	for crea	ating p	hotovol	ltaic co	onverter

S A Astashkevich, E A Bogdanov, G V Kirsanov and A A Kudryavtsev.....13

The electron beam diagnostic of the clustered supersonic nitrogen jets

S V Avtaeva, T S Yakovleva, V V Kalyada and A E Zarvin....17

On electron attachment effect on characteristics of the DBD in chlorine and its mixtures with xenon

S V Avtaeva....23

<u>Interaction of low-temperature plasma with knitted fabric based on natural cellulose</u> fibers

A A Azanova, I A Borodaev, A A Shakhirov, V A Sysoev and V S Zheltukhin....29

Numerical solution of the initial boundary value problems of radio-frequency capacitive coupled discharge.

I B Badriev, V S Zheltukhin and V Ju Chebakova.....37

<u>Pulse-periodic HF induction-type discharge for pumping lasers on self-terminating transitions</u>

V M Batenin, V T Karpukhin, M M Malikov and M A Kazaryan....42

ICCD-imaging of a plasma glow during the prebreakdown stage of nanosecond discharges at both polarities in nitrogen, air, and argon

D V Beloplotov, M I Lomaev, V F Tarasenko and D A Sorokin....46

The gas heterogeneous flows cleaning technology from corona discharge field

A Bogdanov, A Tokarev, V Judanov and V Vinogradov.....51

<b>Processes</b>	of electron	attachment	and	detachment	in ne	<u>ar breakdown</u>	conditions	in a	ir
plasma									

N Ardelyan, V Bychkov, A Belousov and K Kosmachevskii.....55

Argon gas atoms trapping by carbon dendrites

M P Danilaev, E A Bogoslov and Y E Polskii.....60

Ion current density distribution in a pulsed non-self-sustained glow discharge with a large hollow cathode

V V Denisov, S S Kovalsky, N N Koval, I V Lopatin, E V Ostroverkhov and P M Shchani.....65

Thrust and thrust-to-power ratio in electrohydrodynamic propulsion electrode systems

D V Dremin, V Yu Khomich and I E Rebrov.....70

The experimental-theoretical model of the jet HF induction discharge of atmospheric pressure

R Gainullin and A Kirpichnikov.....75

Electrophysical and heat properties of the discharge with liquid anode

D N Mirkhanov, Al F Gaisin, A I Kuputdinova and R A Mukhametov.....81

Discharge between the jet and dropping liquid cathode and metal anode

Al F Gaisin, E E Son and N F Kashapov.....85

Modeling of glow discharge in a gas flow

I G Galeev and T Ya Asadullin....90

Nonlinear Spatial Absorption of Alfven Waves by Dissipative Plasm	inative Plasma	v Dissi	Waves by	Alfven	ption of	oatial Absor	linear S	Non
---	----------------	---------	----------	--------	----------	--------------	----------	-----

M B Gavrikov and A A Taiurskii.....95

Site of maxima of conductivity, temperatures, density of the current and specific capacity of the thermal emission in the HFI-discharge

A Gerasimov, A Kirpichnikov, F Sabirova and R Gainullin....100

High Power Argon, Nitrogen Plasma Torches

A Hakki, N Kashapov and K Sadikov.....105

Evolution of the shape of a high-current and moderate energy electron beam at its propagation through D2 at low pressure

Yu S Akishev, V B Karalnik, M A Medvedev, A V Petryakov, N I Trushkin and A G Shafikov.....111

Difference in shape and width of  $D\alpha$  lines in the overvoltage and abnormal glow regimes of open discharge in narrow gap

Yu S Akishev, V B Karalnik, M A Medvedev, A V Petryakov, N I Trushkin and A G Shafikov.....116

<u>Improvement of Technological Properties of a Vegetal Tanning Agent in Gas Discharge</u> Plasma

A K Khairullin, E F Voznesensky, G R Rakhmatullina, A M Sabirov and N V Tikhonova.....121

Materials surface smoothing to sub-nanometer level of roughness by argon cluster ion beam

N G Korobeishchikov, I V Nikolaev and M A Roenko.....125

### Electromagnetic launcher for heavy projectiles

A V Kozlov, A V Kotov, V P Polistchook, A V Shurupov and M A Shurupov.....129

Modification of an aluminum electrode in a surface dielectric barrier discharge plasma

A V Lazukin, I V Selivonin, I A Moralev and S A Krivov.....134

<u>Influence of small additives of nitrogen in 1D-modeling of non-uniform microwave</u> discharge of low pressure in hydrogen

Yu A Lebedev, A V Tatarinov and I L Epstein....138

Laser ignition of liquid petroleum gas at elevated pressures

E Loktionov, N Pasechnikov and V Telekh.....143

Influence of target structure on laser plasma generation efficiency

E Loktionov and V Telekh....147

<u>Improvement of technical purpose materials performance characteristics with the radio</u> frequency low pressure plasma

L Yu Makhotkina and V I Khristoliubova.....151

Propagation of a negative streamer over a bubble floating on a water surface

Yu S Akishev, V B Karalnik, M A Medvedev, A V Petryakov, N I Trushkin and A G Shafikov.....156

Radio-frequency Induction plasma modification effects of disperse systems based on mineral glass

I S Miftakhov, E F Voznesensky, A I Nagmutdinova, A V Trofimov, V A Sisoev, A R Garifullina and I V Krasina.....160

The change in physical and mechanical properties of technical fabric by means of plasma treatment

S Ilyushina, I Krasina, A Minyazova, M Antonova, A Parsanov and B Eworo.....165

Electrical properties of titanium nitride films synthesized by reactive magnetron sputtering

W M Mohammed, A I Gumarov, I R Vakhitov, I V Yanilkin, A G Kiiamov, S S Kharintsev, S I Nikitin, L R Tagirov and R V Yusupov.....169

Experiments on phase transitions in three-dimensional dusty plasma under microgravity conditions

V I Molotkov, V. N. Naumkin, A. M. Lipaev, D. I. Zhukhovitskii, A. D. Usachev, V. E. Fortov and H. M. Thomas.....174

Modification of polycarbonate surface in oxidizing plasma

A A Ovtsyn, S A Smirnov, T G Shikova and I V Kholodkov.....179

The shape of DBD plasma jet striking into the static and quickly moving dielectric and metallic substrate

Yu S Akishev, V B Karalnik, M A Medvedev, A V Petryakov, N I Trushkin and A G Shafikov.....184

How ionization waves (plasma bullets) in helium plasma jet interact with a dielectric and metallic substrate

Yu S Akishev, V B Karalnik, M A Medvedev, A V Petryakov, N I Trushkin and A G Shafikov.....189

<u>Modification of Surface Properties of Ultrahigh-Molecular – Weight Polyethylene Films by DC Discharge</u>

M Piskarev, A Gilman, A Kuznetsov and A Ozerin.....194

Arc ignition at heating of graphite by fixed current

V P Polistchook, I S Samoylov, R Kh Amirov and V I Kiselev.....199

The study of low temperature plasma of pulse discharge in relation to air cleaning units.

A Ponizovskiy, S Gosteev and O Kuzhel.....204

The kinetics of energetic O ions in discharge H<sub>2</sub>O plasma

A A Ponomarev and N L Aleksandrov.....210

Accurate and approximate methods to calculate capacitance and potential coefficients of two-particle system

M Rodin and A Filippov.....215

The effect of electrically conductive additives on the plasma pyrolysis of heavy hydrocarbons

K G Sadikov, A O Sofronitskiy and V M Larionov.....220

Some numerical simulation results of the dynamic temperature distribution in dc plasma torch «Thermoplasma 50-01»

A Saifutdinov, S Fadeev and I Fayrushin....224

Periodical plasma structures controlled by external magnetic field

I V Schweigert and M Keidar.....228

<u>Transition in discharge plasma of Hall thruster type in presence of secondary electron emissive surface</u>

I V Schweigert, M A Yadrenkin and V P Fomichev.....232

Effect of secondary electron emission on subnanosecond breakdown in high-voltage pulse discharge

I V Schweigert, A L Alexandrov, P Gugin, M Lavrukhin, P A Bokhan and Dm E Zakrevsky.....236

Influence of DC and AC external electric field on the propagation of "plasma bullets" along DBD helium plasma jet

Yu S Akishev, V B Karalnik, M A Medvedev, A V Petryakov, N I Trushkin and A G Shafikov.....241

The role of secondary processes in kinetics of triplet states of a hydrogen molecule in an ECR discharge

V A Shakhatov, Yu A Lebedev, A Lacoste and S Bechu....246

Antimicrobial properties of nanostructured plasma condensates from medical implants

I I Shamsutdinov, L T Bayazitova, M M Grebenshchikova and M M Mironov.....250

One-step synthesis of N-doped graphene in a plasma jet reactor

M B Shavelkina, R Kh Amirov, S L Kanashenko, A V Naumkin, I R Vahitov, A I Gumarov, I V Yanilkin and L R Tagirov.....255

Mathematical modelling of RF plasma flow at low pressure with electrodynamics

A Yu Shemakhin and V S Zheltukhin....260

Molecular dynamics simulation of ion sputtering of the solutions of sodium and calcium chlorides

N A Sirotkin, D L Gurina and V A Titov.....264

Kinetics of the synthesis of ultradisperse cadmium and zinc oxide-like powders in a plasma-solution system

K V Smirnova, D A Shutov, V V Rybkin, A N Ivanov and M V Gromov.....268

Structure pattern peculiarities and electrical characteristics of surface dielectric barrier discharge in air driven by impulse and sine high voltage

M Sokolova, V Voevodin, M Malashin, I Rebrov and N Kiselev.....273

<u>Positive Streamer in the Surface Dielectric Barrier Discharge in Air: Numerical Modelling and Analytical Estimations</u>

V Soloviev and V Krivtsov.....279

Thermal steam plasma decomposition of organochlorine compounds

A V Surov, D I Subbotin, V E Popov, S D Popov, A I Litvyikova, Gh V Nakonechniy, E O Serba and N V Obraztsov.....284

High voltage AC plasma torch operating on vapours of organic substances

A V Surov, S D Popov, E O Serba, V A Spodobin, Gh V Nakonechniy, A V Pavlov, A V Nikonov, D I Subbotin, V E Popov and N V Obraztsov.....289

Laboratory demonstration in the air red and blue mini-jets

V F Tarasenko, V A Panarin, V S Skakun and E A Sosnin.....294

Generation of runaway electrons beams during the breakdown of high-pressure gases

V F Tarasenko, A G Burachenko and E Kh Baksht.....299

The emergence and development of spark channels in the plasma column of a gas discharge between water-solution cathode and a copper anode

G K Tazmeev, B A Timerkaev and A K Tazmeev.....304

Transfer of charges and substances in a gas-discharge plasma from the liquid electrolyte cathode containing salts of alkali metal

Kh K Tazmeev, B A Timerkaev and G K Tazmeev.....308

Surface modification of additive manufactured metal products by an intense electron beam

A D Teresov, N N Koval, Yu F Ivanov, E A Petrikova and O V Krysina.....312

The low-cost microwave plasma sources for science and industry applications

V N Tikhonov, S N Aleshin, I A Ivanov and A V Tikhonov.....316

Discharge creeping along the surface in the process for producing nanomaterials

B A Timerkaev, A A Andreeva and A O Sofronitskiy.....321

<u>Creation of relief coatings on the surface of silicate materials in the plasma of radio-frequency induction discharge at low pressure</u>

A.V. Trofimov, E.F. Voznesensky, I.S. Miftakhov, A.I. Nagmutdinova, I.V. Krasina, F.S. Sharifullin and E.A. Skidchenko.....325

On transition from diffuse mode to the constricted one with high-current cathode spot in overvoltage open discharge in D2

Yu S Akishev, V B Karalnik, M A Medvedev, A V Petryakov, N I Trushkin and A G Shafikov.....329

Effect Crossed Electric and Magnetic Fields of a Glow Discharge

R. Vafin, I. Yagafarov, Y. Khusainov, A. Pesin and D. Pustovoytov.....334

Modification of polypropylene in the afterglow of the atmospheric pressure discharges in air and argon

D P Vasilkin, T G Shikova, V A Titov, S A Smirnov and N S Khomyakova.....339

On efficiency during the generation of runaway electrons beams in stationary open discharge

V S Voiteshonok, A I Golovin, A V Turkin and A I Shloydo.....344

Features of triple recombination in ultracold plasma

V S Vorob'ev....349

<u>Influence of plasma modification on hygienic properties of textile fabrics with nonporous membrane coating</u>

E F Voznesensky, R G Ibragimov, O V Vishnevskaya, V A Sisoev, G G Lutfullina and N V Tihonova.....353

Experimental study of heat transfer in a glow discharge

R F Yunusov and M M Garipov.....357

Experimental study of voltage fluctuations in a glow discharge

R F Yunusov and M M Garipov.....362

<u>Generation of quasi-perpendicular Collisionless Shocks by Laser-Produced Plasma to simulate the effects of super-compression of the Earth's magnetosphere</u>

Yu P Zakharov, A G Ponomarenko, V A Terekhin, A I Golubev, V M Antonov, E L Boyarintsev, K V Vchivkov, A V Melekhov, V G Posukh and P A Prokopov.....368

The possibilities of control of the characteristics of a glow discharge by using the organization of supersonic gas flow

B R Zalyaliev, B A Timerkaev and I I Amirzyanov.....373

The role of the ambipolar field in the formation of the EDF and the criteria of the local approximation

Chengxun Yuan, K M Rabadanov, E A Bogdanov, A A Kudryavtsev and Zhongxiang Zhou.....378

Photoionization of hydrogen molecular ion by ultrashort photo-pulse in a wide range of field magnitudes

D N Arkhipov, S A Astashkevich, A A Mityureva and V V Smirnov.....382

# Formation of high intensity ion beams with ballistic focusing

T.V. Koval, A.I. Ryabchikov, A.E. Shevelev, An Tran My Kim and V. P. Tarakanov.....386

Generation of acoustic disturbances by the moving charged gas-suspension

D A Tukmakov and N A Tukmakova.....391

Interface layer formed in a low-temperature plasma of hydrocarbons on iron

A M Lyakhovich and A A Shakov.....395

<u>Investigations of the growth of the vapor-air shell of a gas discharge with a liquid</u> electrolytic cathode of sodium hydroxide solution

R N Kashapov, L N Kashapov and N F Kashapov.....399

Research of plasma-electrolyte discharge in the processes of obtaining metallic powders

R N Kashapov, L N Kashapov and N F Kashapov.....404