

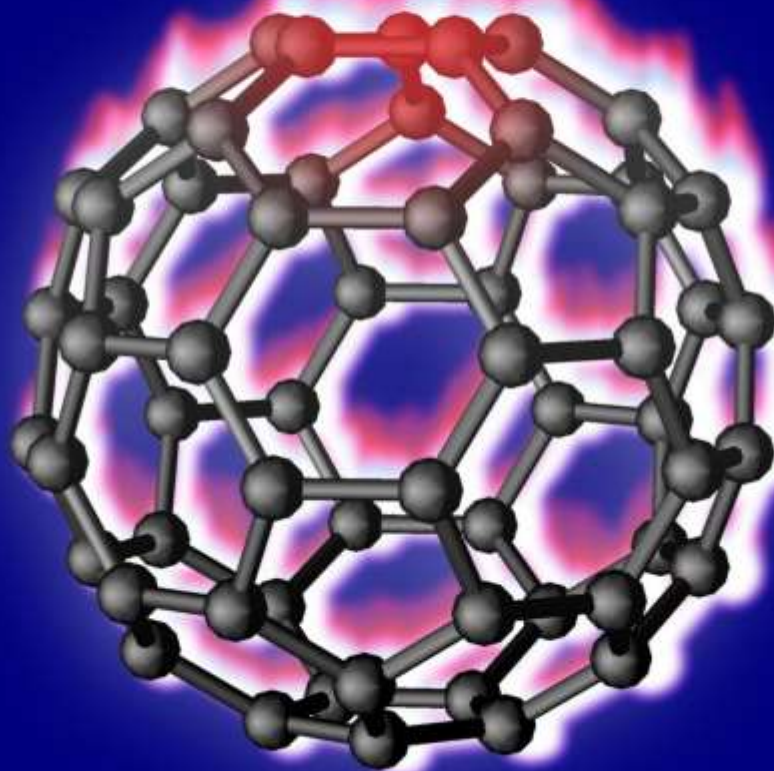
The Ministry of Education & Science of the Republic of Kazakhstan
Scientific Committee

Al-Farabi Kazakh National University
The Institute of Combustion Problems



X International Symposium

The Physics and Chemistry of Carbon and Nanoenergetic Materials



September 12-14, 2018
ALMATY, KAZAKHSTAN

Dear distinguished participants of the symposium and conference!

We are very pleased to welcome the participants of the X International Symposium "The Physics and Chemistry of Carbon and Nanoenergetic Materials".

Every other year since 2000, the Institute of Combustion Problems holds an International symposium "The Physics and Chemistry of Carbon and Nanoenergetic Materials".

It should be noted that this conference is conducted with financial support of the International Science and Technology Center (ISTC) which has allocated US \$ 15 000 which allowed us to invite the leading scientists from neighbouring countries and beyond. On behalf of the symposium participants we would like to thank ISTC very much.

In all parts of the world the searches for new forms of communications are conducted and in this regard the joint research projects and international conferences are particularly important. We believe that this conference will become an international arena where all conditions for establishment and development of an effective scientific collaboration and long-term partnership relations between research teams of CIS countries and colleagues from Belgium, Portugal, Italy, Spain, Greece, United Kingdom, USA, China, Uzbekistan will be created.

The interest in nanotechnology in leading industrial countries continues to grow. Over the past ten years in Kazakhstan number of scientific publications has grown and number of people involved in nanotechnologies continued to increase. This strong growth is fueled by progressive growth of new nanotechnology products and technologies.

We are sure that the X International Symposium "The Physics and Chemistry of Carbon and Nanoenergetic Materials" will be important step in solution of fundamental problems and of course it may give impulses to new projects in the field of carbon nanomaterials, nanoengineering and nanoenergetics

We wish all symposium participants fruitful work and pleasant entertainment!

Zulhair Mansurov and V.E. Zarko
Conference Co-chairs
(on behalf of the Organizing Committee)

CHAIR ORGANIZING COMMITTEE

Prof. Z.A. Mansurov (KZ)
Prof. V.E. Zarko (RU)

VICE CHAIRMAN OF ORGANIZING COMMITTEE

Dr. S.K. Tanirbergenova

SECRETARY OF ORGANIZING COMMITTEE

Dr. M. Nazhipkyzy

MEMBERS OF ORGANIZING COMMITTEE

G.I. Ksandopulo (KZ), T. Bandosz (USA), E.K. Ongarbayev (KZ),
G. Mitchell (Portugal), B.I. Oksengendler (UZ)
A.A. Zakhidov (USA), M.I. Tulepov (KZ),
S.V. Mikhalovsky (UK), Lodewyckx Peter (Belgium),
D.Ivanov (France), M. Gabdullin (KZ), M. Muratov (KZ)

PROGRAM-PUBLICATION COMMITTEE

S.Kh. Aknazarov,
O.Yu. Golovchenko,
D. Bodykov

MEMBERS OF LOCAL ORGANIZING COMMITTEE

T.B.Seitov, B. Lesbayev, L.F. Poliakova, F. Sultanov, G.T. Smagulova, M.K. Atamanov

SCIENTIFIC PROGRAM

- 1. Carbon Materials and their Application.**
- 2. Nanoenergetic Materials.**
- 3. Nanomaterials and SHS synthesis.**

The Symposium Program includes plenary, oral and poster presentations. The Communication languages of Symposium are Russian & English. The time limit on speeches: plenary presentation is 30 minutes and oral presentation is 10- minutes.

Introduction

Welcome to X International Symposium "The Physics and Chemistry of Carbon and Nanoenergetic Materials" in Almaty, Kazakhstan. The objective of the Almaty, Kazakhstan conferences is to provide a platform for researchers, engineers, academicians as well as industrial professionals from all over the world to present their research results and development activities in Carbon and Nanoenergetic Materials, Energy and Nanotechnology.

Presentation Instructions

Instructions for Oral Presentations

Devices Provided by the Conference Organizer:

Laptop Computer (MS Windows Operating System with MS PowerPoint and Adobe Acrobat Reader) Digital Projectors and Screen Laser Sticks

Materials Provided by the Presenters:

PowerPoint or PDF files (files shall be copied to the conference computer at the beginning of each session)

Duration of Each Presentation:

Plenary Session: **25** minutes for presentation and 5 minutes for questions and answers

Regular Oral Presentation: **12 (7)** minutes for presentation and **3 (3)** minutes for questions and answers

Instructions for Poster Presentation

Materials Provided by the Conference Organizer:

The stand to put poster

Materials Provided by the Presenters:

Home-made Posters

Maximum poster size is A0

Load Capacity: Holds up to 0.5 kg

Best Paper Award

One best paper will be selected from each oral presentation sessions, and the Certificate for the Best Papers will be awarded at the end of each session on September 12-14, 2018.

Dress code

Please wear formal clothes or national representative of clothing

Scientific Program of the X International Symposium
“The Physics and Chemistry of Carbon and Nanoenergetic Materials” 2018

DAY 1
September/12/2018

08:30 – 09:30 **Registration**
09:30 – 09:40 **Opening Ceremony**

Plenary session and Keynote Session

Plenary Speakers
09:40-11:10

Coffee break: 11:10 – 11:40

Plenary Speakers
11:40-13:10

LUNCH: 13:10 – 14:30

Oral session I
14:30 – 15:40

Coffee break+Poster session: 15:45 – 16:45

Oral session II
16:45 – 18:00

Reception: 18:00

DAY 2
September/13/2018

Plenary session

Plenary Speakers
09:00-11:00

Coffee break: 11:00 – 11:30

Plenary Speakers
11:30 – 12:45

LUNCH: 13:10 – 14:30

Oral session I
14:30 – 15:45

Coffee break: 15:45 – 16:15

Oral session II
16:15 – 17:30

BANQUET: 18:30

DAY 3
September/14/2018

Plenary session

Plenary Speakers
10:00 – 11:05

Coffee break: 11:05 – 11:30

Plenary Speakers
11:30-13:00

LUNCH: 13:00 – 14:00

12:30 - 13:00 **Closing ceremony. Diploma awarding**

14:30 – 17:00 **Visiting Institute of Combustion Problems, KazNU, Faculty of Chemistry and Chemical Technology, Museum**

Day 1, September 12, 2018

08:30 – 09:30	Registration	
09:30 – 09:40	Opening Ceremony	
Plenary session		
Session Chairs	Mansurov Z.A., General Director of Institute of Combustion Problems, Kazakhstan Teresa Badosz, Professor of Chemistry at the City College of New York, New York, USA	
Plenary Speakers		
09:40 – 10:10	Badosz T., Professor of Chemistry at the City College of New York, New York, USA Importance of Carbon Porosity for Energy Related Applications	
10:10 – 10:40	Ivanov D., France Exploring fast structure formation processes with a combination of chip calorimetry and real-time synchrotron X-ray scattering	
10:40 – 11:10	Burkitbayev M.M., al-Farabi Kazakh National University, Almaty, Kazakhstan Preparation, properties, and application of sulfur nanoparticles	
Coffee break 11:10 – 11:40		
11:40 – 12:10	Mitchell G.R., Vice-Director Centre for Rapid and Sustainable Product Development – (CDRSP-IPEIRIRA) Marinha Grande, Portugal Opportunities for Direct Digital Manufacturing with Energy Storage Devices	
12:10 – 12:40	Harris P., Electron Microscopy Laboratory, Department of Chemistry, University of Reading, UK Non-graphitizing carbon: its structure and formation from organic precursors	
12:40 – 13:10	Oksengendler B.L., Institute of Ion-plasma and Laser Technologies, Academy of Sciences of Uzbekistan, Tashkent, Uzbekistan Nanofractals: basic conception and applications	
LUNCH 13:10 – 14:30		
Oral Session		
Session Chairs:	Session 1 Carbon Materials and their Application Session Chairs: Ongarbayev E.K., KazNU, Kazakhstan; Ivanov D., France	Session 2 Nanoenergetic Materials Session Chair: Tulepov M.I., KazNU, Kazakhstan; Oksengendler B.L., Uzbekistan
14:30 – 14:45	Gabdullin M.T., Almaty, Kazakhstan Nanotechnologies in hydrogen energy	Messerle V.E., Almaty, Kazakhstan Modeling of plasma ignition of pulverized ultramilling coal
14:45 – 15:00	Muratov M.M., Almaty, Kazakhstan Research and development of national nanotechnological laboratory of open type in the field of nanomaterials and nanotechnology.	Tulepov M.I., Almaty, Kazakhstan Energy-intensive materials for gas-generator cartridges
15:00 – 15:15	Eleuov M., Almaty, Kazakhstan Rice husk-derived porous carbon with few-layer graphene for symmetric electric double-layer supercapacitor electrodes	Yinghua Ye., China Enhance Effect of Ammonium perchlorate on the Reactivity of Nano Al/CuO Thermite
15:15 – 15:30	Smagulova G.T., Institute of Combustion Problems, Almaty, Kazakhstan Carbon nanotubes: features of synthesis and applications	Lizhi Wu, China Performance of TiO ₂ /Al Reactive Multilayer Films using in Laser-Driven Flyer Plates
15:30 – 15:45	Abzhali A.K., Calgary Nanoenergetic materials and low carbon energetics on common resource and technological bases	Mylytkbayeva L.K., Almaty, Kazakhstan Carbon dioxide conversion of methane on the catalysts based on metal oxides of variable valency
Coffee break + Poster session I: 15:45 – 17:00		
17:00 – 17:15	Zhubanova A.A., Almaty, Kazakhstan Use of advanced nanomaterials for bioremediation of contaminated ecosystems.	Tileuberdi E., Almaty, Kazakhstan Producing synthetic oil through the oil sand pyrolysis
17:15 – 17:30	Shokatayeva D., Almaty, Kazakhstan The physical and structural properties of bacterial cellulose obtained by cultivation of a producer strain on media with industrial wastes	Umbetkaliev K.A., Almaty, Kazakhstan Technology of plasma gasification of solid fuels
17:30 – 17:45	Jandosov J., Almaty, Kazakhstan In vitro adsorption studies of voltaren removal by rice husk-derived charcoals	Sadykov B.S. Almaty, Kazakhstan Mechanochemical treatment and nanostructured surface of metal particles is an effective way to increase the reactivity of systems
17:45 – 18:00	Kaidar B., Almaty, Kazakhstan Obtaining of carbon-containing fibers by the method of electrospinning	Kamunur K., Almaty, Kazakhstan Burning Characteristics of AN/MgAl-based Composite Gas Generators Supplemented with Fe ₂ O ₃

DINNER: 18:00

Day 2, September 13, 2018

Plenary session

Session Chairs:	Mikhailovsky S.V., School of Pharmacy and Biomolecular Sciences, University of Brighton, United Kingdom Lodewyckx P., Royal Military Academy, Department of Chemistry, Brussels, Belgium
Plenary Speakers	
09:00 – 09:30	Cesare Oliviero Rossi, Department of Chemistry and Chemical Technologies, University of Calabria, Italy The effect of multiwalled carbon nanotubes on the rheological behavior of bitumen
09:30 – 10:00	Xanthopoulou G.G., Institute of Nanoscience and Nanotechnology, Athens, Greece Nanocomposite Energetic Materials by Solution Combustion Synthesis: Synthesis and Combustion Characterization
10:00 – 10:30	Mysyk R., CIC energigune, Spain Electrochemical capacitors: electrode materials, mechanisms and current R&D challenges
10:30 – 11:00	Michela Alfe, Istituto di Ricerche sulla Combustione-CNR, Napoli, Italy An old but new nanomaterial: exploiting carbon black for synthesis of advanced materials

Coffee break 11:00 – 11:30

Plenary Speakers

Session Chair:	Mikhailovsky S.V., School of Pharmacy and Biomolecular Sciences, University of Brighton, United Kingdom Lodewyckx P., Belgium
11:30 – 12:00	Mikhailovsky S.V., School of Pharmacy and Biomolecular Sciences, University of Brighton, United Kingdom New trends in the use of carbon materials for extracorporeal blood purification
12:00 – 12:30	Lodewyckx P., Royal Military Academy, Department of Chemistry, Brussels, Belgium Estimating the service life of activated carbon filters for air purification
12:30 – 12:45	ISTC. Turebayev A.

LUNCH 13:00 – 14:30

Oral Session

	Session 3 Nanomaterials and SHS synthesis; Oil and hydrocarbons processing Mitchell G. R., Marinha Grande, Portugal; Sultanov F.R., Kazakhstan
Session Chairs	
14:30 – 14:45	Harris P., Electron Microscopy Laboratory, Department of Chemistry, University of Reading, UK Structural transformation of graphite by passage of an electric current
14:45 – 15:00	Ongarbayev EK, Almaty, Kazakhstan Removal of metals and sulfur from tar by adsorbents modified with rare metals and nanocarbon
15:00 – 15:15	Teltayev B.B., Almaty, Kazakhstan Increasing of low temperature stability of bitumen with the use of nanocarbon powder
15:15 – 15:30	Abdulkarimova R.G., Almaty, Kazakhstan Self-propagating high temperature synthesis of composite materials based on boron carbide
15:30 – 15:45	Sultanov F.R., Almaty, Kazakhstan Recent developments in oil/water separation techniques

Coffee break: 15:45 – 16:15

16:15 – 16:30	Suleimenov K.A., Astana, Kazakhstan Study of thermooxidative pyrolysis of Shubarkol coal in a circulating fluidized layer
16:30 – 16:40	Nurpeissova A., Astana, Kazakhstan Novel $Li_4Ti_5O_{12}/SiC$ -PAN composite anode for lithium-ion batteries
16:40 – 16:50	Azat S., Almaty, Kazakhstan Silica/Ag composite materials as a new adsorbent for the removal of mercury ions from water
16:50 – 17:00	Temirgaliyeva T.S., KazNU, Almaty Kazakhstan Effective use of Carbon nanotube matrices in high-performance, lightweight electrochemical capacitor electrodes
17:00 – 17:10	Medyanova B.S., Almaty, Kazakhstan Synthesis of carbon nanostructures by the method of low-temperature CVD in the presence of electric field
17:10 – 17:20	Seitzhanova M., Almaty, Kazakhstan Obtaining graphene-based membranes
17:20 – 17:30	Daulbayev Ch., Almaty, Kazakhstan Obtaining of biologically soluble membranes based on polymeric nanofibres and hydroxyapatite of calcium.

BANQUET 18:30

Plenary session

Session Chairs	Mansurov Z.A., General Director of Institute of Combustion Problems, Almaty, Kazakhstan Ashurov N., Laboratory Nanostructured Composite Polymer Materials, Uzbekistan
10:00 – 10:20	Ashurov N., Laboratory Nanostructured Composite Polymer Materials, Uzbekistan Perovskite-based solar cells: problems and ways of their solution
10:20 – 10:35	Vasilieva N., Almaty, Kazakhstan Synthesis of functional oxide materials
10:35 – 10:50	Beisenov R.E., Kazakh National Research Technical University, Almaty, Kazakhstan Heterostructures based on CVD graphene and transition metal dichalcogenides (TMD)
10:50 – 11:05	Inseпов Z.A., Tynyshtykbayev K.B., Nazarbayev University, Astana, Kazakhstan Low-temperature synthesis of graphenic carbon nanocomposites by surface passivation of porous silicon nanocrystallites with carbon atoms
Coffee break 11:05 – 11:30	
11:30 – 12:00	Zakhidov A., Deputy Director of UTD-NanoTech Institute, Texas, USA Nanoenergetic Carbon nanotube twist fibers for high power actuators
12:00 – 12:30	Mansurov Z.A., General Director of Institute of Combustion Problems, Almaty, Kazakhstan Synthesis and Properties of High Energy Materials
12:30 - 13:00	Closing ceremony. Diploma awarding

LUNCH 13:00 – 14:00

14:30 – 17:00	Visiting tour at the Institute of Combustion Problems, KazNU, Faculty of Chemistry and Chemical Technology, Museum
----------------------	---

Posters

Day 1, September 12, 2018

1. Coal tar processing into nanomaterials

Imangazy A., Smagulova G.T., Kerimkulova A.R., Zakhidov A.A.

2. Al-based mixtures for flameless ration heaters

Kaliyeva A.M., Tileuberdi Ye., Galfetti L., Ongarbayev Ye.K., Mansurov Z.A

3. Testing composite material based on nano-particulate magnetite and carbonized rice husk for CO₂ sorption

Zhumagaliyeva A., Gargiulo V., Doszhanov Ye., Alfe M.

4. The study of the morphological structure of nanocarbon materials after chemical activation

Nyssanbayeva G.R., Kudaibergenov K.K., Ongarbayev Ye.K., Mansurov Z.A., Capua R., Alfe M., Gargiulo V.

5. Возможно ли управлять химическими реакциями на углеродных и родственных цепях с помощью солитонов?

Оксенгендлер Б.Л., Никифорова Н.Н., Тураева Н.Н., Карпова О.В., Нечипоренко Ю.Д.

6. Investigation of the effect of activated carbon (from plant raw material) based on metal oxides for pyrotechnical purposes

Yelemessova Zh.K., Lesbayev B.T., Ruiqi Shen

7. Electrical conductivity study of porous carbon composite derived from rice husk

Supiyeva Zh., Pavlenko V., Biisenbayev M., Béguin F., Mansurov Z.

8. Synthesis of SiC nanostructures on the surface of copper films

Kenzhegulov A.K., Suyundykova G.S., Mansurov B.Z., Medyanova B.S., Partizan G., Aliev B.A.

9. High Mass-Loading Sulfur-Composite Cathode for High Performance Lithium-Sulfur Batteries

Baikalov N., Almagul M., Kurmanbayeva I., Bakenov Z.

10. Металлическая углеродная сажа.

Жаксылыкова А.Н., Курманбаева Г.Г., Нургаин А., Жапарова А.А., Нажипкызы М., Лесбаев Б.Т., Приходько Н.Г.

11. Synthesis of solid high-energy compounds

Seisenova A.B., Aknazarov S.KH., Juan Maria Gonzalez-Leal, Golovchenko O.YU., Bairakova O.S., Kapizov O.S.

12. Functionalization of carbon based wound dressings with antimicrobial phytoextracts for bioactive treatment of septic wound

Akimbekov N.Sh., Abdieva G.Zh., Ualieva P.S., Zhusipova D.A., Digel I., Tastambek K.T., Zhubanova A.A.

13. Silica based anode from local agricultural waste for LiB

Sadykova A., Mentbayeva A., Adi A., Kurmanbayeva I., Bakenov Z.

14. Особенности формирования структуры пленок $\alpha\text{-C}<\text{Pd}_x>$ и ее влияние на величину запрещенной зоны в зависимости от мощности плазменного разряда

Рягузов А.П., Немкаева Р.Р., Гусейнов Н.Р.

15. Исследование агрегативной устойчивости водонефтянных эмульсий при добыче высоковязких нефтей

Салахов Р.Х., Хамидуллин Р.Ф.2, Бодыков Д.У.1, Сейтжанова М.А.

16. Парамагнитные характеристики рисовой шелухи при ее термодеструкции
Рябкин Ю.А., Байтимбетова Б.А., Лебедев И.А., Серикканов А.С., Дмитриева Е. А.

17. Зависимость сигнала эпр углеродной пленки от температуры на некоторых подложках
Рябкин Ю.А., Байтимбетова Б.А., Лебедев И.А., Серикканов А.С., Дмитриева Е. А.

18. Supercapacitor electrode material from carbon nanomaterials
Christoph S.

19. ИЗУЧЕНИЕ ВОЗДЕЙСТВИЯ ЭЛЕКТРОГИДРАВЛИЧЕСКОГО ЭФФЕКТА НА ВЫСОКОВЯЗКУЮ НЕФТЬ

Бодыков Д.У.¹, Сейтжанова М.А.^{1,2}, Салахов Р.Х.¹, Мансуров З.А.^{1,2}

20. Применение композиционного материала, упрочненного углеродными нанотрубками в пиротехнических замедлителях
Габдрашова Ш.Е., Тулепов М.И., Элоуади Б.

21. Графен и природные образования
Шабанова Т.А., Ауелханкызы М., Глаголев В.А.

22. Selective hydrogenation of acetylene using different carriers
Tanirbergenova S.K., Tairabekova S.Zh., Tugelbayeva D.A., Zhylybaeva N.K., Naurzbayeva G.M., Moldazhanova G.M., Mansurov Z.A.

23. Изучение характеристики горения газогенераторных составов на основе нитрата натрия
Турсынбек С., Байсейтов Д.А., Тулепов М.И., Казаков Ю.В., Абдракова Ф.Ю., Мансуров З.А.

24. Diatomite: Origins and Uses.
Zhaparova A., Nurgain A., Zhalgasbaikyzy A., Nazhipkyzy M., Lesbayev B.T., Prikhodko N.G., Mansurov Z.A.

25. Угольные брикеты с зажигательными составами.
Рахова Н.М., Пустовалов И.А., Султанова З.Л., Сасыкова Л.Р., Спанова Г.А., Абдракова Ф.Ю., Тулепов М.И., Мансуров З.А.

26. Подбор горючего цементатора, позволяющего произвести качественное горение некондиционных углей.
Рахова Н.М., Пустовалов И.А., Султанова З.Л., Сасыкова Л.Р., Спанова Г.А., Абдракова Ф.Ю., Тулепов М.И., Мансуров З.А.

26. Study of soot precursor formation in hydrocarbon flames
Auyelkhankyzy M., Slavinskaya N.A., Lesbayev B.T., Prikhodko N.G., Mansurov Z.A.

27. Применение 3D прintrинга для изготовления изделий
Султахан Ш.Т., Наурызбаева Г., Нажипкызы М., Мансуров З.А.

28. The most efficient solid fuel for rocket launching
Serikbayev B., Tureshova G.

29. Методы снижения пробивной способности фронта пламени в шахте
Мансуров З.А., Тулепов М.И., Казаков Ю.В., Абдракова Ф.Ю., Султанова З.Л., Ахинжанова А.С., Шалтыкова Д., Мадиев С.

30. Creation of coatings based on hydrophobic soot
Hamidreza Pourghazian Esfahani, Alireza Pourghazian Esfahani, Gulim G. Kurmanbayeva, Assel N. Zhaksylykova, Aigerim R. Seitkazinova, Meruyert Nazhipkyzy, Zulkhair A. Mansurov

31. Synthesis of WS₂ crystals by the chemical vapor deposition (CVD) method on a SiO₂ substrate
Beissenov R., Shaikenova A., Muratov D., Mansurov Z.A.
32. Исследование формирования пористого анода для применения в твердооксидных топливных элементах
Умирзаков А.Г., Бейсенов Р.Е., Мереке А.Л.
33. О моделях кольматационно-суффозионной фильтрации дисперсных систем
Хамзина Б.С., Байкадамов Б.А.
34. Получение и применение наноструктурированных сорбентов на основе природного графита
Аманжолова Д.М., Кудайбергенов К.К.
35. Sorption interactions of heavy metals with biochar in soil remediation studies
Kerimkulova M.R., Mansurov Z.A., Kozybaeva F.E., Oshakbayeva Zh.O., Kerimkulova A.R., Azat S.
36. Methods of reducing the front performance flame in shaft
Mansurov Z.A., Tulepov M.I., Kazakov Y.V., Abdrakova F.Y., Sultanova Z.L., Akhinzhanova A.S., Shaltykova D., Madiev S.
37. Изготовление 3D-пористого анода на основе оксида титана, оксида кобальта для фотокаталитического расщепления воды.
Мереке А.Л., Умирзаков А.Г., Бейсенов Р.Е., Рахметов Б.А., Муратов Д.А., Айтмуқан Т.
38. Разработка медленногорящего замедлительного состава
Габдрашова Ш.Е., Тулепов М.И., Казаков Ю.В., Элоуади Б.

Chapter 2

ORAL PRESENTATIONS

Day 1, September 12, 2018

Session 1 - Carbon Materials and their Application

TABLE of CONTENTS

<u>M.T. Gabdullin</u> The synthesis of carbon nanomaterials by the PECVD method	2
Muratov M.M., Almaty, Kazakhstan Research and development of national nanotechnological laboratory of open type in the field of nanomaterials and nanotechnology.	5
Eleuov M., Almaty, Kazakhstan Rice husk-derived porous carbon with few-layer graphene for symmetric electric double-layer supercapacitor electrodes	8
Smagulova G.T., Institute of Combustion Problems, Almaty, Kazakhstan Carbon nanotubes: features of synthesis and applications	10
Abzhali A.K., Calgary Nanoenergetic materials and low carbon energetics on common resource and technological bases	12
Zhubanova A.A., Almaty, Kazakhstan Use of advanced nanomaterials for bioremediation of contaminated ecosystems	17
Shokatayeva D., Almaty, Kazakhstan The physical and structural properties of bacterial cellulose obtained by cultivation of a producer strain on media with industrial wastes	21
Jandosov J., Almaty, Kazakhstan In vitro adsorption studies of voltaren removal by rice husk-derived charcoals	25
Kaidar B., Almaty, Kazakhstan Obtaining of carbon-containing fibers by the method of electrospinning	28

RESEARCH AND DEVELOPMENT OF NATIONAL NANOTECHNOLOGICAL LABORATORY OF OPEN TYPE IN THE FIELD OF NANOMATERIALS

Muratov M.M.

National Nanotechnological Laboratory of Open Type, al-Farabi, Kazakh National University, Almaty, Kazakhstan
mukhit.muratov@gmail.com

Abstract. Due to unique properties, nanomaterials are among the most popular materials as they have wide range of potential applications in various areas. Our research team deals with various tasks: obtaining materials, creating techniques and technologies, computer modeling of the obtained materials and studying their structural, optical, electrical, physical and mechanical properties. The materials were obtained in the laboratory by different methods, such as carbon nanotubes by the CVD method, graphene oxide by the Hammers method, graphene was synthesized by reduction from graphene oxide, diffusion and CVD methods, fullerenes C₆₀ and C₇₀ by electric arc method, polymer fibers by electro spinning. Nanostructured semiconductor materials ZnO, ZnS and the class of two-dimensional semiconductor materials WS₂, WSe₂, InSe also were investigated. Subsequently, the obtained materials were used in the production of sensors and supercapacitors. Additionally, new research is being actively conducted for the creation of nanomaterials by electron and ion-beam lithography.

Introduction

From the moment of discovery of some nanomaterials [1,2], the relevance of its application has been growing daily due to their unique electron, optical, thermal, mechanical and chemical properties that give researchers opportunities to reach considerable success in fundamental and applied science and development of advanced technologies and techniques. Carbon nanotubes, fullerenes and graphene have become universal platforms for new material and device researches also have found their way in almost every aspect of the scientific world, including as transparent electrodes, chemical sensors, high-frequency devices, optoelectronic sensors, alternative energy sources.

Supercapacitors

In the conditions of modern progress in order to accumulate energy, there is an urgent need for lightweight, flexible and capacious electrodes which are used in electronic devices, drones, flexible electric disks and electric vehicles.

Composite materials from graphene oxide (GO) and metal oxides can be used as a possible electrode material for pseudocapacitors. Pseudocapacitors are ionistors using reversible electrochemical processes on the surface of electrodes, which have a high specific capacitance [5]. Graphene nanosheets are conductive substrates for the growth of MnO₂.

The obtaining composite materials MnO₂-graphene are evaluated as electrode materials for supercapacitors. Electrochemical results show that the maximum specific capacity of the MnO₂-graphene composite is 1300 F/g.

Sensors

Graphene oxide on the basal plane contains hydroxyl, carbonyl and carboxyl functional groups, which makes it hydrophilic and completely soluble in water. This property makes graphene oxide sensitive to moisture, which can be used to determine humidity in the atmosphere [6]. In this

regard, currently the role of graphene oxide is of great importance in the measurement and control of ambient humidity for industrial and agricultural activities [7]. Our group of scientists studied the humidity sensors based on graphene oxide at humidity: 17%, 40%, 70%, 80%, 90%, 95% for 10 hours at room temperature.

Scanning electron microscopy of dry flakes of graphene oxide was performed (Figure 1). The microphotography clearly shows the layered structure of graphene oxide.

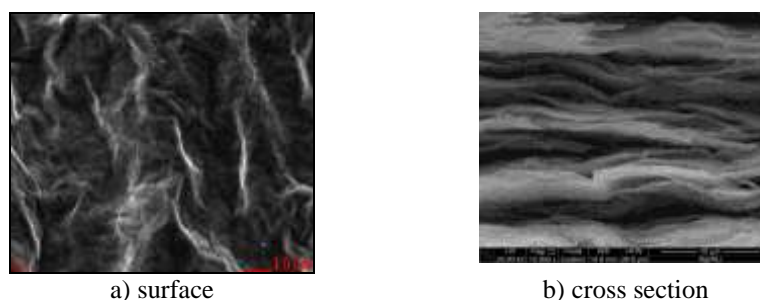


Figure 1 – Electron micrographs of graphene oxide

Figure 2 shows a schematic representation of an installation for studying the sensitivity of a humidity sensor, where 1 is a multimeter for measuring capacitance and resistance; 2 - the crane; 3 - the sensitivity element on graphene oxide; 4 - the standard of the humidity sensor; 5 - the measuring chamber; 6 - the measuring block; 7 - computer for displaying data.

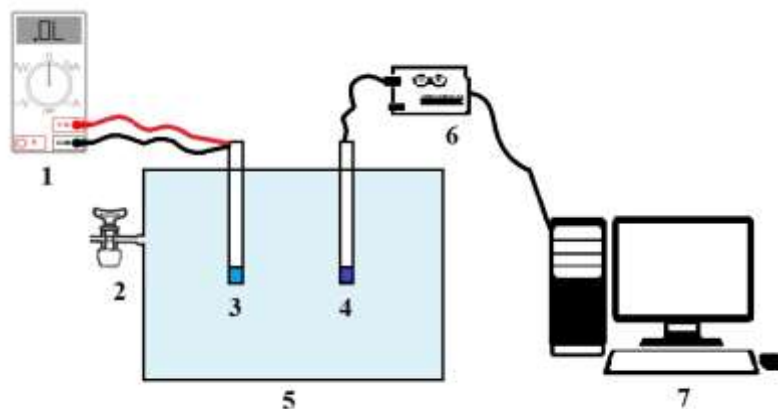


Figure 2 – Schematic view of the installation

Thus, the technology of obtaining sensors was developed. The results of the measurements show that the sensor based on graphene oxide works stable almost in all humidity range.

Lithography

Charged particles such as an ions where used for ion beam lithography. Consequently, ion-beam lithography is capable of overcoming the fundamental resolution limit ~10 nm.

Taking into account all the advantages of ion-beam lithography, the task was formulated of studying all the basic laws of ion interaction with modern resistors. A strict comparison of the sensitivity of the resist polymethylmethacrylate (PMMA) to irradiation with electron and ion beams

was made. It is shown that, the resist exhibits a positive (at low doses) and a negative (at higher doses) sensitivity behavior.

Experiments were carried out to study the depth of etching of the resist as a function of the radiation dose. It was investigated by atomic force microscopy to assess the depth of a etching. Figure 3 shows the topography of the surface and profile of the depth line as a function of the radiation dose.

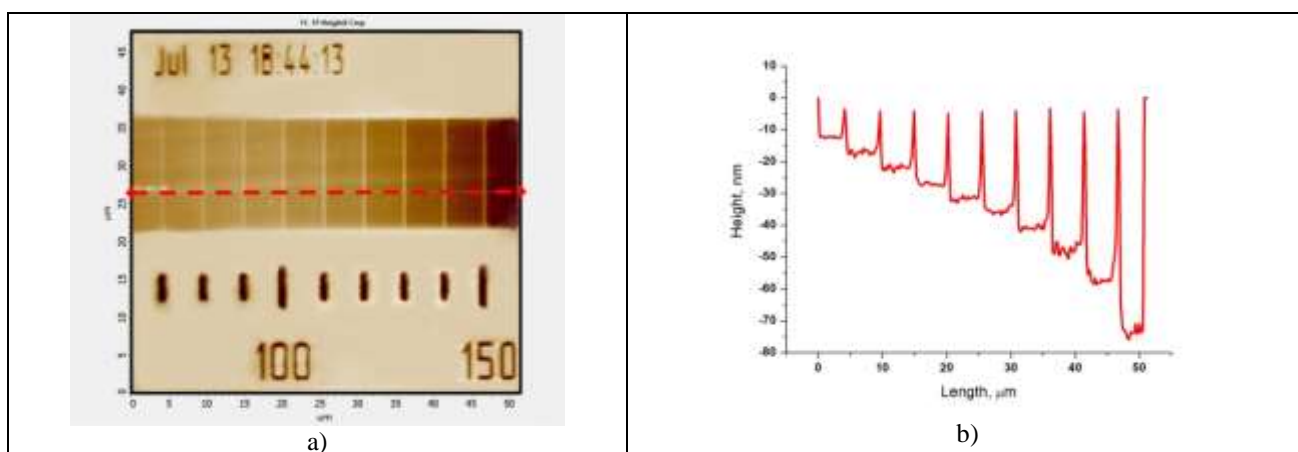


Figure 3 – AFM image of electron lithography: a) surface topography, b) profile along the dashed line

Conclusion

Thus, this report represents some directions of researches carried out on the basis of NNLOT. Research works implement nanostructuring using methods of electron and ion-beam lithography, as well as synthesis, analysis and application of a wide range of nanomaterials beginning with carbon nanostructures: fullerenes, graphene, GO, carbon nanotubes and ending with various semiconducting systems.

References

- 1 Novoselov K. S. et al. Electric Field Effect in Atomically Thin Carbon Films // *Science*. – 2004. – Vol. 306. – P. 666 – 669.
- 2 Wu, Y. H.; Qiao, P. W.; Chong, T. C.; Shen, Z. X. Carbon Nanowalls Grown by Microwave Plasma Enhanced Chemical Vapor Deposition // *Adv. Mater.* – 2002. – Vol.14. – P. 64.
- 3 Srinivas G., Zhu Y. W., Piner R., Skipper N., Ellerby M., Ruoff R.. Synthesis of graphene-like nanosheets and their hydrogen adsorption capacity // *Carbon*. – 2010. – Vol.48 (3). – P. 630-635.
- 4 Xu W.C., Takahashi K., Matsuo Y., Hattori Y., Kumagai M., Ishiyama S., Kaneko K., Iijima S., Investigation of hydrogen storage capacity of various carbon materials.// *International Journal of Hydrogen Energy*. – 2007. – Vol. 32 (13). – P. 2504-2512.
- 5 Yadav A., Khaire R.M. Overview of Supercapacitor // *International Journal of Advanced Research in Computer Science and Software Engineering*. – 2013. – V. 3. – P. 6.
- 6 Naik G., Krishnaswamy S.. Room-Temperature Humidity Sensing Using Graphene Oxide Thin Films // *Graphene*. – 2016. – Vol.5. – P. 1-13.
- 7 Lee, C. & Lee, G. Humidity sensors: A Review // *Sens. Lett.* – 2005. – Vol.3 – P. 1–15.