IX International Conference

PLASMA PHYSICS and PLASMA TECHNOLOGY

PPPT-9

Minsk, Belarus
September 17 – 21, 2018

http://ifanbel.bas-net.by/pppt-9/Downloads.html

- The final version of the program
- PPPT-9 Book of Proceedings

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.)

International Program Committee

Chairmen: N.V. Tarasenko (Belarus)
V.E. Fortov (Russia)
T.S. Ramazanov (Kazakhstan)

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SCHEDULE OF THE PPPT-9 Preliminary version !!!

	Mon, September 17th		Tue, September 18th	Wed, September 19th	Thu, September 20th	Fri, September 21th
	7:00-19:00 Registration					
	Hall I	Hall II	Hall I	Hall I	Hall I	Hall I
9:00-9:20			Gornushkin	Savastenko	Krcma	Soni
9:20-9:40						
9:40-10:00			t1-1	t7-1	t3-1	t5-1
10:00-10:20	Opening		t1-2	t7-2	t3-2	t5-2
10:20-10:40	Petrov		t1-3	t7-3	t3-3	t5-3
10:40-11:00			10:40 – 11: 00 Coffee break			
11:00-11:20	Kuraica		t1-4	t7-4	11:00-21:00 Excursion	t5-4
11:20-11:40			t1-5	t7-5		t5-5
11:40-12:00	Gilmutdinov		t1-6	t7-6		t5-6
12:00-12:20			t1-7	t7-7		t5-7
12:20-12:40	t2-1		t1-8	t7-8		12:20 – 13:00 Young Scientist Award and Closing
12:40-14:00	12:40-14:00 Lunch					
14:00-14:20	t2-2	t4-1	De Giacomo	Filatova		
14:20-14:40	t2-3	t4-2				
14:40-15:00	t2-4	t4-3	Trtica	t7-9		
15:00-15:20	t2-5	t4-4		t7-10		
15:20-15:40	t2-6	t4-5	t6-1	t7-11		
15:40-16:00	15:40-16:00 Coffee break					
16:00-16:20	16:00-16:40 Short poster presentations		t6-2	t7-12		
16:20-16:40			t6-3	t7-13		
16:40-17:00			t6-4	t7-14		
17:00-17:20	17:00-18:40 Hall III Poster session 1		17:00-18:40 Hall III Poster session 2	t7-15		
17:20-17:40				t7-16		
17:40-18:00				t7-17		
			19:00-23:00 Conference Dinner	19:00-21:00 Ballet		

NEW FINDING IN LOW PRESSURE GAS DISCHARGES APPLICATIONS AT MEPhI

V. Kurnaev, A. Kaziev

with contribution from LaPlas staff of National Research Nuclear University MEPhI (Moscow Engineering Physics Institute):

Visgalov I.V. , Gutorov K.M., Sorokin I.A.,Tumarkin A. V., Kharkov M. M., Kolodko D. V., V. Berdnikova M. M., Mozgrin D. V., Pisarev A. A, Stepanova T. V, Borisyuk Y.V., Oreshnikova N.M

and students

Ageychenkov D. G. Drobinin V. E., Kozlova V V , Leonova K. A., Nenashev, N M.

9th International Conference on Plasma Physics and Plasma Technology, PPPT-9»
(Minsk, Belarus, 17-21, September 2018)

Outline

- **Introduction**
  - MEPhI University
  - LaPlas Institution
  - Plasma Physics Department + PSI&PT Laboratory
- **Self Oscillated Secondary Electron Emission Discharge**
- **Magnetron based technologies**
  - High-current impulse magnetron sputtering
  - Magnetron sputtering from liquid target
- **Plasmas for surface modification**
  - Inductively-coupled plasma
  - Plasma immersion ion implantation
  - Pulsed periodic abnormal glow discharge with hollow cathode
- **Conclusion**

+ Lab. on Plasma Surface Interactions and Plasma Technologies under supervision of Prof. S. Krasheninnikov (USA), now Dr.Zakharov L.E. (USA)

Conferences and schools:

Bi-annual:

- **Int. Conf. on Ion Surface interactions (ISI)** –the next in August 2019
- **Novel methods of plasma diagnostics** - the next **13-15 November 2018**
- **Int. School on Physics of Plasma Surface Interactions** (in 2 years)

Annual:

- **Plasma physics+ Laser & plasma technologies** - the next **February 2019**
- **Plasma surface interactions** - the next **24-25 January 2019**

Proceedings are published in indexed by Scopus /WoS

3rd International school on Physics of Plasma Surface Interactions MEPhI 16-20July 2018

Conclusion

New type of gas discharges are found and investigated at MEPhI:

- **Self Oscillated Secondary Electron Emission Discharge**
- **High-current impulse magnetron Discharge (HCIMD)**
- - Magnetron sputtering from liquid target
- **Pulsed Periodic Abnormal Glow Discharge with Hollow Cathode (PPAGDHC)**

It is shown that these discharges have technological potential for different tasks.

Some known discharge plasma are used to obtain products with new specific properties.

Полезные ресурсы

- http://ifanbel.bas-net.by/pppt-9/Downloads.html
- The final version of the program
- PPPT-9 Book of Proceedings

Для LIBS:

Igor Gurnushkin (*BAM Federal Institute for Material Research and testing)* Dinamical Chemical model of Laser Induced Plasma – **пригласить на СМДП-2018**

Лабутин и Зайцев *(МГУ) моделирование LIBS (с.71), регистрация молекул абляция метеоров FeO (астероидная опасность) с.279. с.372*

*Существуют открытые базы данных **NIST LIBS** (National Institute of Standards and Technology) database –можно пользоваться!*

Alessandro De Giacomo *(Univ. Bari, Italy)* ***NELIBS*** *Au наночастицы из за возб. плазмонов – многофотонная ионизация –многократно вырастает выход! (Progr.9) in Spectrochimica Acta Part B Atomic Spectroscopy 148 · June 2018*

M.Tirtica *(Белград) LIBS – new trends*

Vinca ins. of nuclear physics exp in Belgrad

Ершов Павлов -Белю

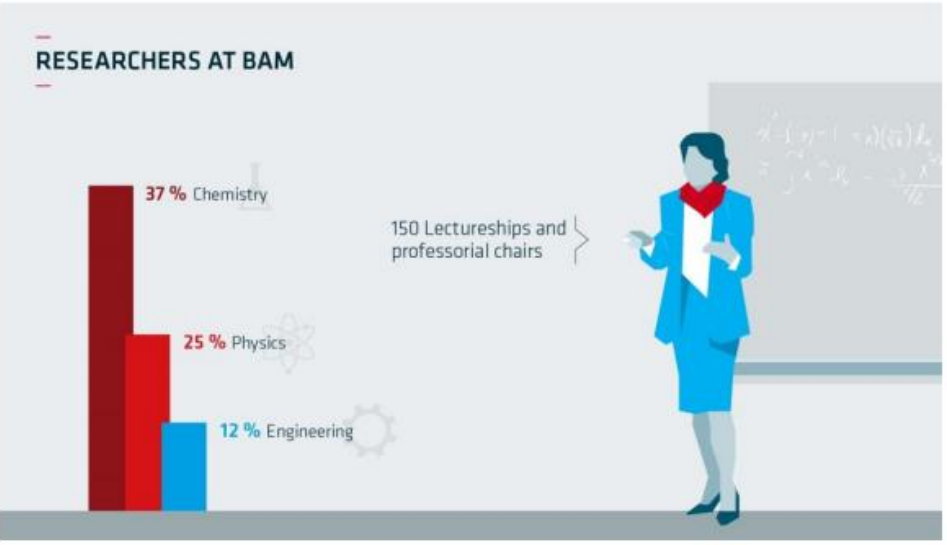
Igor Gornushkin
Bundesanstalt für Materialforschung und -prüfung | BAM
Inorganic Trace Analysis
35.88

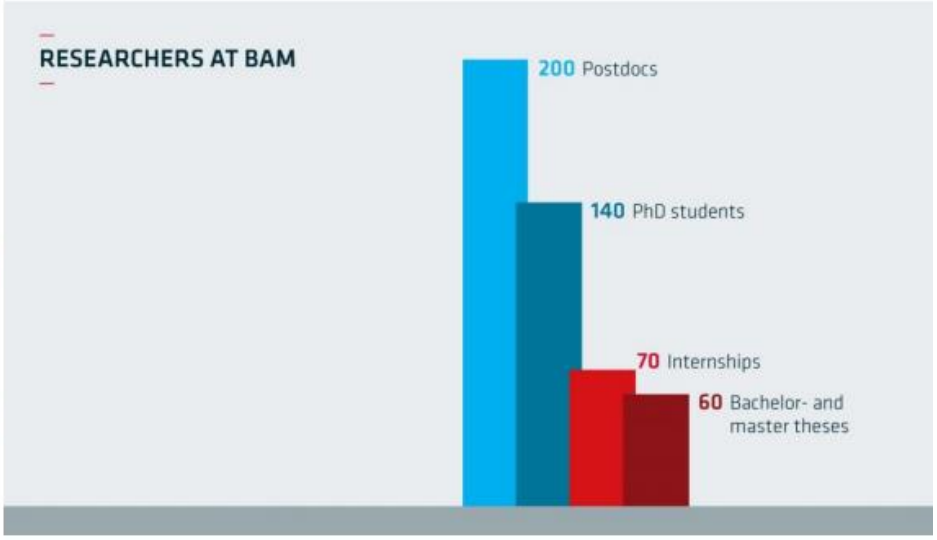
Milorad M. Kuraica
Professor, Faculty of Physics University of Belgrade

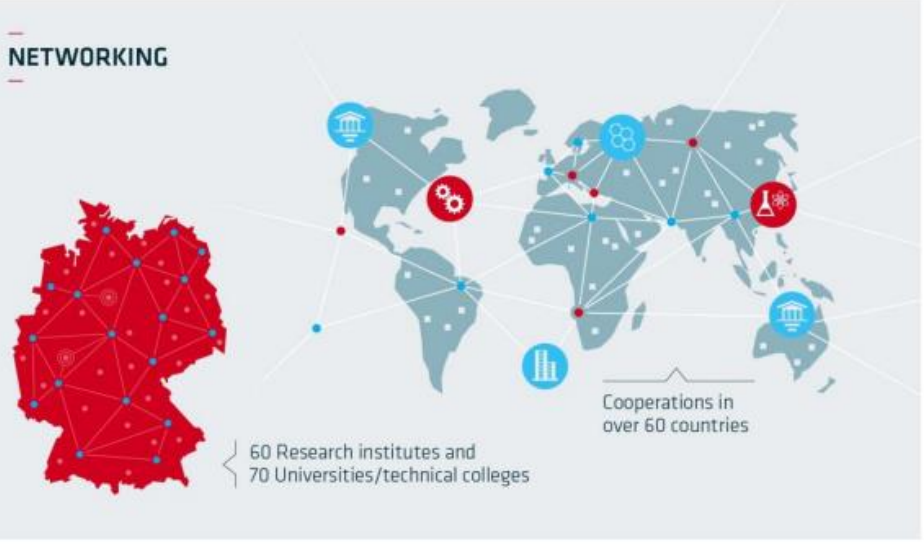
Alessandro De Giacomo
Università degli Studi di Bari Aldo Moro
Chemistry
36.53 · Chemical sciences

BAM: who?

BAM







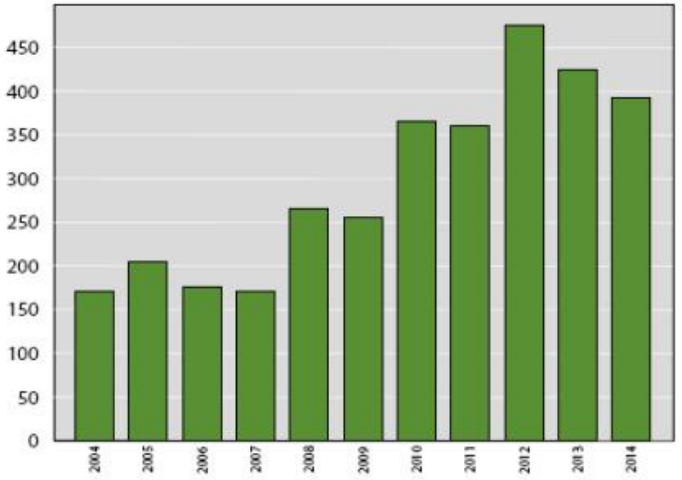
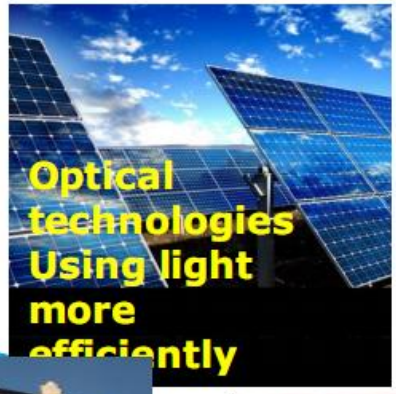


Abbildung 18: Zahl der referierten Zeitschriftenartikel der BAM von 2004 bis 2014 aus dem ISI Web of Science.

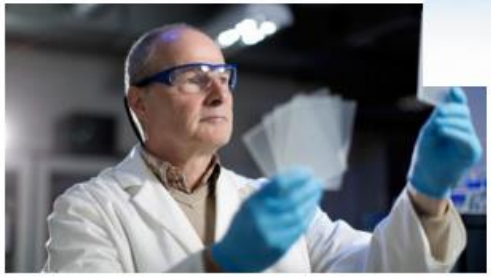
BAM: what?

Nanotechnology
Visualising
diseased cells



Standard
reference
materials

Rapid oil test
using smartphones



Polyurethane How
long do plastics last?

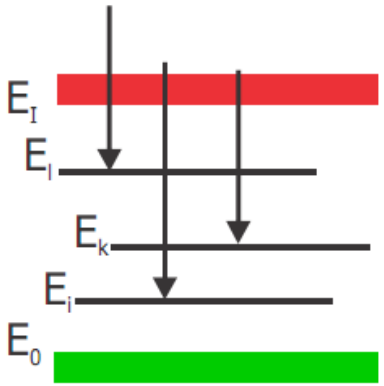
Protection from insects

Laser induced Breakdown Spectroscopy (LIBS)

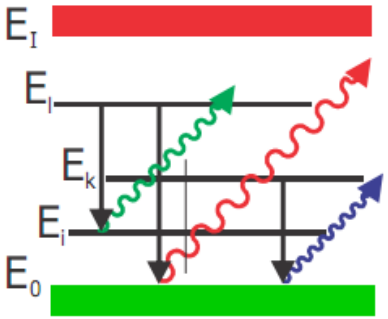
BAM

Plasma Expansion

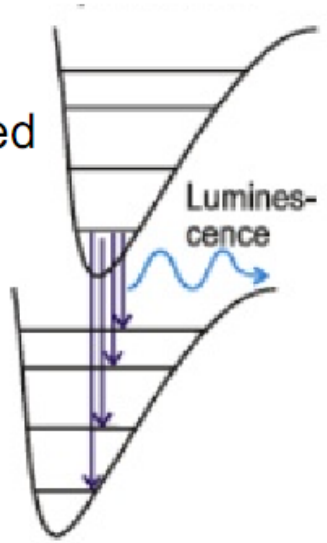
Some 100 ns:
Unspecific
ff- or fb- emission



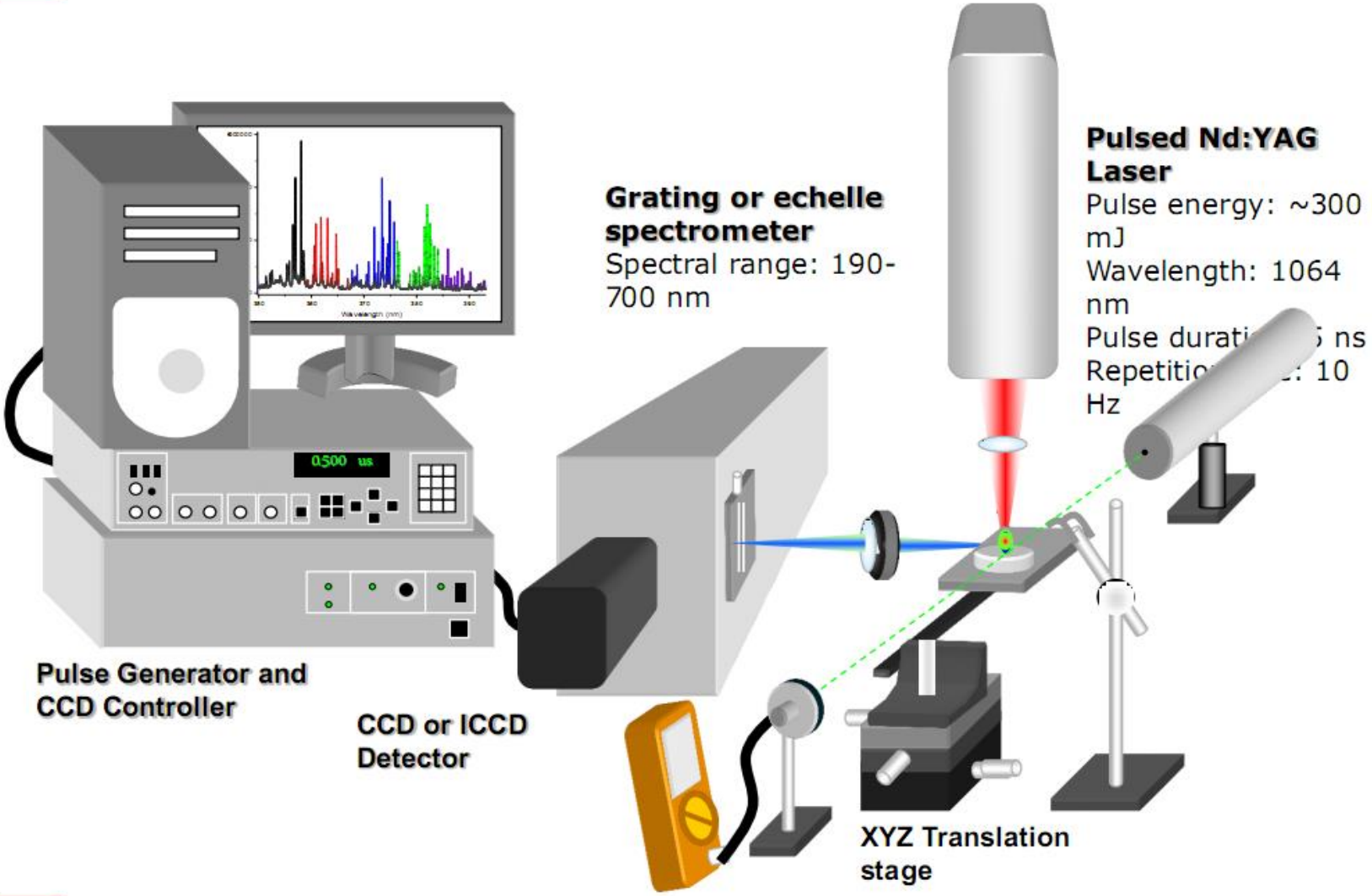
Some μs:
Emission of excited atoms and ions



Some 10's μs:
Emission of excited molecules



Instrumentation

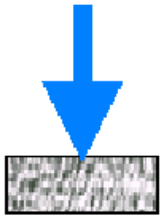


Laser induced breakdown

BAM

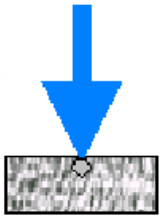
Laser strikes the surface

t=0 s



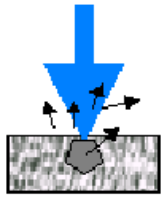
Fast increase in surface temperature

t~0-1 ns



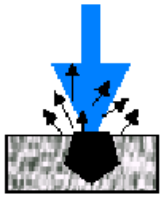
Surface melts, vaporizes

t~0-1 ns



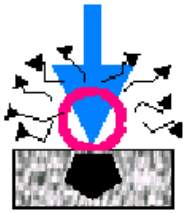
Underlying layers reach critical T,p

t~0-1 ns



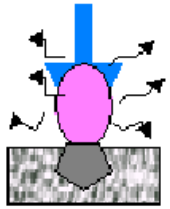
Surface explodes, breakdown occurs, plasma forms

t~1-5 ns



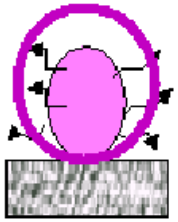
Plasma expands, becomes opaque

t~5-10 ns



Plasma continues expanding, shock wave forms

t~10 ns-10 µs

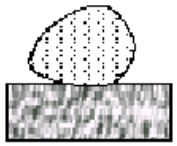


Plasma cools down, becomes unstable, decays

t>10 µs

Condensation, formation of particles and clusters

t>20 µs



Summary for modeling

BAM

- Dynamical model for LIPs is developed that includes ionization processes and general chemical network

- It allows one to model radiation spectrum of LIPs and study effects of plasma shape and dynamics on the spectrum

- It can also be used to facilitate experimental observations of formation of molecules in LIPs

- It can be used to calculate products and yields in plasma chemical reactors

PLASMA APPLICATION FOR CATALYST PREPARATION

N.A. Savastenko[1], I.I. Filatova[2], V.A. Lyushkevich[2], V. Brüser[3], S.A. Maskevich[1]

[1]International Sakharov Environmental Institute BSU, Belarus

[2]B.I. Stepanov Institute of Physics, National Academy of Sciences of Belarus

[3]Leibniz-Institute for Plasma Science and Technology Greifswald, Germany

IX International Conference
PLASMA PHYSICS AND PLASMA TECHNOLOGY (PPPT – 9)

Minsk, Belarus, September 17 – 21, 2018

PLASMA APPLICATION FOR CATALYST PREPARATION

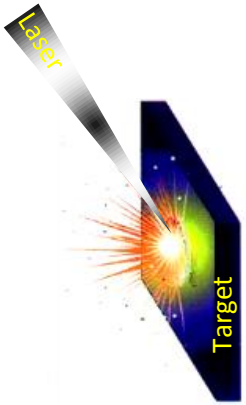
Basic Principles

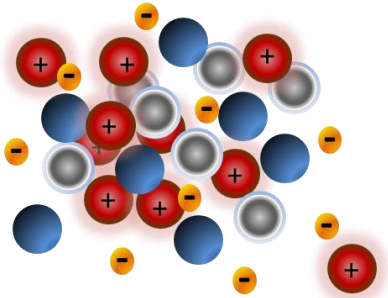
Synthesis of catalytically active nanoparticles

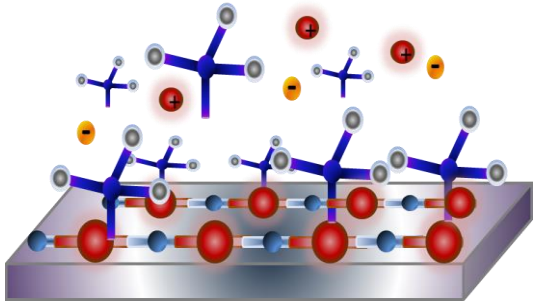
Plasma assisted deposition of catalytically active materials on the support

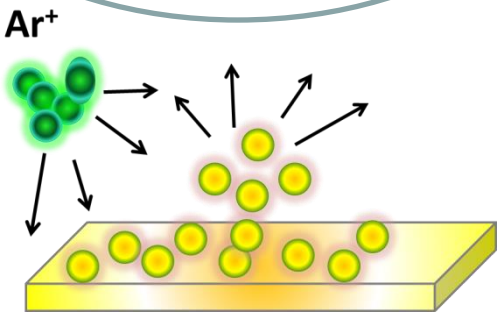
Plasma

Laser ablation





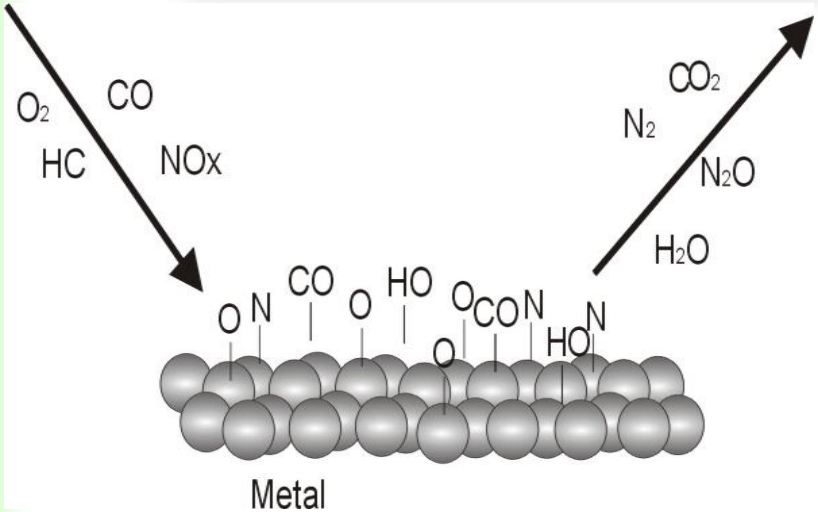




Plasma modification of either catalysts or support

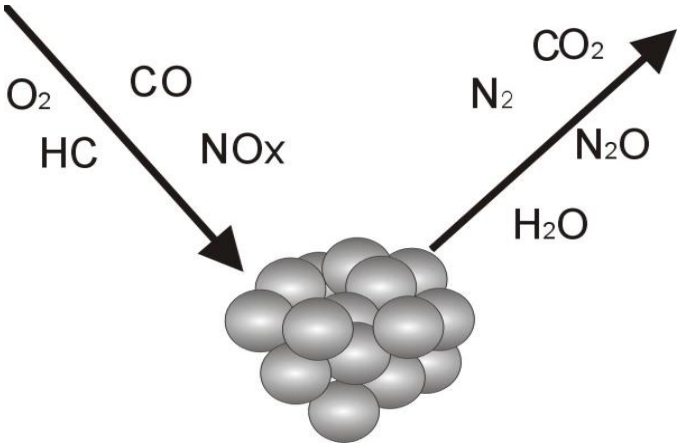
AUTOMOTIVE EXHAUST GAS CATALYSTS

Automotive Catalysis on Nanoscale



catalysis on metal surfaces ***depends on*** the face of the metal crystal used

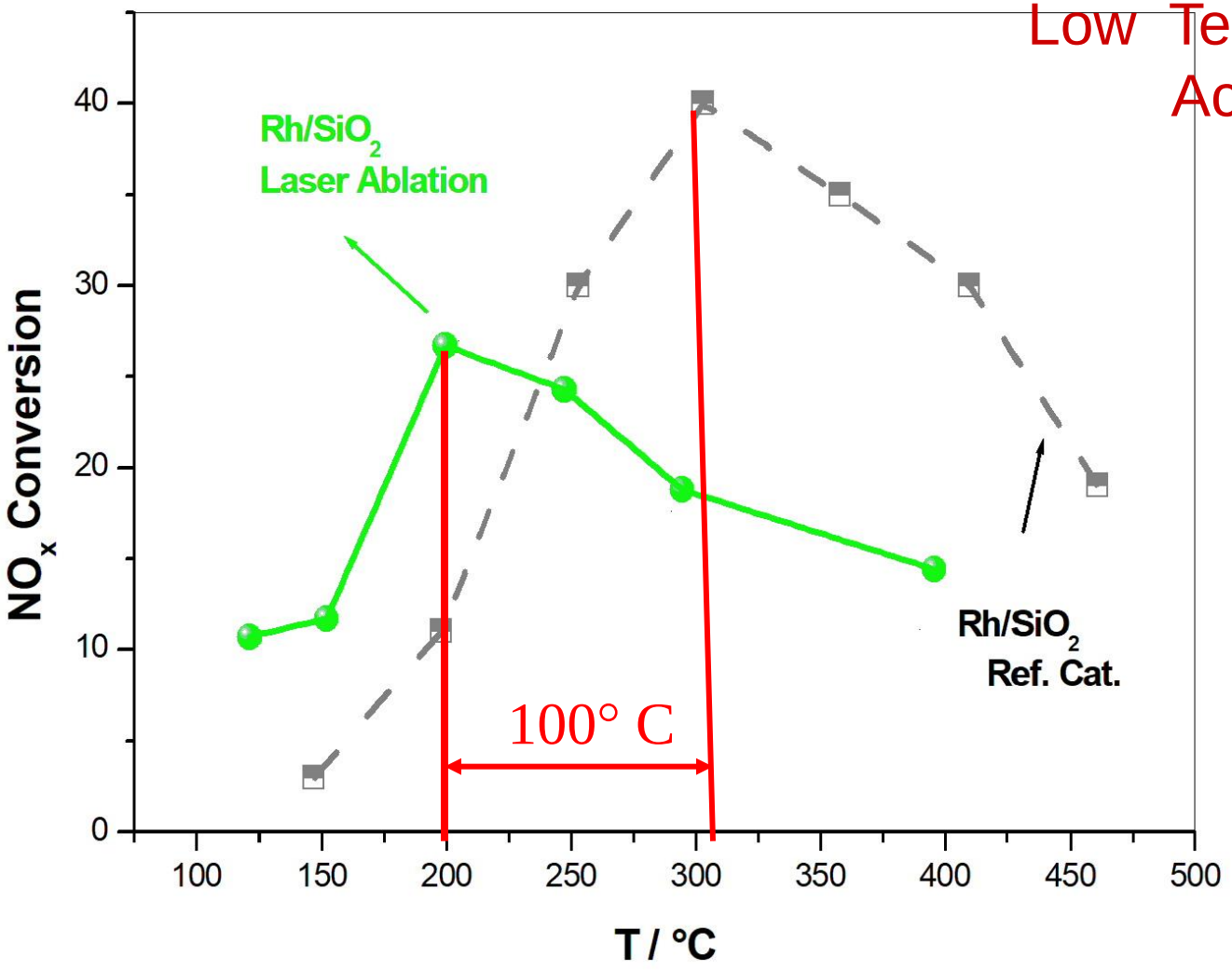
nanoparticles are expected to ***be much more effective***



Nanoparticles have edges and corners that crystal faces do not have

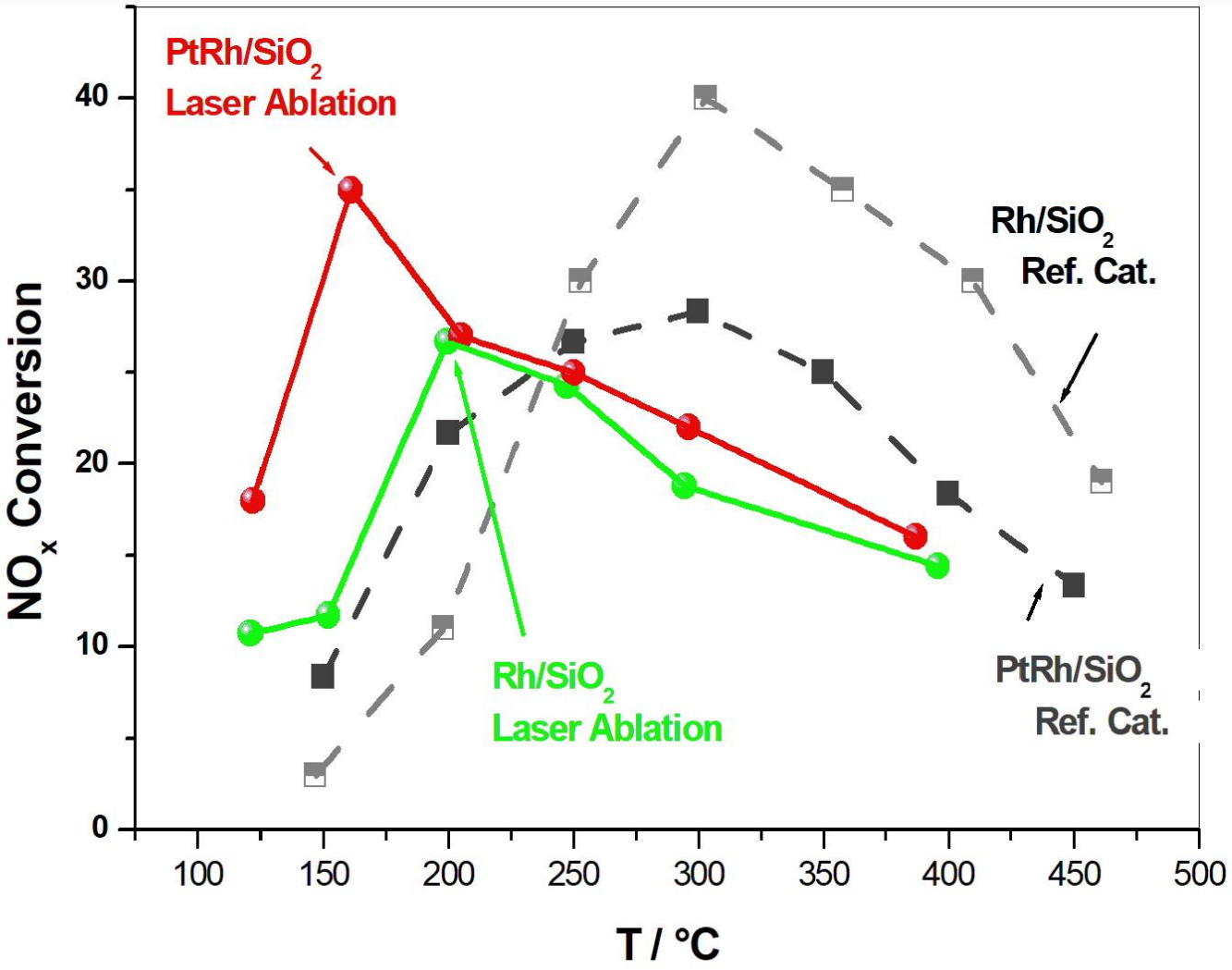
AUTOMOTIVE EXHAUST GAS CATALYST

Performance of Monometallic-Nanopowders



AUTOMOTIVE EXHAUST GAS CATALYST

Enhancing Low Temperature Activity



ELECTROCATALYSTS

Methods and Equipments

Plasma treatment is to replace conventional heat treatment step in catalyst preparation.

- Replacement of pyrolysis by low-temperature plasma treatment minimizes some problem caused by high temperature such as aggregation, crystalline size grow and sublimation.
- The plasma treatment induces the functional groups on the surface.
- These functionalities can improve the wettability and, in turn, influence on the impregnation of substrate with catalyst precursor.
- They can enhance the catalytic performance of catalysts.

ELECTROCATALYSTS

Catalysts Preparation

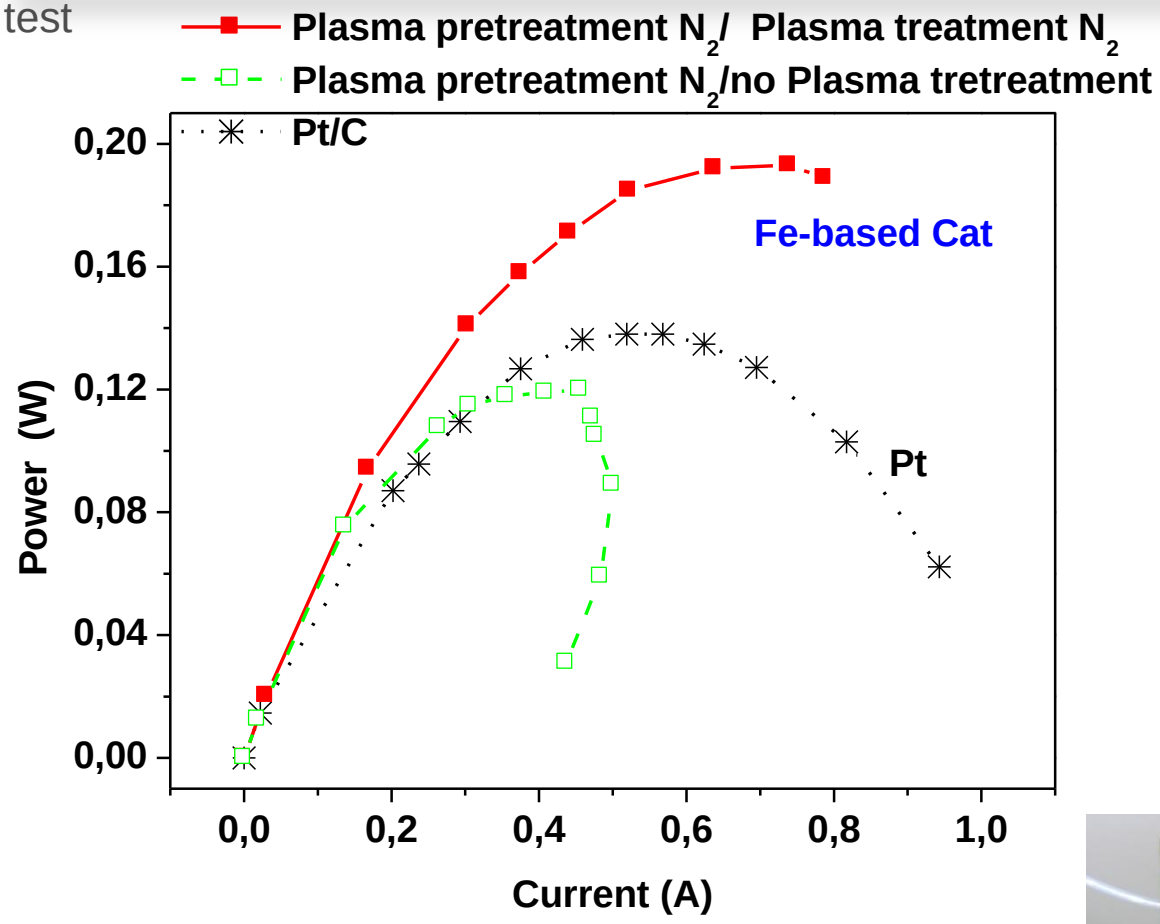
Catalysts preparation includes:

- Plasma functionalization:
  - ⇨treatment of support (Vulcan XC-72) by Ar:O_2 -, Ar-, N_2-, and HN_3 - Radio Frequency (RF) plasma ;
- Impregnation catalysts support with catalysts precursor:
  - ⇨phthalocyanine and porphyrin complexes;
- Catalyst fixation via
  - ⇨Ar:O_2 -, Ar-, and N_2-, - radio frequency (RF) plasma
  - ⇨ Ar- and N_2 -Dielectric Barrier Discharge (DBD) plasma.

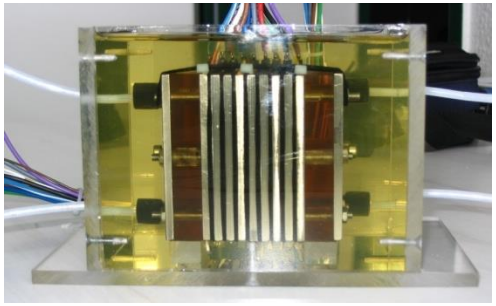
ELECTROCATALYSTS

Deposition of Plasma Treated FeTFPPCl on the MEA

PEMFC test



Plasma treatment improves the catalysts performance up to 70%.



Tests have been performed by AMT GmbH, Rostock, Rermany

CONCLUSIONS

- Laser ablation technique is a promising way to obtain nanopowders with unique catalytic properties (automotive catalysts)
- Plasma treatment enhanced electrocatalysts performance due to morphological and chemical changes up to 70%
- Threefold increase of rate constant for MO photodegradation was achieved by BDD-plasma treatment of photocatalyst impregnated with Ag NPs.

Разряды в жидкостях

PIN-HOLE BASED DISCHARGES IN LIQUIDS: GENERATION, PROPERTIES AND APPLICATIONS

F. Krčma, Z. Kozáková

Brno University of Technology, Faculty of Chemistry, Purkyňova 118, 61200 Brno, Czech Republic, krcma@fch.vut.cz

Plasma in water solutions can be also generated at low power of a few watts. Because of the liquid environment there is a great potential for the biomedical applications. The first successful tests were focused on sterilization and bulk liquid bacterial inactivation. In general, application of plasma-liquid systems is a basis of all plasma medicine topics like sterilization, wound healing, proliferation, coagulation, ablation etc.

To conclude, the pin-hole and also other electrical discharges generated in liquids are very effective sources for the strongly non-equilibrium environment combining more physical and chemical processes. Thus they open a new dimension in the wet chemistry followed by a broad field of future applications across classical disciplines.

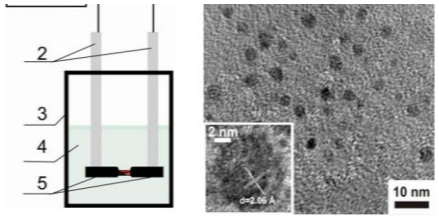


Fig. 1 - (a) Schematic diagram of the setup for NPs synthesis by electrical discharge in liquid: 1-power supply, 2-electrode holders, 3-reactor cell, 4-liquid, 5-electrodes; (b) typical TEM image of carbon NPs generated in water

Changing the surface groups is believed to be effective in improvement of photoluminescence properties of the synthesized C, Si and SiC NPs.

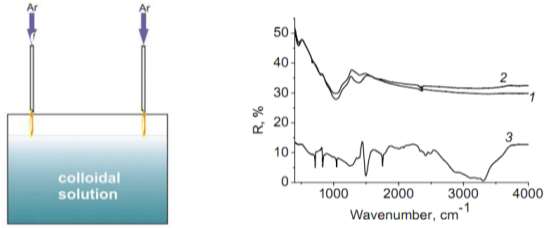


Fig. 2 - (a) Schematic diagram representing the double plasma–liquid system for surface engineering of NPs; (b) FT-IR spectra of as-prepared (1) and plasma processed C-NPs in water (2) and in ammonia solution (3).

PLASMA-ELECTROLYTE PRODUCTION OF STAINLESS STEEL POWDER FOR SELECTIVE LASER MELTING TECHNOLOGY

L.N. Kashapov[1], R.N. Kashapov[1,2], N.F. Kashapov[1]

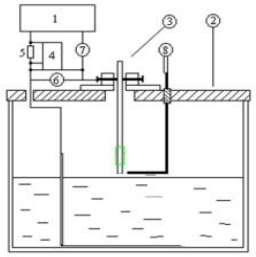


Fig. 1 – The scheme of the experimental setup

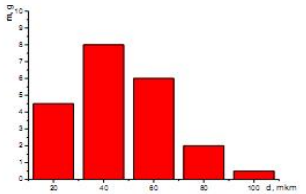
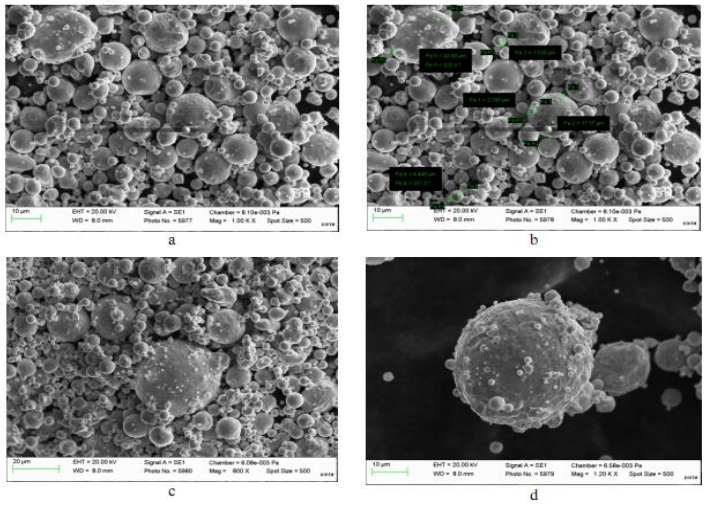


Fig. 2 – Powder distribution histogram



Плазма в сельском хозяйстве

APPLICATION OF PLASMA AND RADIO WAVE TECHNOLOGIES IN AGRICULTURE: PROTECTION OF PLANTS, IMPROVEMENT OF PLANT GROWTH AND YIELD

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, Nezavisimosti Ave. 68, 220072 Minsk, Belarus, filatova@presidium.bas-net.by

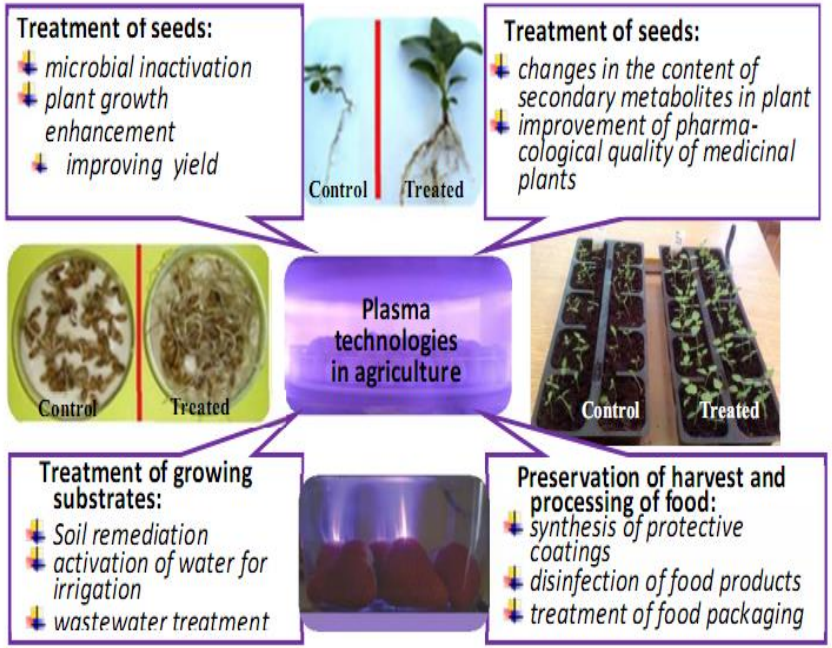


Fig. 1 – Areas of plasma application in agriculture, ecology and food industry

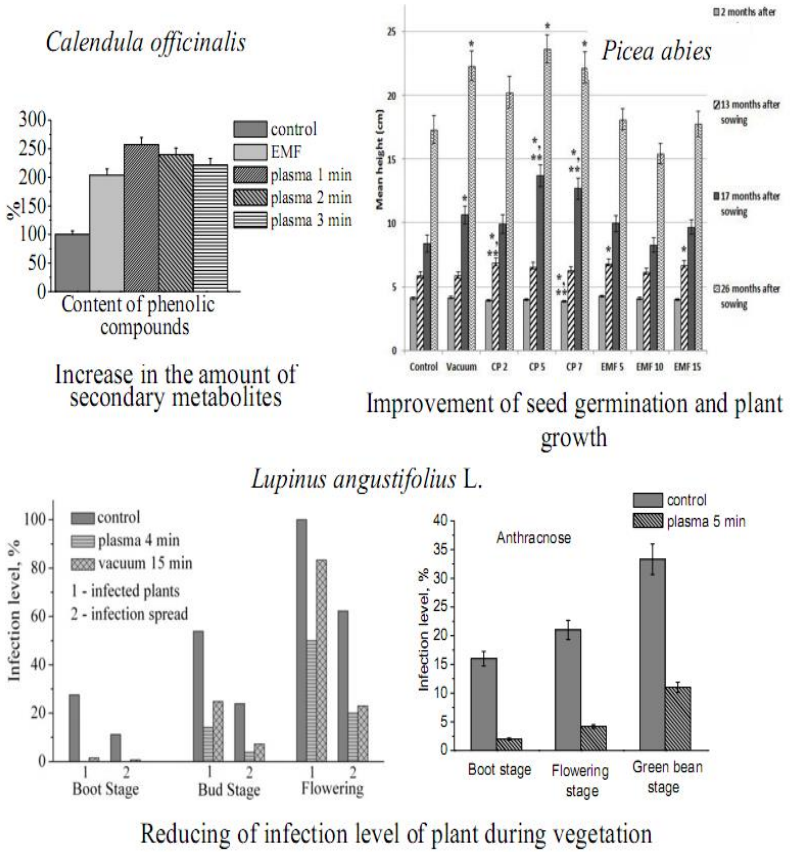


Fig. 2 – Some outcomes obtained as a result of laboratory and field experiments with a number of annual, perennial woody and medicinal plants /6–10/

Л.И.Филатова –родоначальник этого направления и готова с сотрудничеству и приему студентов

Биомедицина

INACTIVATION COMPONENTS PRODUCTION MECHANISMS OF AN AIR DC PLASMA JET

V.I. Arkhipenko, A.V. Kazak, A.A. Kirillov , L.V. Simonchik, V.V. Shkurko*

B.I. Stepanov Institute of Physics of NAS of Belarus, 68-2 Nezavisimosty Ave., 220072, Minsk, Belarus, a.kirillov@dragon.bas-net.by
*Graduate School of the National Academy of Sciences of Belarus, 1 Knorina Ave., Minsk, Belarus

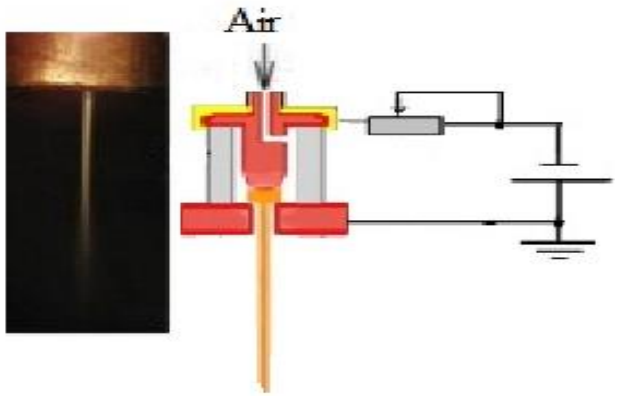


Fig.1. Photo air plasma jet and scheme of discharge device

WETTABILITY AND ELECTRET PROPERTIES OF PLASMA-TREATED POLYTETRAFLUOROETHYLENE FILMS

M.Yu. Yablokov[1], D.E. Temnov[2,3] S.M. Kulemina[2], A.A. Kuznetsov[1]

[1]Enikolopov Institute of Synthetic Polymer Materials, Russian Academy of Sciences, Profsoyuznaya Str. 70, 117393 Moscow, Russia
[2] Herzen State Pedagogical University of Russia , 6 Kazanskaya st., 191186, St. Petersburg, Russia
Saint Petersburg National Research University of Information Technologies, Mechanics and Optics, Kronverkskiy prospekt, 49, 197101, St. Petersburg, Russia
E-mail: yabl1@yandex.ru

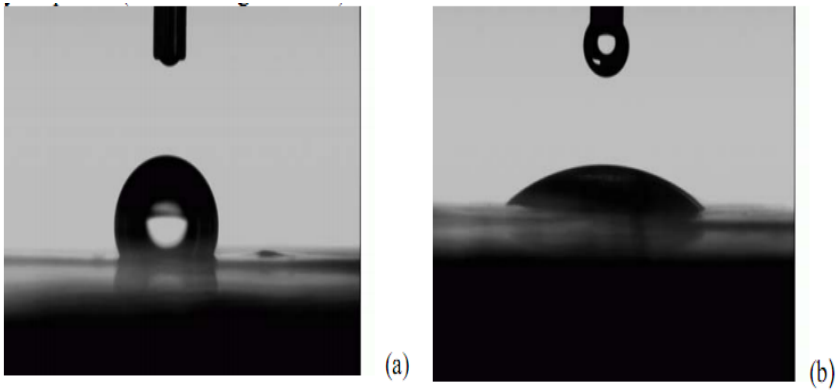


Fig. 1 - Water droplets on PTFE films: (a) pristine polymer film, contact angle of water θ=110°, (b) polymer film treated at the anode, contact angle of water θ=33°