German-Russian
Young Scientists Conference

Renewable Energy - Biotechnology - Nanotechnology

Tomsk (Russia) - 20-22 May 2014
PROGRAMME & ABSTRACTS

Institute of Power Engineering, Tomsk, Russia
Yuri S. Borovikov, PhD, Director
borovikov@tpu.ru

Institute of High Technology Physics, Tomsk, Russia
Alexey N. Yakovlev, PhD, Director
yakovlev_an@tpu.ru

Nano-Centre, Tomsk Polytechnic University, Tomsk, Russia
Oleg L. Khasanov, Prof. Dr. Sc.
30, Lenin Avenue, Tomsk, 634050, Russia
Tel.: +7 3822 427 242
khasanov@tpu.ru

Institute of Physics and Technology Tomsk Polytechnic University, Russia
Tamara G. Petrashova, Ass. Prof.
Tel.: +7-3822- 563- 888;
Fax: +7(3822) 563 888
petrashova@tpu.ru

East-West-Science Centre (OWWZ), Kassel University, Germany
Nicole Burghardt, Dipl.-Biol.&MSc.
Mönchebergstr. 7, 34117 Kassel, Germany
Tel.: +49 561-8043609
gorzka@uni-kassel.de
burghardt@uni-kassel.de

Furtwangen University, Germany
Institute of Applied Research
Alexey Ivanov, MSc.
Alexey.ivanov@hs-furtwangen.de

Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Germany
Dirk Kirchner, MSc.
Dirk.kirchner@iwes.fraunhofer.de
Kassel University, Germany

Department of Grassland Science and Renewable Plant Resources
Liina Nurk, MSc
Liina.nurk@uni-kassel.de

Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Germany
Nils Schäfer, Dipl.-Ing.
Nils.schaefer@iwes.fraunhofer.de

German Biomass Research Centre (DBFZ), Leipzig, Germany
Walter Stinner, Dr.
Walter.stinner@dbfz.de

Kassel University, Germany
Institute of Physics
Timo Ueltzhöffer, Dipl.-NanoSc.
Timo.uelzhoeffer@physik.uni-kassel.de

Department of Hydrogen Energy and Plasma Engineering, Tomsk, Russia
Valery P. Krivobokov, Prof., DSc
krivobokov@tpu.ru

Department of Industrial Electric Power Supply, Tomsk, Russia
Boris V. Lukutin, Prof., D.Sc
Mikhail A. Surkov, Ass. Prof. PhD
lukutin48@mail.ru

Department of Biotechnology and Organic Chemistry, Tomsk, Russia
Vladimir Yu. Serebrov, Prof.
svyu@tpu.ru

Department of Biotechnology and Organic Chemistry, Tomsk, Russia
Marianna V. Chubik, Ass. Prof. PhD
chubic@tpu.ru

Department of Biotechnology and Organic Chemistry, Tomsk, Russia
VictorD. Filimonov, Prof., D.Sc
filimonov@tpu.ru
Irina U. Chochlova, Postgrad.
girinairina@tpu.ru

Department of Nanomaterials and Nanotechnologies, Tomsk, Russia
Anna Yu. Godymchuk, Ass. Prof., PhD
godymchuk@tpu.ru

High Current Electronics Institute, Tomsk, Russia
Andrey A. Solovyev, Ass. Prof.
andrewsol@mail.ru

Department of Theoretical and Experimental Physics, Tomsk, Russia
Vladimir F. Pichugin, Prof. D.Sc
pichugin@tpu.ru

Department of Material Science in Mechanical Engineering, Institute of Strength Physics and Materials Science SB RAS, Tomsk, Russia

Sergey V. Panin, Prof. Dr. Sc.
svp@ispms.tsc.ru

Department of Industrial Electric Power Supply, Tomsk, Russia
Alexander A. Sivkov, Prof. D.Sc.
Ivan I. Shanenkov, MSc
sivkovaa@mail.ru

GOALS:

- to transfer knowledge and technology of partner countries;
- to initiate and enforce further cooperation between companies and scientific institutions in the subject areas of Biotechnology, Nanotechnology and Energy;
- to advance Young Researchers' efforts.

FOCUS:

- knowledge and skills in specialized areas;
- cross-cultural scientific discussion.

The topics of the **Young Scientists Conference** have been selected according to the recommendations of the German-Russian Working Group «Nanotechnology», German-Russian Network «NanoBRIDGE» and the priority programmes of the Federal Ministries of Education and Research in Germany and Russia.

LANGUAGE English

TOPICS

1. Renewable Energy
• Sustainable system development
• BioEnergy
• Decentralised energy supply

2. Biotechnology
• Biomass conversion
•Power to gas
•Environmental remediation

3. Nanotechnology
•Waste water treatment / filtration
•Surface coatings
•Nanotechnologies for applications

SESSIONS

Plenary Session: Young Scientists and Cross-linked Environmental Concept of Biotechnology, Nanotechnology and Energy
Session 1. Renewable Energy

Session 2. Biotechnology
Session 3. Nanotechnology
Poster Session

VENUE

Conference venue
Tomsk Polytechnic University
30 Lenin ave., Tomsk, TPU Main building, room 234
Tel./Fax: +7 (3822) 563 888
Web-pages: http://ysc.tpu.ru
www.tomsk2014.owwz.de

LOCAL ORGANIZERS

Institute of Power Engineering
Institute of High Technology Physics
Nano-Centre and Department of Nanomaterials and Nanotechnologies
Conference coordinator
Tamara G. Petrashova
E-mail: Petrashova@tpu.ru
Tel./Fax: +7(3822) 563 888

PROGRAMME

Tuesday, May 20, 2014

07:00 – 08:00 Arrival, transfer to «Guest Hotel», accommodation
10.30 – 11:00 Transfer from «Guest Hotel» to the conference venue
10.00 – 11:00 Registration and information–(not for the German group – for the Russian participants)

Opening and Welcome

Venue: TPU Main Building, room 234

Chairs: *Oleg Khasanov, Prof. Dr.* Tomsk Polytechnic University
Nicole Burghardt, Dipl.-Biol., MSc., East-West-Science Centre (OWWZ), Kassel University

11.00 **Welcoming words**
Mrs. Svenja Ewert, Svenja Ewert, Consular Attaché for Economic Affairs, German Consul General in Novosibirsk

11:15 **Opening Speech**
Fedor A. Gubarev, Head of the Division of Postgraduate Studies TPU, Tomsk
Oleg Khasanov, Prof. Dr., TPU, Tomsk

11.30 **Activities and Funding Options for Young Scientists**
German Academic Exchange Service (DAAD) / the German Center for Research and Innovation-Moscow
Dr. Martin Krispin, German Center for Research and Innovation, Moscow

11:50 **German-Russian Networks in Nano- and Biotechnologies – Perspectives**
Nicole Burghardt, *Dipl.-Biol., MSc.*, East-West-Science Centre (OWWZ), Kassel University, Kassel

PLENARY SESSION
Cross-linked Environmental Concept of Biotechnology, Nanotechnology and Energy

12:10 **Development of Plasma Technologies at TPU**
Prof. Valery P. Krivobokov, DSc, Department of Hydrogen Energy and Plasma Engineering, TPU, Tomsk

12:30 **Hydrogen Energy Technologies**
Prof. Torsteinn I. Sigfusson, Innovation Center of Iceland

12:40 **Potential Environmental Impact of Nanomaterials**
Anna Yu. Godymchuk, Ass. Prof, PhD
Department of Nanomaterials and Nanotechnologies, TPU, Tomsk

12:50 -13:40 – Lunch («Jam» Café)

PLENARY SESSION
Young Scientists and Cross-linked Environmental Concept of Biotechnology, Nanotechnology and Energy

Chairs: *Nicole Burghardt*, *Dipl.-Biol., MSc.*, East-West-Science Centre (OWWZ), Kassel University
Tamara G. Petrashova, *Ass. Prof.*, TPU, Tomsk

13:40 **Flexibilization of Biogas Production from Biogas Plants**
Dirk Kirchner, MSc., Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Kassel, Germany

14:00 **Advanced Developments in Coating Deposition**
Andrey A. Solovyev, Ass. Prof., High Current Electronics Institute, Tomsk, Russia

14:20 **Aspects of Geographic Information Systems (GIS) in Regional and Spatial Planning**
Nicole Burghardt, Dipl.-Biol., MSc., Burghardt and Partner, Engineers and Biologists, Kassel

14. 40 - 18.00 – Visit to TPU Museum. Visit to TPU laboratories
18.00 – 19.00 - **Dinner**
19.00 – Social event: **Network Building with a Cup of Tea. Visit to café TEA DWELLING**

MULTIPLE SESSIONS

Wednesday, May 21, 2014

8.30 -9:00 - Transfer to the venue

Session 1&2 **Renewable Energy & Biotechnology**	
Venue: **TPU Building 8, room 331** **9:00** **Chairs:** *Nils Schäfer, Dipl.-Ing. ,* Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Kassel, Germany *Mikhail A. Surkov, Ass. Prof., PhD Department of Industrial Electric Power Supply,* Tomsk, Russia **Co-chair**: *Ilyas A. Rakhmatullin, PhD-student of Energy Institute,* TPU, Russia	
1.	**Conformance Testing of Generating Units According to Low-and Medium-Voltage Grid Code Requirements** *Nils Schäfer, Dipl.-Ing.*, Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Kassel, Germany
2.	**Autonomous Power Supply with Renewable Energy Sources** *Boris V. Lukutin, Prof. ,D.Sc., Mikhail A. Surkov, Ass. Prof., PhD,* Department of Industrial Electric Power Supply, TPU
3.	**Biodiesel Production from Sunflower Oil** *Daler Amanbayev, Student,* Institute of Physics and Technology, TPU supervised by *John Nieland*, Metabolistik Consulting, Aarhus School of Engineering, Meta-IQ, Århus Area, Denmark
4.	**Developing Methods for Selecting the Quantity and the Power of Diesel Generators** *Aleksandr Doroshenko, Student,* Department of Industrial Electric Power Supply, TPU supervised by *Boris V. Lukutin, Prof. ,D.Sc.,* Department of Industrial Electric Power Supply
Coffee break, poster session & Networking 10:20 – 11:30 **TPU Building 8, Second floor hall**	
1.	**11:30 "WWER-1000" to Investigate Physical Parameters of Nuclear Reactor in Case One of the Pumps is Nonoperational** *Duy Ha Phung, Student*, Institute of Physics and Technology, Department of Physics and Technology, TPU
2.	**Heat and Mass Transfer in Wet Fibroporous Material Considering Moisture Evaporation** *Yekaterina Gubina, Student*, Institute of Power Engineering, TPU supervised by Vyacheslav Yu. Polovnikov, TPU, Institute of Power Engineering
3.	**Power Balance of the Siberian Federal District: Dynamics and Prospects** *Valeriya Leonova, Student*, Department of Electrical and Power Engineering supervised by Galina N. Climova, Ph.D. Assistant, Department of Industrial Electric Power Supply, TPU
4.	**Biotechnological Methods of Uranium Salts Extraction from Industrial Waste** *Anna Moskalenko*, postgraduate student, Department of Biotechnology and Organic Chemistry, TPU supervised by *Marianna V. Chubik, Ass. Prof., PhD,* Department of Biotechnology and Organic Chemistry
	13:00 - 14. 00 Lunch
Venue: **TPU Building 8, room 331** **14:00** **Chairs**: *Walter Stinner, Dr.* German Biomass Research Centre (DBFZ), Leipzig, Germany *Vladimir Yu. Serebrov Prof.,*TPU **Co-chair:** Olga A. Guselnikova, MSc., Department of Biotechnology and Organic Chemistry, TPU	
1.	**Zero Waste Cascade Ultilisation for the Production of Energy** *Walter Stinner, Dr.,* German Biomass Research Centre (DBFZ), Leipzig, Germany
2.	**Role of Biologically Active Lipids in the Intracellular and Extracellular Signaling - the Subject of Research in Biotechnology**

	Vladimir Yu. Serebrov, Prof., Department of Biotechnology and Organic Chemistry , TPU
3.	**Studying of the Phenazine Derivaties from Pseudomonas Aeruginosa** *Yekaterina Palchevskaya, Student*, Department of Biotechnology and Organic Chemistry, TPU supervised by *Marianna V. Chubik, Ass. Prof., Ph.D.* in Medical Science , TPU Department of Biotechnology and Organic Chemistry, TPU
4.	**Mathematical Simulation of Heat Transfer in Layered Skin During Forest Fire Exposure** *Dariya Korobkina, Student,* Department of Theoretical and Industrial Heat Systems Engineering, Institute of Power Engineering, TPU supervised by *Nikolay V. Baranovskiy*, TPU
Posters	
1.	**Autonomous Solar-Wind Power Forecasting Systems** *Alena Okhorzina, PhD-student,* Department of Information-Measuring Engineering, Institute of Non-Destructive Testing, TPU supervised by Dr. Alexey Yurchenko, prof., Department of Information-Measuring Engineering, TPU
18:00 – 19.00 - Dinner	
Social Event: Tomsk Views at Night	

Session 3.
Nanotechnology

Venue: **TPU Building 8, room 144**
09:00
Chairs: *Timo Ueltzhöffer, Dipl.-NanoSc.,* Institute of Physics, Kassel University, Germany
Anna Yu. Godymchuk, Ass. Prof , PhD Department of Nanomaterials and Nanotechnologies, TPU, Tomsk
Co-chair: *Alexey O. Khasanov, postgraduate student,* Department of Nanomaterials and Nanotechnology, TPU

1.	**Rolled-Up Stripe-patterned Exchange Bias Tubes for Controlled Movement of Superparamagnetic Beads** *Timo Ueltzhöffer, Dipl.-NanoSc.,* Institute of Physics, Kassel University, Germany
2.	**Physical Vapor Deposition (PVD) Methods for Biocoating Deposition: Challenges and Prospects** *Vladimir F. Pichugin, Prof. D.Sc,* Department of Theoretical and Experimental Physics , TPU
3.	**Plasma Dynamic Synthesis of Hard and Superhard Materials** *Ivan I. Shanenkov*, MSc., supervised by Alexander A. Sivkov, Prof. D.Sc , Department of Industrial Electric Power Supply, TPU
4.	**Study of the Dynamics of Hydrogen Accumulation in Nanocrystalline Ti-6Al-4V** *Nikita Pimenov, Student*, Institute of Physics and Technology, TPU supervised by Vladimir S. Sypchenko, TPU
Coffee break, poster session & Networking 10:20 – 11:30 TPU Building 8, Second floor hall	
5.	**11:30 The Effect of the Metal Oxide Nanoparticles on the Red Blood Cells Morphology** *Anna Kozelskaya, junior research scientist,* Institute of Strength Physics and Materials Science SB RAS
6.	**Application of Sulfated Magnetic Nanoparticles in the Synthesis of Biologically Active Ureas** *Vera Kuksenok, PhD student*, Institute of High Technology Physics, Department of Bioengineering and Organic Synthesis, TPU supervised by *V.D. Filimonov, Prof. ,D.Sc.*, Department of Biotechnology and Organic Chemistry, TPU
7.	**Computer Simulation of Cardiac Electrical Activity Using an Electrocardiograph on Nanosensors** *Michael Grigoriev, PhD-student,* Medical Instrument-Making lab №63, Institute of Non-Destructive Testing, TPU supervised by Diana Avdeeva, Prof., Dr.S., Department of Information-Measuring Engineering
13:00 - 14.00 Lunch	
8.	**14.00 Possibility of Morphologic and Crystallographic Orientation of Magnetic Powders Particles Compacted under Interparticle Friction Reduction** *Daniil Iazykov, Engineer,* TPU Nano-Centre

9.	**The Possibility of Boron Carbide Coating Formation by Using a Coaxial Magnetoplasma Accelerator** *Anastasiia Makarova, Student,* Institute of Power Engineering, Department of Industrial Electric Power Supply, supervised by *Alexander Sivkov, Prof. ,D.Sc.*, Institute of Power Engineering, Department of Industrial Electric Power Supply, TPU
10.	**Research of Microarc Calciumphosphate Coatings Wettability** *Valentina Chebodaeva, Student,* Institute of Physics and Technology, TPU supervised by *Yurii P. Sharkeev, Prof. ,D.Sc.*, Department of Theoretical and Experimental Physics, TPU
11.	**Synthesis of Surface Modified Zero-valent Iron Nanoparticles via Spontaneous Reaction with Arenediazonium Tosylates** *Olga Guselnikova, Student,* Department of Bioengineering and Organic Chemistry supervised by *Pavel S. Postnikov,* Department of Bioengineering and Organic Chemistry, Institute of High-Technology Physics, TPU
12.	**Thermal Processes and Mass Transfer in the Target – Substrate System in the Deposition of Coatings Using High-power Pulsed Ion Beams** *Anastasiya Simonova, Student,* Department of Hydrogen Energy and Plasma Engineering, Institute of Physics and Technology supervised by *Galina A. Bleykher, PhD, Ass.Prof,* Department of Hydrogen Energy and Plasma Engineering, Institute of Physics and Technology, TPU
Posters	
1.	**Step into the Future. New Environmental Programme of TPU. The Second Life of Paper** *Julia Rashchupkina, Student,* Institute of High Technology Physics, TPU supervised by *Irina A. Bozhko, PhD, Ass.Prof.,* Department of Nanomaterials and Nanotechnologies, Institute of High Technology Physics, TPU
2.	**Aluminum Oxide and Zirconium Oxide Nanopowders Synthesis by Chemical Precipitation and Nano-spray Drying Methods** *Nurgyssanova Ainura, Student,* Department of Nanomaterials and Nanotechnology, TPU supervised by Galina V. Lyamina, PhD, ass. prof., Department of Nanomaterials and Nanotechnology
3.	**Production of Iron Nanopowders by the Electric Explosion of Wire** *Pustovalov Alexey* TPU, Institute of High Technology Physics, lab №12
4.	**Disaggregation of Aluminum Nanoparticles in Synthetic Lysosomal Liquid** *Elizaveta Karepina, Student,* Department of Nanomaterials and Nanotechnology, TPU supervised by Anna Godymchuk, PhD, ass. prof., Department of Nanomaterials and Nanotechnology
5.	**The Vacancy Generation Influence on the Initial Stage of Ion Implantation Process** *Elena Parfenova, PhD-student,* Institute of High Technology Physics, TPU supervised by Anna G. Knyazeva, Prof. ,D.Sc., Institute of High Technology Physics, TPU
6.	**Nanoparticles Dispersions in Physiological Liquids** *Elena Yunda, student,* Department of Nanomaterials and Nanotechnologies, TPU supervised by Anna Godymchuk, PhD, ass. prof., Department of Nanomaterials and Nanotechnology
18:00 – 19.00 - Dinner	
Social Event: Tomsk Views at Night	

Thursday, May 22, 2014

8.30 -9:00 Transfer to the venue

MULTIPLE SESSIONS

Session 1&2. **Renewable Energy &Biotechnology**
Venue: **TPU Building 8, room 331** **09:00** **Chairs:** Dirk Kirchner, MSc., Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Kassel, Germany *Andrey A. Solovyev, Ass. Prof.,*High Current Electronics Institute, Tomsk, Russia

Co-chair: *Alena Bortuleva, MSc.*

1.	**Efficient Bioenergy Production from Lignocellulosic Biomass** *Liina Nurk, MSc,* Department of Grassland Science and Renewable Plant Resources , Kassel University, Germany
2.	**Involvement of Renewable Energy in the Energy Balance in Isolated Areas of the North** *Violetta Kiushkina, Associate Professor***,** Technical Institute (branch) of the North-Eastern Federal University, Yakutia
3.	**Power Balance of the Siberian Federal District: Dynamics and Prospects** *Valeriya Leonova, Student*, Department of electrical and power engineering supervised by *Galina N. Climova,* Ph.D. Assistant, Department of Industrial Electric Power Supply, TPU
4.	**Formation of Metal-Supported Solid Oxide Fuel Cell** *Artem Zhmurovskii*, *MSc.,* Department of Hydrogen Energy and Plasma Technology , TPU supervised by *Solovyev A.A.*, Ass. Prof., High Current Electronics Institute
12:30 - 13.30 Lunch	
13.30 – 14.30 Conclusion and Résumé Venue: **TPU Building 8, room 144** **Chair:** *Nicole Burghardt*, East-West-Science Centre (OWWZ), Kassel University, Kassel ***1.*** Reports of Chairs on the Sessions Results ***2.*** Free Discussion ***3.*** Making a Conference Resolution	
14.30 – 19.00 Excursion Programme and Free Time	
19.00 – 21.00 Farewell Dinner	

Session 3.
Nanotechnology

Venue: **TPU Building 8, room 144**
09:00
Chairs: *Timo Ueltzhöffer, Dipl.-NanoSc.,* Institute of Physics, Kassel University, Germany
Anna Yu. Godymchuk, Ass. Prof , PhD Department of Nanomaterials and Nanotechnologies, TPU, Tomsk
Co-chair: *Daniel K. Yazykov, MSc.*

1.	**Technologies for Manufacturing Bulk Nanoceramic Articles** *Oleg L. Khasanov , Prof. Dr. Sc.,*Nano-Centre, TPU
2.	**Simulation of Silicon Anodization Process** *Alexey Ivanov, MSc.,* Institute of Applied Research, Furtwangen University, Germany
3.	**Nanostructuring of Structural Steel Surface by Zr-ion Beam Irradiation** *Sergey V. Panin, Prof. Dr. Sc.* **,** Department of Material Science in Mechanical Engineering, TPU Institute of Strength Physics and Materials Science SB RAS
Coffee break, poster session & Networking 10:20 – 11:30 **TPU Building 8, Second floor hall**	
4.	**Surface Modification of Polyhydroxybutyrate Films to Control Wettability** *Dina Syromotina, Student***,** Department of Hydrogen Energy and Plasma Engineering, supervised by *Dr. Roman A. Surmenev*, senior researcher, associate professor, TPU
5.	**Investigation of Properties of TiN Films Obtained with the Dual Magnetron Sputtering System at Various Values of the Partial Pressure of Nitrogen** *Ksenia Mihnevich, Student*, Department of Hydrogen Energy and Plasma Technologies supervised by *Yuri N. Yuriev*, Laboratory of Hydrogen Energy and Plasma Technologies, TPU

6.	**Simple Model of Intermetallics Formation in Surface Layer during Ion Implantation** *Asfandyar Khan, PhD-student,* Institute of High Technology Physics, TPU supervised by *Anna G. Knyazeva*, Prof. Dr.S., Institute of High Technology Physics
12:30 - 13.30 Lunch	
13.30 – 14.30 Conclusion and Résumé Venue: **TPU Building 8, room 144** **Chair**: Nicole Burghardt, East-West-Science Centre (OWWZ), Kassel University, Kassel ***1.*** Reports of Chairs on the Sessions Results ***2.*** Free Discussion ***3.*** Making a Conference Resolution	
14.30 – 19.00 Excursion Programme and Free Time	
19.00 – 21.00 Farewell Dinner	

Friday, May 23, 2014

06:30 – Departure for the Airport

PROGRAMME COMMITTEE:

- Mikhail A. Sonkin Dr, Prof., Vice-Rector for Research and Innovations, Tomsk Polytechnic University
- Alexey N. Pestryakov Dr, Prof., Deputy Vice-Rector for Research and Innovations, Tomsk Polytechnic University
- Gabriele Gorzka East-West-Science Center (OWWZ), Kassel University, Germany
- Nicole Burghardt Kassel University , Germany
- Dirk Kirchner Fraunhofer Institute for Wind Energy and Energy System Technology, Germany
- Liina Nurk Kassel University, Germany
- Alexey Ivanov Furtwangen University, Germany
- Nils Schäfer Fraunhofer Institute for Wind Energy and Energy System Technology, Germany
- Walter Stinner German Biomass Research Centre (DBFZ), Germany
- Timo Ueltzhöffer Kassel University, Germany
- Alexey N. Yakovlev PhD, Director, Institute of High Technology Physics, Tomsk Polytechnic University
- Yuri S. Borovikov PhD, Director, Institute of Power Engineering, Tomsk Polytechnic University
- Oleg L. Khasanov Dr, Head, Department of Nanomaterials and Nanotechnologies, Director, Nanomaterials and Nanotechnologies Centre, Tomsk Polytechnic University

ORGANIZING COMMITTEE

- Tamara G. Petrashova Head of the Project, PhD, Associate Professor, Department of Foreign Languages, Institute of Physics and Technology , TPU , Tomsk, Russia
- Evgenia V. Frantsina Academic Career Center, Director TPU, Tomsk, Russia
- Yulia V. Falkovich Leading Expert, Coordinator for International Research,

- Science and Innovation Office, PhD, Associate Professor, Tomsk, Russia
- Liliya G. Kiryanova PhD, Head, Communication Policy Division, Tomsk Polytechnic University
- Alexandra A. Panina PhD, Ass. Prof., Department of Nanomaterials and Nanotechnologies, Institute of High Technology Physics, Tomsk Polytechnic University
- Alexander Ya. Park Assistant lecturer, Department of Industrial Electric Power Supply, Institute of Power Engineering, Tomsk Polytechnic University
- Mikhail A. Surkov PhD, Ass. Prof., Department of Industrial Electric Power Supply, Institute of Power Engineering, Tomsk Polytechnic University
- Nikita V. Martyushev PhD, Ass. Prof., Department of Material Science and Process Metallurgy, Institute of High Technology Physics, Tomsk Polytechnic University
- Olga V. Sidorova Expert, Academic Career Center, TPU, Tomsk, Russia, member of Organizing Committee.

Please contact the Organizing Committee at TPU:

Tamara G. Petrashova, Associate Professor, TPU , Tomsk
Tel.: +7-3822- 563- 888;
Fax.: +7(3822) 563 888
e-mail: petrashova@tpu.ru
Web-site: http://ysc.tpu.ru

Contact in Germany:

East-West-Science Center (OWWZ)
Kassel University
Dr. Gabriele Gorzka
Dipl.-Biol., MSc. Nicole Burghardt
Fon: +49 561 804-3609
E-Mail: gorzka@uni-kassel.de
Web-site: www.tomsk2014.owwz.de

Funding:

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Germany
Land of Ideas

Supported by:

The Young Scientists Conference – Renewable Energy - Biotechnology - Nanotechnology is included into the list of the events in the EU-Russia Year of Science 2014.

Members of the TPU Renewable Energy Club have actively participated in the organization of the conference.

German-Russian
Young Scientists Conference

Renewable Energy - Biotechnology - Nanotechnology

Tomsk (Russia) - 20-22 May 2014

ABSTRACTS

PLENARY SESSION

ACTIVITIES AND FUNDING OPTIONS FOR YOUNG SCIENTISTS

Martin Krispin

German Academic Exchange Service (DAAD)
The German Center for Research and Innovation, Moscow

The German House for Research and Innovation (DWIH) Moscow

The German Houses of Research and Innovation (DWIH) provides a platform for the German research and innovation landscape, showcasing the accomplishments of German science, research, and research-based companies and promoting collaboration with Germany and innovative German organizations. Our goal is to present German scientific and research organizations abroad under the banner of the DWIHs.
The German Houses of Research and Innovation are part of the Internationalization Strategy of the German Federal Government and the Federal Foreign Office's Research and Academic Relations Initiative. The Federal Foreign Office is implementing this project in cooperation with the Federal Ministry of Education and Research and in close collaboration with the Alliance of German Science Organizations, which includes the Alexander von Humboldt Foundation, Fraunhofer-Gesellschaft, German Academic Exchange Service (DAAD), German Council of Science and Humanities (WR), German National Academy of Sciences Leopoldina, German Rectors' Conference (HRK), German Research Foundation (DFG), Helmholtz Association, Leibniz Association, Max-Planck-Gesellschaft - as well as the Association of German Chambers of Industry and Commerce (DIHK).

The houses were created for various goals:

- Promote Germany as a research location
- Provide a forum for international dialogue and scientific exchange
- Provide support and services (advising for international researchers; organizing educational events; facilitating collaboration)

The German House for Research and Innovation in Moscow goes back to a June 2009 meeting between Germany's then Foreign Minister Frank Walter Steinmeier and his Russian counterpart Sergey Lavrov, when both agreed with expanding the institute under the leadership of the DAAD. In 2011 a joint declaration between Dr. Guide Westerwelle and Sergey Lavrov on the

establishment of a German House of Research and Innovation in Moscow was signed. Currently the DWIH project in Moscow is lead jointly by the German Academic Exchange Service (DAAD) and the German Research Foundation (DFG) and comprises partners with a representation/representative in Moscow like the Helmholtz Association of German Research Centres (HGF), Alexander von Humboldt-Foundation (AvH), the Freie Universität Berlin and the German Historical Institute (DHI) Moscow. The German-Russian Chamber of Foreign Commerce (AHK) is also member of the DWIH. DWIH Moscow´s current director is Dr. Gregor Berghorn (DAAD).

In its various activities the DWIH Moscow focuses mainly on the topics of the German-Russian Modernization Partnership, i.e. climate, energy, health care, resource management, logistics and legal cooperation. Beside these, it has established an event portfolio on additional fields of German Russian scientific interest as aviation and space, energy saving technologies in constructing, bioenergy and several more. The DWIH regularly organizes and supports German-Russian events like e.g.:

- Science Lectures of outstanding German scientists (also via Live-Streaming with selected partners in the regional scientific and economic centres in Russia)
- Science Talks with high-ranked representatives of German and Russian science, science organizations, company-based research and representatives of regional administrations
- The „German-Russian Week of the Young Researcher", once a year on varying subjects in the Russian regions
- Regular meetings with rectors of leading Russian universities
- Symposia/Conferences on current scientific topics
- Information seminars in centres of scientific and innovative research in Russia
- Economy and innovation: participation in economic conferences on innovative topics
- Round table talks with scientists and journalists
- Participation in fairs in the field of German research marketing

In 2013, the German House of Research and Innovation in Moscow participated in more than 40 events and organized itself several high-ranked scientific events.

GERMAN-RUSSIAN NETWORKS IN NANO- AND BIOTECHNOLOGIES – PERSPECTIVES

Nicole Burghardt

East-West-Science Centre (OWWZ), Kassel University, Kassel

burghardt@uni-kassel.de

The East-West-Science Centre (OWWZ*)* was established in 1992 at Kassel University. It is the Hessian Competence Centre for cooperation in research and development with countries in Central and Eastern Europe. OWWZ starts initiatives and supports East-West networks in science and technology transfer. The centre is experienced in

- coordination and management of East-West international projects (European programmes and federal German programmes)
- organization of international conferences, workshops and match meetings
- conceptual design and organization of expert seminars for professional qualification
- target- and target-group oriented information transfer and networking
- regional and knowledge-oriented cluster cooperation

The objectives of the **German-Russian Cooperation Network Biotechnology** are to initiate and establish cooperation between companies and scientific institutions in both countries and furthermore to provide a systematic and sustainable basis for cooperation in traditional fields, as for example molecular biology or biochemistry, as well as in younger research areas such as the environmental and resource management.

The service offerings of the cooperation network include the implementation of events as well as the allocation of specialized information, publication of trends and cooperation opportunities in a monthly newsletter and individual services for project teams.
Especially bilateral projects are attended result-oriented for: this includes consultation on funding, application and project management involving patenting, marketing of products and setting up businesses. This consulting offer addresses German and Russian experts from science and business, focusing especially on small and midsize enterprises interested in cooperating with institutions and partners in the field of biotechnology.

NanoBRIDGE - Bridging of the German and Russian Nanotechnology Excellence
The overall aim of the German-Russian network NanoBRIDGE is to intensify the scientific and technical cooperation in nanotechnology especially in biomedical applications, in nanoanalytics and applied nanotechnology. Russian and German partners are to benefit equally from joint research and development projects, scientific and technical events and exchanges of experts, young scientists and students to enhance their international competitiveness in a strong and sustainable way. NanoBRIDGE offers participation in Project development teams, Network conferences, Qualification courses, Internships in companies.

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ASPECTS OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) IN REGIONAL AND SPATIAL PLANNING

Nicole Burghardt[a,b], René Burghardt[b]

[a] *Kassel University – East-West Science Centre (OWWZ)*
[b] *Burghardt and Partner, Engineers and Biologists – Kassel*

info@lp-kassel.de

Today spatial and environmental planning is not manageable without the use of Geographic Information Systems (GIS). In 1962 the first Geographic Information System was developed by Dr. Roger Tomlinson (1933 – 2014) in Canada aiming to determine the land capability for rural Canada by mapping information about soils agriculture, recreation, wildlife, waterfowl, forestry and land use at a scale of 1:50.000. Nowadays GIS are high-bred software systems and due to the complexity of different application areas, many special Geographic Information Systems have been developed through the years. In general they all unite spatial data and information with intend of organisation, mapping, analysis, visualisation, and crosslinking. Especially in the fields of regional and spatial planning the options of a multi-level access provided by GIS are quite useful. Development processes in environmental management – for example of wind farms or power grids etc. – must interlink series of virtual parameters of different derivation (e.g. regulatory frameworks, technical demands, place of location etc.) and

have to analyse them via different information planes. Target-oriented use of GIS as an instrument therefore results in the increase of functionality, complexity, capacity, dynamic and transparency regarding modern planning requirements.

PLASMA TECHNOLOGIES RESEARCH IN THE INSTITUTE OF PHYSICS AND TECHNOLOGY AT TOMSK POLYTECHNIC UNIVERSITY

Valery Krivobokov

Department of Hydrogen Energy and Plasma Engineering, National Research Tomsk Polytechnic University

krivobokov@tpu.ru

The report presents results of research carried out in Laboratory 23 in the Institute of Physics and Technology, Tomsk Polytechnic University (TPU), Tomsk, Russia, in the field of producing and using gas-discharge plasma to treat the surface of materials and manufactured products. The report covers some issues relevant to developing magnetron plasma sources, including those with the liquid-phase target. Significant attention is paid to the development of plasma installations to deposit modifying coatings on the surface of materials and manufactured products. These primarily comprise large-size equipment for coating the surface of sheet glass with low-emission coatings. As a result of this operation the glass becomes transparent for the visible light and non-transparent for the infrared one.

Some products of research on the use of plasma coatings to protect spacecraft against solar radiation are presented. A special high-performance installation for the production of protective elements for satellites has been developed and launched into manufacturing. The construction of a plasma installation developed in TPU for depositing transparent electroconducting coatings on the surface of polymer materials, which are widely used in space equipment, is discussed.

A number of other same-type machines are also presented. Research has proved modifying plasma coatings to be really effective in various fields of industry.

POTENTIAL ENVIRONMENTAL IMPACT OF NANOMATERIALS

Anna Godymchuk

Department of Nanomaterials and Nanotechnologies, National Research Tomsk Polytechnic University

godymchuk@tpu.ru

An increasing dispersion of nano- and microsized anthropogenic and engineered particles has become a major cause for concern in terms of occupational and environmental health risk

and potential hazard. The lecture includes a survey on the physicochemical properties, fate, and toxicity of engineered nanoparticles in the environment including atmosphere, aquatic systems, soils and biological objects. The special attention will be given to the influence of abiotic parameters on nanoparticles migration in the environment and human body, the uptake, translocation and clearance of inhaled nanoparticles, and the dermal uptake of nanoparticles. Also mechanisms of nanoparticles interaction with biological objects, cellular uptake, toxicity mechanisms as well as acute toxicity to aquatic organisms, mammals, and plants will be particularly considered. Finally, a mixed effect of nanoparticle physicochemical properties (size, dose- and concentration, surface charge, shape, surface-area, chemistry, dissolution, aggregation) on toxicological properties will be presented by means of comparison studies of nanoparticles behavior in different environmental media.

FLEXIBILIZATION OF BIOGAS PRODUCTION FROM BIOGAS PLANTS

Dirk Kirchner

Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Kassel, Germany

Dirk.kirchner@iwes.fraunhofer.de

Basics and current research activities

Currently most of the biogas plants in Germany produce electricity continuously, based on the old Renewable Energy Sources Law (EEG).

This is based on the fact that the biogas plant operator receives a fixed compensation per produced kWh. That leads to high operation times and full-load hours of the biogas plants to generate a maximum revenue.

Due to the increasing share of fluctuating energy sources like wind and PV it becomes necessary to operate biogas plants in a flexible way to avoid energy surplus and therewith negative stock exchange prices.

The flexibilization of biogas plants can be realized with e.g. additional biogas storage facilities. Additionally, the implementation of another CHP (combined heating power plant) is essential for shifting the energy production for a short period of time (hours/days). Other ways to operate the biogas plant flexibly are a variable feedstock management, biological, physical and chemical pre-treatment processes to shift the energy production for a longer period of time (days/month).

Currently there are various research projects which deal with the flexibilization of biogas production.

Actually it gives some research projects, which be involved with the question of the flexible biogas production.

The presentation gives an overview of possible processes how to operate a biogas plant flexibly and the latest research project on this topic.

ADVANCED DEVELOPMENTS IN COATING DEPOSITION

Andrey Solovyev

High Current Electronics Institute, National Research Tomsk Polytechnic University

andrewsol@mail.ru

This report presents an overview of recent advances of the Laboratory of Applied Electronics (Institute of High Current Electronics, Tomsk) concerning the application of such a

method of vacuum physical vapor deposition (PVD) as magnetron sputtering for deposition of different functional coatings. The area of interests of the Laboratory of Applied Electronics includes the development of equipment and vacuum coaters for thin film deposition and the study of various functional coatings. The latest advances in the formation of wear-resistant hydrocarbon coatings, low-E coatings and electrochromic films are discussed.

SESSION 1. RENEWABLE ENERGY

CONFORMANCE TESTING OF GENERATING UNITS ACCORDING TO LOW-AND MEDIUM-VOLTAGE GRID CODE REQUIREMENTS

Nils Schäfer

Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), Kassel, Germany

nils.schaefer@iwes.fraunhofer.de

The share of distributed generation (e.g. wind power generators, photovoltaic systems, cogeneration units) installed in the electric grid has significantly grown over the past twenty years. For reasons of grid stability and security of supply distributed generating units and plants connected to the public grid are requested to show a behavior similar to that of large-scale power plants. Therefore grid codes require capabilities such as active and reactive power set-point control, Q(U) control, fault-ride through (FRT) or active power reduction in case of over-frequency. In order to meet these requirements several countries have specified a certification process for distributed generating units and plants. A major part of this certification process consists of type testing of distributed generating units. During this type testing generating units have to prove their capabilities according to the aforementioned grid code requirements. Fraunhofer IWES has gained a lot of experience in type testing of distributed generating units, especially in the field of photovoltaic inverters. In this presentation grid code requirements and the certification process for connection to the German medium-voltage network are described. Furthermore the presentation focuses on Fraunhofer IWES' lab infrastructure and experience gained during type testing.

AUTONOMOUS POWER SUPPLY WITH RENEWABLE ENERGY SOURCES

Boris Lukutin, Mikhail Surkov

Department of Industrial Electric Power Supply, National Research Tomsk Polytechnic University

lukutin48@mail.ru

Increasing the power efficiency and overall performance of autonomous systems of electrical supply is possible by adopting a new technology – hybrid power stations including diesel-generators, wind generators and PV-installations (WPS and PV-PS), and also buffer stores of electric power. An important feature of hybrid systems with energy stores is the possibility of optimising the loading of the generating equipment and matching consumption and electric power generation.

In the given project it is planned to conduct complex researches of operating conditions of an autonomous hybrid power station containing a diesel-generator, an installation of renewable power and a buffer energy storage.

Within the limits of the project it is solving a technical problem of creating diesel-generators on variable frequency of the shaft rotation a as part of a hybrid power station at capacity and character of power loading dependence. The object of research is caused by the circumstance that taken principles of management of industrial DPS do not guarantee a fuel consumption minimum at loading change, and applied control systems of teamwork of the equipment of hybrid power stations do not allow reaching the high power efficiency.

INVOLVEMENT OF RENEWABLE ENERGY IN THE ENERGY BALANCE IN ISOLATED AREAS OF THE NORTH

Violetta Kiushkina

Technical Institute (branch) of the North-Eastern Federal University, Yakutia

viola75@mail.ru

The power industry of the Republic of Sakha (Yakutia), the leader in the amount of small-scale power generation in the north of Russia, is a fairly unique complex. At the same time, low performance characteristics of energy sources, specific climatic and geographical and physical conditions of the region complicate the challenge of energy supplying in the area with decentralized electricity generation, which is about 60 % of the republic's territory. Solving the problem of electrification for all consumers, especially in the Far North, through centralized power supplies is not possible. The present period is the best time to implement projects in renewable as well as conventional energy for the more efficient energy complex, thanks to the cooperation and experience of foreign companies in developing arctic installations. Advantages and usefulness of small-scale power stations diversifying their energy resources with renewable ones can improve the reliability and survivability, and enhance energy security of settlements in geographically remote areas of the region. A diversified and balanced energy mix in the local areas and isolated Arctic territories will result in more sustainable energy supply, promotion of energy-saving policies and success of remote regions.

EFFICIENT BIOENERGY PRODUCTION FROM LIGNOCELLULOSIC BIOMASS

Liina Nurk, Michael Wachendorf

Department of Grassland Science and Renewable Plant Resources, Kassel University, Steinstrasse 19, 37213 Witzenhausen, Germany

Liina.Nurk@uni-kassel.de

Biomass rich in lignocellulose (e.g. extensive grassland, biomass from landscape management) is rarely used for animal feeding due to its low nutritive value and declining livestock levels. For grassland conservation purpose, mowing is essential nevertheless and using the material for energy recovery emerges as new utilization opportunity. However, on the one hand the material is suboptimal for standard biogas techniques, due to its limited degradability and methane yields. On the other hand, it is challenging in combustion because of high contents of Cl, K, Mg, N and S causing slagging, corrosion and emission.

The "Integrated Generation of Solid Fuel and Biogas from Biomass" technology (IFBB) overcomes these problems by separating the easy digestible constituents and the minerals from the well combustible fibers. For the IFBB procedure the biomass is conserved by ensiling. The

silage is processed by hydrothermal conditioning and mechanical separation, whereas the resulting solid is used as fuel with improved combustion characteristics, and the fluid is converted to biogas with subsequent use by a combined heat and power unit. The fuel quality of the mechanically dehydrated silage is improved in comparison to the untreated biomass, because of the partial elution of mineral compounds, which are detrimental to combustion. The easily soluble and highly degradable organic compounds and the minerals go in the fluid part which is characterized by high methane yields in biogas production. After fermentation, the digestate can be used as fertilizer.

BIODIESEL PRODUCTION FROM SUNFLOWER OIL

Daler Amanbayev[a], John Nieland[b]

[a] *Institute of Physics and Technology, National Research Tomsk Polytechnic University*
[b] *Aarhus School of Engineering, Meta-IQ, Århus Area, Denmark*

daleramanbayev@gmail.com

Southern Africa is composed of some of the poorest countries in the world. The energy demand in these countries compels them to spend millions of dollars in the purchases of mineral oil and gas to meet their demands while these countries have the ability to produce their own sources of energy from biodiesel. The most common way to produce biodiesel is via trans-esterification process which refers to a catalyzed chemical reaction involving vegetable oil and methanol to yield fatty acid methyl esters (biodiesel). Research has proven that the use of sunflower as a feedstock for biodiesel production yields zero waste. Apart from the fact that there is no waste generated, the sunflower is an attractor of bees and most sunflower farms have been used for honey cultivation, which will result in a two-way income generation, and hence will go a long way to reduce poverty and improve the GDP of Southern Africa countries.

DEVELOPING METHODS FOR SELECTING THE QUANTITY AND THE POWER OF DIESEL GENERATORS

Aleksandr Doroshenko, Yermek Sarsikeyev, Boris Lukutin

Department of Industrial Electric Power Supply, National Research Tomsk Polytechnic University

avd5@tpu.ru

The paper proposes a method of optimizing the quantity and power of diesel power generators of an autonomous diesel power plant, which is used as the main power supply for decentralized consumers.

POWER BALANCE OF THE SIBERIAN FEDERAL DISTRICT: DYNAMICS AND PROSPECTS

Valeriya Leonova, Galina Climova

Department of electrical and power engineering, National Research Tomsk Polytechnic University

zvdlera@mail.ru

The sustainable system of energy supply in the Siberian Federal District requires first of all accurate forecast and research of the factors relating to energy consumption. The Siberian Federal District (SFD) possesses rich fuel, energy and raw material resources, also being a major supplier of resources to other regions. The balance of electrical energy efficiency (EE) is a partial derivative of the composite energy balance in the SFD considered at the socio-economic level of the territory development, as well as an indicator of effectiveness concerning the implementation of the State policy in the field of energy conservation. The most significant factor affecting power consumption is the gross regional product (GRP) and capacitance of GRP. Mining and manufacturing industries are characterized by the production of electrical capacitance. Following the scenario of Russia's social and economic development till 2030, some research of changes relating to the dynamics of the GRP has been done by modifying its structure. Also the paper offers approximate forecast concerning electric capacity by 2020 in comparable prices. So with 18% decrease, capacitance will decrease by 13%, not affecting the GRP trend. In our opinion, the policy of energy efficiency may not only include introduction of energy-saving technologies, but bring about a more accurate forecast analysis of the SFD electric balance.

AUTONOMOUS SOLAR-WIND POWER FORECASTING SYSTEMS

Alena Okhorzina, Alexey Yurchenko, Artem Kozloff

Department of Information-Measuring Engineering, National Research Tomsk Polytechnic University

ameba_89@mail.ru

The paper reports on the results of climatic testing of silicon PV modules and PV power systems of 50-5 kW conducted in Russia (Siberia and the Far East. A unique experimental base for field tests of solar energy systems was constructed in Tomsk in 1996. The experimental base includes: TOR (meteo.iao.ru), the station of atmosphere parameters control (38 parameters); a mobile station of functioning monitoring of PV modules; a demonstrational functioning zone of 240 and 1200 Watt solar energy complexes and laboratory test benches. The monitoring system which controls the power system work was developed. Testing over 17 years and a large amount of experimental studies enabled us to develop a precise mathematical model of the PV module in natural environment under climatic and hardware factors. The model was used to develop Generating power forecasting technique for PV power systems with 5% accuracy up to a month forecasting interval. The forecasting technique developed enhanced minicomputer-based forecasting systems. Forecasting systems considering meteorological data and solar power system operability (stored energy, energy consumption dynamics, etc.) control the grid and energy consumption level and provide uninterrupted power supply for essential systems.

"WWER-1000" TO INVESTIGATE THE PHYSICAL PARAMETERS OF NUCLEAR REACTOR IN CASE ONE OF THE PUMPS IS NONOPERATIONAL

Duy Ha Phung

Department of Physics and Technology, National Research Tomsk Polytechnic University

phungduyha@gmail.com

Vietnam government is planning for construction of the first two nuclear power plants by 2020, one of them will be applying the WWER-1000 technology, the Russian type of pressurized water reactor (PWR). Thus, the research how it works, in which simulator plays a very important role, is necessary. Currently there are a lot of software products written for PWR in general as well as others for the WWER-1000 reactor in particular, that allow researching incidents which can occur in the reactors. This paper presents the "WWER-1000 reactor simulator" to investigate breakdowns in the case when the primary coolant pump stops working. It also examines the parameters of neutron flux, temperature of the reactor core, temperature of the fuel rods as well, and then evaluates the possible dangers cause for the nuclear power plants.

HEAT AND MASS TRANSFER IN WET FIBROPOROUS MATERIAL CONSIDERING MOISTURE EVAPORATION

Yekaterina Gubina, Vyacheslav Polovnikov

Institute of Power Engineering, National Research Tomsk Polytechnic University
KatyaTomsk@sibmail.com

Results of numerical simulation of heat and mass transfer in a wet fibroporous material in conditions of evaporation and steam diffusion were obtained. Values of heat and mass fluxes were established. The contribution of evaporation effect to total heat flux and need to consider volume fractions of water and steam into the structure of fibroporous material in calculation of effective thermal conductivity were shown. Nonstationarity of heat and mass transfer in conditions of considered problem can be ignored.

FORMATION OF METAL-SUPPORTED SOLID OXIDE FUEL CELLS

Artem Zhmurovskii, Dmitrii Terentev, Alena Borduleva

Hydrogen Energy and Plasma Technology Department, National Research Tomsk Polytechnic University
l.a.r.e.s@mail.ru

A perspective vacuum physical vapor deposition (PVD) method such as magnetron sputtering (MS) has been adopted to form a dense thin yttrium stabilized zirconia (YSZ) and Ni/YSZ anode layers on the Ni-Al substrate. Ni-Al substrate was prepared by self-propagating high-temperature synthesis from compacted Ni and Al powders. A cathode layer was formed by spreading lanthanum strontium manganite (LSM) paste on electrolyte layer. The cell reached a maximum power density of 360 mW cm-2 at 800 °C and 0.7 V.

SESSION 2. BIOTECHNOLOGY

ZERO WASTE CASCADE UTILIZATION FOR THE PRODUCTION OF ENERGY

Walter Stinner, Dr.
German Biomass Research Centre (DBFZ), Leipzig, Germany

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ROLE OF BIOLOGICALLY ACTIVE LIPIDS IN THE INTRACELLULAR SIGNALING – THE SUBJECT OF RESEARCH IN BIOTECHNOLOGY

Vladimir Yu. Serebrov
Department of Biotechnology and Organic Chemistry, Tomsk Polytechnic University
Department of Biochemistry and Molecular Biology, Siberian State Medical University
serebrov@ssmu.ru

Hepatocellular carcinoma is the most common outcome of chronic hepatitis. The sphingolipids-sphingomyelin (SPM), ceramide (CER) and sphingosine (SPZ) play key role in regulation of cell proliferation and apoptosis. These processes are the two basic ones, responsible for the tumor development. Our research was carried out on Vistar rats in which the chronic hepatitis was caused by two times a week during 65 day subcutaneous introductions 112 mg 50% oil solution of carbonic tetrachloride (CCl_4)/ 100 g of the animal body weight and group of rats in which hepatocellular carcinoma was caused by introduction of 0.2% N-nitrosodiethylamine in drinking water. The rats were divided into 4 groups: 1-intact rats; 2-rats with CCl_4 introduction (hepatitis rats); 3-rats with 0.9% NaCI solution injections (chronic hepatitis control group); 4-rats which hepatocellular carcinoma was caused. It was shown that during hepatocellular carcinoma development the quantities of SPM and CER were reduced for the entire research period, but the content of SPZ was increased from 21st day (63 ±2.53, $p<0,05$) by the maximum on 90th day (71 ±2.73, $p<0,05$) in comparison with the control group of animals (50.5±4.72, $p<0,05$). During chronic hepatitis development the contents of SPM and CER were decreased, the content of SPZ was increased until 65th day (54.8±4.89, $p<0,05$) in comparison with the control group (47.8±3.67, $p<0,05$). This changes during the early stage of hepatocellular carcinoma development and the late stages of chronic hepatitis development are analogous.

Discussion the result of intravenous admission of CER and SPM that were loaded in liposome during the carcinoma or chronic hepatitis development and possibility of creation the new class of medicine as the subject of research in biotechnology.

BIOTECHNOLOGICAL METHODS OF URANIUM SALTS EXTRACTION FROM INDUSTRIAL WASTE

Anna Moskalenko, Marianna Chubik

Department of Biotechnology and Organic Chemistry, National Research Tomsk Polytechnic University

moskalenkoav@tpu.ru

High demand in new materials which are capable of permanently eliminating radionuclides comes from the actuality of the problem of environment contamination by radionuclides in general and water environment contamination in particular.

In the last years in many countries research on new class sorbent development is actively progressing, these sorbents should constitute of biogenic substances and include them as the main element – biosorbent. For example, they are produced from microbe mass or fungi which are microbilogical industry wastes. Apart from that, application of different nanoforms of metal oxides as a sorbent is viewed as promising.

The main direction of our research is development and analysis of the methods of sewage and industrial waters cleanup from radioactive contaminants by the means of deposited nanoparticles of titanium oxide on mold mycelium, these nanoparticles being capable of selective absorption of radioactive ions even in the presence of many other competing ions.

The being developed hybrid sorbent for cleanup of water objects from radionuclides is different from others by high sorbent capabilities of its components, such components are presented by nanotubes and nanopowders of metal oxides and modified by these nanoforms mycelium of nonpathogenic mold fungi of different kinds.

STUDYING OF THE PHENAZINE DERIVATIES FROM PSEUDOMONAS AERUGINOSA

Yekaterina Palchevskaya

Department of Biotechnology and Organic Chemistry, National Research Tomsk Polytechnic University

palchevskaya.kat@mail.ru

Phenazines represent a group of heterocyclic nitrogen-containing compounds showing a broad spectrum of antibiotic properties. Phenazines are studied extensively for their application in plant disease management. Pseudomonas aeruginosa produce three phenazine compounds as secondary metabolites. These metabolites are known as phenazine-1-carboxylic acid (PCA), 2-hydroxyphenazine-1-carboxylic acid and 2-hydroxyphenazine (2-OH P). In this study the separation and characterization of phenazines were done by using thin layer chromatography,

column chromatography and ultraviolet spectrum. Two compounds were isolated and their concentration was identified.

MATHEMATICAL SIMULATION OF HEAT TRANSFER IN LAYERED SKIN DURING FOREST FIRE EXPOSURE

Dariya Korobkina, Nikolay Baranovskiy

Department of Theoretical and Industrial Heat Systems Engineering, National Research Tomsk Polytechnic University

korobkina.darya@mail.ru

Mathematical model of forest fire thermal influence on integuments of the person is presented in this paper. The basic way of transfer of heat from forest fire to a body of the person is thermal radiation. Thermal radiation depends on intensity an integument damage rate. The skin is the greatest part of body. It makes approximately 14-16 % of weight of the adult person and plays a number of the important roles and occupies the space 1,5-2,0 m^2 depending on the sizes of a body of the person. Three-layer structure of person skin is considered in present paper. Heat transfer process in layered structure of skin mathematically is described by system of the non-stationary equations of heat conductivity with corresponding initial and boundary conditions. Results of mathematical simulation of forest fire thermal influence on person skin are presented in this paper. Temperature distribution in layered structure of skin during the various moments of time and for various values of radiant thermal flux intensity is obtained.

SESSION 3. NANOTECHNOLOGY

ROLLED-UP STRIPE-PATTERNED EXCHANGE BIAS TUBES FOR CONTROLLED MOVEMENT OF SUPERPARAMAGNETIC BEADS

Timo Ueltzhöffer

Kassel University, Germany

Time.uelzhoeffer@physik.uni-kassel.de

The ongoing miniaturization in microfluidic devices requires new promising concepts and systems for various applications. Therefore we want to use strain-induced rolled-up tubes that allow flexible fuel-free transport of superparamagnetic beads. The transport through this kind of tubes is controlled by magnetic stray fields above magnetically patterned exchange bias systems. The used systems of CoFe/MnIr-bilayers exhibit the exchange bias effect, meaning that their magnetic hysteresis loop is shifted due to coupling of antiferromagnetic and ferromagnetic spins. However, rolling such systems up to tubes is still a challenge. The transport on flat systems has been shown. Further experiments were able to reveal that the magnetic and structural properties of exchange bias systems are preserved during their further processing to rolled-up tubes. The magnetic stray field landscapes by such rolled-up stripe-patterned exchange bias systems can be used to control the transport of superparamagnetic particles through the tube by applying external magnetic fields. Furthermore three-dimensional pathways could be provided due the flexible substrate-free particle transport.

SIMULATION OF SILICON ANODIZATION PROCESS

Alexey Ivanov

Furtwangen University, Germany

alexey.ivanov@hs-furtwangen.de

Etch front propagation during the process of electrochemical etching of silicon in electropolishing regime is simulated with finite elements method. Electrical and diffusion models are developed and simulations are compared to experimental results. It is shown, that the mechanism of shape transformation of the etch form from convex to concave during the process for the applied conditions is due to diffusion transport of reactants in electrolyte. A general electrochemical model is presented. Limitations of the presented models are discussed. Applications of the process are demonstrated.

TECHNOLOGIES FOR MANUFACTURING BULK NANOCERAMIC ARTICLES

Oleg Khasanov

Nano-Centre, National Research Tomsk Polytechnic University

khasanov@tpu.ru

Novel methods for manufacturing ceramic and composite parts having complex shapes have been developed using techniques for pressing of dry nanoscaled and micrometric powder under powerful ultrasound assistance and "collector" compacting. The technology excludes the binders and plasticizers from the processing, so it leads to reduction of the processing cycle, as well as to preservation of nanoscaled structure in sintered parts. The methods increase the quality and performance characteristics of the parts from different types of functional and structural ceramics: dielectric, ferroelectric, optical, armor, etc. Ones provide the required shapes and dimensional tolerances of the parts without additional machining. The methods have been patented in Russia, USA, EU, South Korea and other countries and then have been transferred to industry.

ION-PLASMA METHOD of BIOCOATING DEPOSITION:CHALLENGES and PROSPECTS

V. Pichugin, A. Pustovalova, M. Konishchev

* *Department of Theoretical and Experimental Physics, National Research Tomsk Polytechnic University*

pichugin@tpu.ru

The problem of the improvement of biocompatibility of materials interacting with organism is a modern trend in medical materials science. Ion-plasma methods of biocoating deposition are very promising.

We have fulfilled integrated studies of physicochemical and biomedical characteristics of the two types of coatings for biomedical application. First is based on calcium phosphate and produced by rf-magnetron sputtering of the targets made from hydroxyapatite. These coatings exhibit high performances and biocompatibility and do not cause of active local and systemic reactions.

The second class is the coatings based on titanium oxynitrides deposited by the method of reactive magnetron sputtering. As the properties of TiN_xO_y-type structures substantially depend on the N/O ratio, it is anticipated that they will be successfully used in creating new types of biocompatible coatings, which are biologically active and promote abatement of thrombosis and fibrinogen deposition, so are very promising for contact with blood.

NANOSTRUCTURING OF STRUCTURAL STEEL SURFACE BY Zr-ION BEAM IRRADIATION

Sergey Panin[1,2], Ilya Vlasov[1,2], Viktor Sergeev[1,2],
Oleg Bogdanov[1], Pavlo Maruschak[3], Boris Ovechkin[1]

[1,2] 634050, Lenina avenue 30, National Research Tomsk Polytechnic University, Russia
[1,2] 634021, Akademicheskii avenue 2/4, Institute of Strength Physics and Material Science SB RAS, Tomsk, Russia, e-mail: svp@ispms.tsc.ru
[3] 46001, Ruska 56, Ternopil National Ivan Pul'uj Technical University, Ukraine
svp@ispms.tsc.ru

Pecularities of structure modification over cross-section as well as mechanical properties of 12Cr1MoV and 30CrMnSiNi2 steel specimens subjected to ion-arc treatment by Zr ion beam were investigated. It is shown that the treatment brings to the formation of the softened subsurface layer with approximate thickness of 100 μm. The core of the specimen also experience the changing of the hardness that is increased by 22 % for 12Cr1MoV steel while for 8 % for 30CrMnSiNi2 one. The tests have shown that the ion-beam treatment used ensures the increase of fatigue durability by 2-3 times in contrast with the non-treated specimens.

Analysis of strain fields of 30CrMnSiNi2 steel allows to reveal the influence of modified surface layer to provide efficient redistribution of deformation resulting in much later nucleation of the main crack and its slower propagation. This give rise to the increase of fatigue durability of specimens after the treatment. The main reason for the revealed changes is softening of the subsurface layer since in contrast the quenched steel specimen are very sensitive to presence and nucleation of microcracks whose evolution usually is completed with fast nucleation and propagation of main fatigue crack.

PLASMA DYNAMIC SYNTHESIS OF HARD AND SUPERHARD MATERIALS

Ivan Shanenkov, Alexander Sivkov
Department of Industrial Electric Power Supply, National Research Tomsk Polytechnic University
sivkovaa@mail.ru

In the Magnetoplasma Technologies Laboratory a universal method of the plasma dynamic synthesis and obtaining ultrafine hard and superhard materials during one working cycle is being developed. The method is based on the use of high-current erosional-type coaxial magnetoplasma accelerator. The main precursor of the synthesis process is produced by electroerosion from the acceleration channel surface and is carried to the closed space filled with the gaseous precursor in high-speed jet of the electrodischarge plasma. By using this method it is possible to obtain nitrides, carbides and oxides based on aluminum, copper, zinc, tungsten, titanium, boron, ferrum. These compounds are used for the production of different functional ceramic materials. The main advantages of the method are as follows:

- Synthesis implementation and dispersion within one short-term process (the order of 100 microseconds);
- Monocrystalline structure of product particles.

SYNTHESIS OF SURFACE MODIFIED ZERO-VALENT IRON NANOPARTICLES VIA SPONTANEOUS REACTION WITH ARENEDIAZONIUM TOSYLATES

Olga Guselnikova, Maksim Gromov, Pavel Postnikov, Andrey Galanov
Department of Bioengineering and Organic Chemistry, National Research Tomsk Polytechnic University
guselnikovaoa@tpu.ru

Novel and facile approach for the in situ synthesis of zerovalent magnetic aryl coated iron nanoparticles (NPs) is proposed. Arenediazonium tosylates were used as modification agents to give long term protection to the highly reactive zerovalent iron core. Obtained NPs with the average particle size of 10 nm are highly stable and are not exposed to air oxidation, aryl layers protect NP molecules at temperatures up to 250 °C. Advantages of the present methodology rely not only on the rapidity, efficiency, mild conditions of the synthesis and low price of the precursor but also on the formation of strong covalent binding, which makes obtained NPs highly suitable for further medical applications.

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COMPUTER SIMULATION OF CARDIAC ELECTRICAL ACTIVITY USING AN ELECTROCARDIOGRAPH ON NANOSENSORS

Michael Grigoriev, Nikita Turushev
Medical Instrument-Making lab №63, National Research Tomsk Polytechnic University
Mishatpu@mail.ru

The issues related to cardiovascular diseases are considered. The method to solve some of the existing problems has been proposed. Also a two-component Aliev-Panfilov model and the algorithm of the hardware-software complexes are discussed. The obtained results are presented.

NANOPARTICLES DISPERSIONS IN PHYSIOLOGICAL LIQUIDS

Elena Yunda, Anna Godymchuk, Evgeniya Arzamastseva
Department of Nanomaterials and Nanotechnology, National Research Tomsk Polytechnic University
yunda@kth.se

The increasing production of nanomaterials makes the study of the fate of nanoparticles in the environment of immediate interest. Nanomaterials are known to radically change their properties when released into the environment. In this work, the ability of nanoparticles to form stable dispersions in physiological solutions has been demonstrated. The dispersions were prepared by mixing nanopowders of zinc (13.58 m^2/g), copper (24.66 m^2/g), aluminium oxides (54.75 m^2/g), and zirconium dioxide (8.10 m^2/g) with a phosphate buffered saline, an isotonic solution of glucose and synthetic lysosomal fluid. With the help of the laser diffraction method and transmission electron microscopy it was shown that unstable suspensions (with the dispersoid size of 10^{-5}-10^{-4} m) and aggregately stable lyosols (with the particles size of 10^{-7}-10^{-6} m) were formed in dispersions of nanoparticles in physiological media.

THE VACANCY GENERATION INFLUENCE ON THE INITIAL STAGE OF ION IMPLANTATION PROCESS

Elena Parfenova, Anna Knyazeva
Institute of High Technology Physics, National Research Tomsk Polytechnic University
linasergg@mail.ru

The coupled model of elements penetration into the surface layer of a metal in the process of ion implantation is presented. Mechanical stresses arising from the interaction of particles with the surface affect the redistribution of the implanted impurity. In addition, the existence of vacancies in the metal surface and their generation under the influence of stress are considered. The kinetic law is written on the basis of the thermodynamics of irreversible processes. The solution is found numerically. As a result, the distributions of impurity concentration and deformations are obtained for various moments of time. A comparison of the concentration profiles with/without vacancies is shown.

DISAGGREGATION OF ALUMINUM NANOPARTICLES IN SYNTHETIC LYSOSOMAL LIQUID

Elizaveta Karepina, Anna Godymchuk, D. Kuznetsov, S. Senatova
Department of Nanomaterials and Nanotechnology, National Research Tomsk Polytechnic University
karepina_ee@mail.ru

Due to their small size, nanoparticles can easily enter the human body with breath and interact with the lysosomal liquid. Having entered the liquid medium, nanoparticles and their aggregates form lyophobic dispersions with different aggregation stability. This work presents a study of the electrokinetic parameters of aqueous suspensions of electroexplosive aluminum nanoparticles in the citric acid solution, the basic component of the lysosomal fluid. The

correlation between nanoparticles concentration and abating conductivity of suspensions has been demonstrated during the agglomeration of aluminum nanoparticles. Meanwhile, for the studied suspensions with different concentration of nanoparticles the minimum value of conductivity was found, after which the particles aggregates begin to disintegrate due to the high diffusion mobility of the carboxyl groups in acid medium.

PRODUCTION OF IRON NANOPOWDERS BY THE ELECTRIC EXPLOSION OF WIRE

Alexey Pustovalov, Sergey Zhuravkov
Institute of High Technology Physics, lab №12, National Research Tomsk Polytechnic University
Pustovalov@tpu.ru

The work presents the study of the properties of nanopowders produced by the electric explosion of wire (EEW) in the atmosphere of Ar, CO, CO_2, N_2. It was established that with the increase of the electric strength of a gas the wire acquires more energy, enabling the reduction of a particle average size. The EEW in gaseous media that have high dissociation energy (N_2 and CO) produces metal powders that consist of crystalline α-Fe и γ-Fe. EEW products obtained in CO_2 consist of α-Fe and bivalent iron oxide.

ALUMINUM OXIDE AND ZIRCONIUM OXIDE NANOPOWDERS SYNTHESIS BY CHEMICAL PRECIPITATION AND NANO-SPRAY DRYING METHODS

Ainura Nurgyssanova
Department of nanomaterials and nanotechnology, National Research Tomsk Polytechnic University
nurgysanova@mail.ru

Nanostructured materials exhibit superior properties such as excellent strength, toughness, and hardness, due to the presence of refined grains. One of the more promising technological methods for obtaining fine-grained powder is the sol-gel technology. Nanostructured oxide powders are used in the field of ceramics and can be produced by chemical synthesis, mechanical or physical methods, e.g. chemical precipitation and spray drying methods.

STEP INTO THE FUTURE. NEW ENVIRONMENTAL PROGRAMME OF TPU. THE SECOND LIFE OF PAPER

Julia Rashchupkina, Diana Airapetyan, Olesia Laput
Institute of High Technology Physics, National Research Tomsk Polytechnic University
yulia994@list.ru

This project faces one of the most important environmental issues of Tomsk – that of paper collection. It was decided to create paper collection stations in the heart of the city – its universities. The research was conducted which allowed estimating the average amount of papers per student and per teacher. Also, the further development of the project has been suggested.

THE EFFECT OF THE METAL OXIDE NANOPARTICLES ON THE RED BLOOD CELLS MORPHOLOGY

Anna Kozelskaya
Institute of Strength Physics and Materials Science SB RAS
annakozelskaya@gmail.com

The effect of metal oxide nanoparticles on the surface morphology of rat erythrocyte membranes is studied using atomic force microscopy. The nonspecific mechanisms of the interaction between nanoparticles (Al_2O_3, SiO_2, ZrO_2) and lipid bilayer membranes are discussed. It is shown that the electrostatic interaction plays an important role for contact cells with erythrocytes.

APPLICATION OF SULFATED MAGNETIC NANOPARTICLES IN THE SYNTHESIS OF BIOLOGICALLY ACTIVE UREAS

Vera Kuksenok, Victoria Shtrykova, Victor Filimonov, Andrey Galanov
Department of Bioengineering and Organic Synthesis, National Research Tomsk Polytechnic University
vera.kuksenok@mail.ru

It has been shown that nanoparticles Fe_2O_3@SO_3H easily form salts with pharmacophoric benzhydrylamines. The obtained nano-composites were successfully used in the green synthesis of valuable benzhydrylureas with the anticonvulsant activity.

POSSIBILITY OF MORPHOLOGIC AND CRYSTALLOGRAPHIC ORIENTATION OF MAGNETIC POWDERS PARTICLES COMPACTED UNDER INTERPARTICLE FRICTION REDUCTION

Daniil Iazykov, Edgar Dvilis, Artem Kachaev
Nano-Centre, National Research Tomsk Polytechnic University
realize@tpu.ru

With the advent of high-performance Nd–Fe–B permanent magnets, research and development of new permanent magnets has largely concentrated on rare-earth-based alloys. As a result of intensive research, several new rare-earth-based alloys for permanent magnets have been found. Among them, Sm–Fe–N alloy is one of the candidates for high-performance

permanent magnets. The superiority of Sm–Fe–N magnets arises from the $Sm_2Fe_{17}N_3$ intermetallic compound, which exhibits high-saturation magnetization with a large anisotropy field and high Curie temperature. The common problem in the development of high-energy permanent magnets based on powders is the application of high-power magnetic fields and high temperatures in the compression processes to form a crystal texture. The final orientation of the article structural elements obtained by conventional pressing depends on the external magnetic field, which aligns magnetic particles into a specified order. The interparticle friction at the stage of compaction and consolidation may hinder this process. The paper aims to study the possibility of morphologic and crystallographic orientation of magnetic powder particles compacted under interparticle friction reduction.

STUDY OF THE DINAMICS OF HYDROGEN ACCUMULATION IN NANOCRYSTALLINE TI-6AL-4V

Nikita Pimenov, Vladimir Sypchenko, Nikolay Nikitenkov

Institute of Physics and Technology, National Research Tomsk Polytechnic University

roguestarfly@gmail.com

The study offers a comprehensive description of the process of hydrogen accumulation in nanocrystalline Ti-6Al-4V as one of the most perspective material of the hydrogen energy. This article provides the information about the dynamics of this process, including the calculations of diffusion coefficients for nanocrystalline Ti-6Al-4V.

THE POSSIBILITY OF BORON CARBIDE COATING FORMATION BY USING A COAXIAL MAGNETOPLASMA ACCELERATOR

Anastasiia Makarova, I. Rachmatullin

Department of Industrial Electric Power Supply, National Research Tomsk Polytechnic University

mafania1991@gmail.com

A coaxial magnetoplasma accelerator can generate a dense and high velocity plasma jet by applying a pulsed high-current arc-discharge. The results of the experiment investigations of plasmodynamic synthesis in the B-C system have been shown while hyper speed jet boron carbide electric-discharged plasma steams onto copper substrate. The boron carbide coatings were formed on the copper substrate without a binder material. The formation of the crystalline boron carbide coating on the copper substrate was analyzed through X-ray diffractometry, transmission electron microscopy and scanning electron microscopy.

RESEARCH OF MICROARC CALCIUMPHOSPHATE COATINGS WETTABILITY

Valentina Chebodaeva, Ekaterina Komarova

National Research Tomsk Polytechnic University

vtina5@mail.ru

The influence of the voltage of microarc oxidation of calciumphosphate coatings on the physicochemical properties has been investigated. The linear growth of the roughness and hyperbolic decrease of the surface energy with growth of the oxidation voltage have been revealed. It has been shown that calciumphosphate coatings have low contact angle and high surface energy and, as a consequence, are hydrophilic. The optimal voltage range of the oxidation has been found. It varies from 200 to 250 V. This range ensures the coating formation with the following specified parameters: roughness is 2 – 3,5 μm and contact angle with water and glycerol are 18-25 degrees and 35-45 degrees, respectively. Surface energy was varied from 70 to 80 mN/m.

SURFACE MODIFICATION OF POLYHYDROXYBUTYRATE FILMS TO CONTROL WETTABILITY

Dina Syromotina, Roman Surmenev

Department of Hydrogen Energy and Plasma Engineering, National Research Tomsk Polytechnic University

syromotinads@gmail.com

Polyhydroxybutyrate (PHB), like the majority of biodegradable polymers, has a hydrophobic surface. To increase hydrophilicity, polyhydroxybutyrate thin films were modified by oxygen plasma treatment. During the experiments the working parameters, such as treatment time and power, were varied. The surface properties were described using contact angle measurement. The results showed the increase in hydrophilic properties of the PHB surface after plasma treatment. The water contact angle of the modified PHB decreased on average by 25 per cent, opposite to the surface energy, particularly, polar component, which increased.

INVESTIGATION OF PROPERTIES OF TiN FILMS OBTAINED WITH THE DUAL MAGNETRON SPUTTERING SYSTEM AT VARIOUS VALUES OF THE PARTIAL PRESSURE OF NITROGEN

Ksenia Mihnevich, Yuri Yuriev

Department of Hydrogen Energy and Plasma Technologies, National Research Tomsk Polytechnic University

mikhnevichks@mail.ru

In this work, the dependence of TiN films properties on the partial pressure of nitrogen in the chamber is shown.

SIMPLE MODEL OF INTERMETALLICS FORMATION IN SURFACE LAYER DURING ION IMPLANTATION

Asfandyar Khan, Anna Knyazeva

Institute of High Technology Physics, National Research Tomsk Polytechnic University

asfandyarmath@awkum.edu.pk

Ion implantation is a process in which ions are accelerated in material by electric field and change their structure and properties. This process is used to modify the physical, chemical or electrical properties of the solid. Ion implantation is a useful technique for the enhancement of the properties of materials on the base of change of microstructure, element and phase composition in surface layer. The main focus of our interest is to construct and investigate new simple model for the regularities of surface layer composition change with the help of diffusion problem including chemical reactions for different forms of particle beam impulse taken into account the finiteness of relaxation time of diffusion flux. The general approach is illustrated with the help of some example.

THERMAL PROCESSES AND MASS TRANSFER IN THE TARGET – SUBSTRATE SYSTEM IN THE DEPOSITION OF COATINGS USING HIGH-POWER PULSED ION BEAMS

Anastasiya Simonova, Galina Bleykher

Department of Hydrogen Energy and Plasma Engineering, National Research Tomsk Polytechnic University

ainakim297@yandex.ru

Nowadays high-power pulsed ion beams (HPPIB) are used to modify the surface of materials. In particular, erosion is the removal of material from the exposed surface of the solid. This phenomenon is used for the deposition of functional modifying coatings on the surface of materials. The structure of deposited coatings and performance of modified materials are largely determined by the evolution of the thermal processes in the substrate during the deposition of the coating on it. To understand patterns of these processes, it is important to have a clear idea of the energy balance on the surface of the substrate depending on the beam parameters. Here the issue of the optimal HPPIB parameters is a key one. Finding the solution involved mathematical modeling, which is an effective tool for obtaining data on the evolution of high-speed processes.