

Department of Foreign Languages
Council of Young Investigators



**33RD INTERDISCIPLINARY
CONFERENCE
ON RECENT ADVANCES
IN SCIENCE
AND TECHNOLOGY**

RAST-2021

Tomsk 2021

Department of Foreign Languages TSC RAS SB
May 19, 2021
12.00 PM

Q&A SESSION

12.00 PM – 14.00 PM

Chair: **Dmitrii Genin** (IHCE)

Opening word: **Iuliia Zelichenko** (Head of DFL)

Welcome address: **Aleksandr Konoshonkin, Dr. Sci. (Phys.-Math)** (IAO)

I. 1. Igor Grachev

*Institute of Monitoring of Climatic and Ecological Systems, RAS SB
Department of Ecological Research
Laboratory of Self-Organization of Geosystems*

Modern conceptions about ecological carrying capacity

Ecological capacity - a certain amount of energy accumulated by the ecosystem for a certain period of time in a certain territory. In the scientific community, the concept of ecological capacity in the West and East is being used more and more often every year. Author delimited the understanding and interpretation of environmental capacity from the point of view of various areas of application: the general concept of ecological capacity, ecological capacity in terms of cities, water resources, agriculture, tourism, as well as social capacity.

Keywords: *ecological carrying capacity, carrying capacity, geosystems, ecos, energy, energy approach.*

I. 2. Egor Adamov

*V.E. Zuev Institute of Atmospheric Optics, RAS SB
Division of Optical Wave Propagation
Laboratory of Optical Location*

The multi-aperture systems for the formation of structured beams and control of their characteristics

Multi-aperture systems can be used for example in cutting and welding metal, for giving energy to distances, free space optical communication, and much more. Therefore, it is very important to develop a mathematical model of experimental setup. To test the theory technology of coherent addition of laser beams in the field mathematical modeling methods to form various structured beams.

Keywords: *multi-aperture systems, laser beams, adaptive mirror, mathematical modeling.*

I. 3. Valerii Barmin

Institute of High Current Electronics, RAS SB

Parameters of subnanosecond pulse sharpening by a silicon high-voltage switch

In this study, the parameters of the occurrence of the ultrafast delayed breakdown effect are clarified. It is established that to observe the effect, a minimum rate of rise of the reverse voltage of 0.85 kV/ns is required, and not 1 kV/ns as was established in the previous works.

Keywords: *diode, breakdown, pulse, power.*

I. 4. Anna Belosludtseva

*Institute of Strength Physics and Materials Science, RAS SB
Laboratory of Physics of Nonlinear Media*

The effect of the rotation angle on functionalization in twisted graphene

In this work, we theoretically calculated the angle dependences of the area fractions of superstructures AA, AB (BA), determined the concentration dependence on the twist angle tBLG (twisted bilayer graphene) upon functionalization with fluorine and hydrogen. The results can be useful in determining the optimal conditions and parameters for the functionalization of graphene in the laboratory. The calculations obtained as a result of this work are important not only for tBLG, but can also be used for a number of other hexagonal structures with the same adsorption centers as in tBLG.

Keywords: *twisted graphene, functionalization, modeling.*

I. 5. Khava Nalgieva

Institute of Petroleum Chemistry, RAS SB

Laboratory of Hydrocarbons and High-Molecular Petroleum Compounds

Thermal conversion of asphaltenes in supercritical water

Keywords: *supercritical water, conversion of asphaltenes, thermal cracking.*

II. 1. Dmitrii Gusak

Institute of Monitoring of Climatic and Ecological Systems, RAS SB

Department of Geophysical Research

Laboratory of Bioinformation Technologies

Assembling a device for urban dense air monitoring

The air around us is full of various substances and compounds. These are as vital components: N, O₂, CO₂, and natural components: SiO₂, NH₃, NaCl. The development of mankind has added new compounds to the air: CO, SO₂, NO_x, benzo (a) pyrene. The concentrations of such substances must be monitored to prevent their negative effects. This requires a monitoring network. Consider a device that can help in implementation of the network.

Keywords: *monitoring, network, particulate matter, dust monitoring, device assembly.*

II. 2. Angelina Guliaeva

V.E. Zuev Institute of Atmospheric Optics, RAS SB

Development of a method for bending laser radiation in an integral waveguide based on thin-film lithium niobate

II. 3. Ekaterina Kolesnik

Institute of High Current Electronics, RAS SB

Laboratory of Optical Radiations

Application of Diamonds in Quantum Technology

II. 4. Anastasiya Gusarova

Institute of Strength Physics and Materials Science, RAS SB

Microstructure and properties of in-situ friction stir processed gradient zone of the Al-Cu system

The majority of literature sources dedicated to dissimilar Al-Cu friction stir welding testifies to the formation of intermetallic compounds (IMC) according to diffusion-controlled reactions, i.e., without liquation on the Al/Cu interfaces. Fewer sources report on revealing Al-Cu eutectics, i.e., that IMCs are formed with the presence of the liquid phase. This work is an attempt to fill the gap in the results and find out the reasons behind such a difference. Structural-phase characteristics of an in-situ friction stir processed (FSP) Al-Cu zone were studied. The single-pass FSPed stir zone (SZ) was characterized by the presence of IMCs such as Al₂Cu, Al₂Cu₃, AlCu₃, Al₂MgCu, whose distribution in the SZ was extremely inhomogeneous. The advancing side SZ contained large IMC particles as well as Al(Mg,Cu) solid solution (SS) dendrites and Al-Al₂Cu eutectics. The retreating side SZ was composed of Al-Cu solid solution layered structures and smaller IMCs. Such a difference may be explained by different levels of heat input with respect to the SZ sides as well as by using lap FSP instead of the butt one.

Keywords: *in-situ friction stir process, aluminum alloys, al-cu metallomatrix composite, intermetallic compounds, diffusion-controlled reactions, al-cu eutectics.*

II. 5. Khoshim Urazov

Institute of Petroleum Chemistry, RAS SB

Laboratory of Hydrocarbons and High-Molecular Petroleum Compounds

Nickel oxide-based catalysts in catalytic cracking for upgrading heavy crude oil

Keywords: *heavy oil, catalytic cracking, nickel oxide.*

III. 1. Mariya Degtyareva

Institute of Monitoring of Climatic and Ecological Systems, RAS SB

Department of Ecological Research

Laboratory of Monitoring of Forest Ecosystems

Macroscopic charcoal analyses of lacustrine sediments in the vicinity of Mukhrino station in Khanty-Mansiysk

Study of the wildfires scope, which is a significant factor of the development of ecosystems, allows to identify the role in the successional processes throughout the Holocene. Lake sediments are considered to be a reliable repository of the traces of paleofire activities. In this report the results of the using of the method of macrocharcoal analysis of lake sediments are represented, which helped to reveal the frequency of paleofires. Using this method, a 231 cm thick core of lacustrine sediments was processed.

Keywords: *paleofires, macrocharcoal analysis, western siberia, lacustrine sediments, holocene.*

III. 2. Natalya Kravtsova

V.E. Zuev Institute of Atmospheric Optics, RAS SB

Remote sensing of greenhouse gases in the atmosphere using IR OPO technologies

III. 3. Mikhail Savchuk

Institute of High Current Electronics, RAS SB

Laboratory of Plasma Emission Electronics

Ways to reduce number of droplets in coatings by vacuum-arc method

The presence of macroparticles is one of the main problems of vacuum-arc deposition. In this paper, considered ways to reduce the number of macrodroplets and determined the advantages and disadvantages of each method.

Keywords: *cathode spot, depositing coatings, vacuum arc.*

III. 4. Ekaterina Dymnich

Institute of Strength Physics and Materials Science, RAS SB

Laboratory of Mechanics of Heterogeneous Media

Microstructure-based model for the deformation behavior of additive AlSi10Mg

The present investigation aims to numerically investigate the micromechanical response of an SLM AlSi10Mg alloy at the different length scales. The constitutive equations of the grain behavior are formulated within the crystal plasticity framework. The boundary value problem is solved in the finite element package ABAQUS / Explicit using the VUMAT procedure.

Keywords: *additive manufacturing, crystal plasticity, aluminum.*

III. 5. Denis Fedorov

Institute of Petroleum Chemistry, RAS SB

Oil-contaminated lands recultivation assessment by the case of the Yamalo-Nenets autonomous district fields

The relevance of the chosen topic is caused by the fact that at present, oil production and transportation, rapidly accelerating the pace, leaves millions of tons of spilled oil. Since the soil of the far north has a low capacity for self-recovery by the cause of the harsh climate, the reclamation of these lands must be definitely provided.

Keywords: *oil-contaminated, fields, reclamation, field examination, field works, desktop study.*

IV. 1. Artem Eliseev

*Institute of Monitoring of Climatic and Ecological Systems, RAS SB
Department of Ecological Research
Laboratory of Monitoring of Forest Ecosystems*

Paludification potential of terrain in the south-east of Western Siberia: simulation and assessment

The process of paludification, is the most important Holocene process in the territory of Western Siberia. Paludified soil is unfavorable for farming due to the formation of peat and dangers of groundwater flooding, therefore expensive reclamation measures are required. Our task is to determine the influence of the terrain on the structure and dynamics of wetlands in the area under consideration.

Keywords: *western siberia, srtm, dem, gis saga, paludification potential*

IV. 2. Vera Zhukova

*Institute of Monitoring of Climatic and Ecological Systems, RAS SB
Department of Geophysical Research
Acoustic Research Group*

Temperature stratification of the lower atmosphere during the development of complex meteorological conditions

The spatio-temporal variability of the temperature of the lower atmosphere layer during the development of abnormally early thunderstorms and squalls in the southeast of Western Siberia on the example of the surrounding area of Tomsk is analyzed. It is noted that the highest density of lightning discharges during the event under study is not over the centers of the zones with the highest temperatures, but over their peripheral parts, where large contrasts of temperature changes are observed. The time intervals that preceded the development of storm clouds are correlated with the values of the vertical temperature gradient for the territory of the IMCES SB RAS – 2.2 °/100 m and 1.4 °/100 m for the village of Anikino.

Keywords: *temperature stratification, atmospheric boundary layer, thunderstorm, squall.*

IV. 3. Vladislav Shin

*Institute of High Current Electronics, RAS SB
Laboratory of Plasma Emission Electronics*

Generation of megawatt beams with controlled power during a pulse of submillisecond duration by an electron source with a grid plasma cathode

This work shows the possibility of controlling the temperature of the specimen surface during pulsed electron-beam processing. The method is based on modulation of an electron beam by changing the arc discharge current of a sub-millisecond duration. The possibility of multiple changes in the electron beam during a pulse is shown.

Keywords: *plasma cathode, beam modulation, specimen temperature control.*

IV. 4. Kseniya Reunova

*Institute of Strength Physics and Materials Science, RAS SB
Laboratory of Physics of Structural Transformations*

The effect of solid-solution treatment on the microstructure and mechanical properties of high-nitrogen FeMnCrNiCo high entropy alloys

IV. 5. Uliana Chernova

*Institute of Petroleum Chemistry, RAS SB
Laboratory of Colloidal Oil Chemistry*

Investigation of phase diagrams of binary systems for DES creation

Keywords: *des, deep eutectic solvent, eor, heavy crude oil, phase diagram.*

V. 1. Matvei Kostenko

Institute of Monitoring of Climatic and Ecological Systems, RAS SB

Multipass optical system for a Raman spectrometer

Today, the important task in some areas is to determine the component composition of gas mixtures in real time. For a comprehensive solution of these problems, there are currently a number of universal gas analyzers. The advantages of Raman spectroscopy make it promising for a gas analysis. This report presents the results of using a multi-pass optical system in a Raman spectrometer, which increased the signal. The application of Raman spectroscopy in two areas was demonstrated.

Keywords: *multipass system, cavity, raman spectroscopy.*

V. 2. Mariia Kuznetsova

Institute of Monitoring of Climatic and Ecological Systems, RAS SB

Department of Ecological Research

Laboratory of Dendroecology

Structure of conifer needles: *Pinus pumila*, *P. sibirica* and their hybrids

This study was conducted to investigate the morphological and anatomical characteristics of needle and genetic diversity of *P.sibirica* *P.pumila* and their hybrids. Comparison of various traits of needles helps to understand the nature of hybridization between these species.

Keywords: *p. pumila, p.sibirica, needles, hybridization.*

V. 3. Yuriy Pupyshev

Institute of Monitoring of Climatic and Ecological Systems, RAS SB

Department of Ecological Research

Laboratory of Self-Organization of Geosystems

The mechanism of formation and degradation of the Chuya-Kuray ice-dammed lake

Numerous ice-dammed lakes were formed on the border of the Pleistocene and the Holocene within Eurasia and North America. A notable example of such a lake is the Chuya-Kuray ice-dammed lake in the Altai Mountains. The report shows the results of paleogeographic reconstruction of the ice-dammed lake. Two hypotheses of the paleolake drainage are considered.

Keywords: *ice-dammed lake, pleistocene, flood, paleoshorelines, altai mountains.*

V. 4. Igor Fotin

Institute of Strength Physics and Materials Science, RAS SB

Laboratory of Physical Mesomechanics of Materials and Non-Destructive Testing

Microstructure and XRD analysis of starting powders for manufacture of hot pressed multilayer ceramic composites (ZrC/Al₂O₃)

This work presents the prospects for the use of ceramic materials working under friction the choice of layered ceramic composite materials based on ZrC and Al₂O₃ with some functional layers. Multilayered ceramics, as a rule, are characterized by a higher fracture toughness provided by bifurcation of cracks at the interfaces, which provides an expansion of the areas of practical use of ceramic materials.

Keywords: *multilayer ceramic composite, xrd testing, scanning electron microscope.*

V. 5. Han Liang

Institute of Strength Physics and Materials Science, RAS SB

Laboratory of Physical Mesomechanics of Materials and Non-Destructive Testing

The properties of polyphase ceramics ZrB₂-ZrC-SiC-BN-CNT

In this work, presents the prospects for the use of ceramic materials as antifriction ceramics for the manufacture of triboconjugation pairs, and substantiated the choice of ceramic composite materials based on zirconium diboride, zirconium carbide, silicon carbide, boron nitride and carbon nanotubes. For the development of railway transport, automotive industry, aviation, all require questions to increase the speed of movement and cargo weight. All of this friction exists to ensure braking performance and safety at high load levels. From these positions, special attention is drawn to materials belonging to the class of ceramics. To obtain polyphase heteromodal ceramic composites ZrB₂-ZrC-SiC-BN-CNT---to study their structure and properties. It was found that composites ZSB5C1 have the highest

hardness of 28.92 ± 0.2 GPa, in comparison with composites of composition ZZSB5 and ZZSBC1.

Keywords: *ceramic, hardness, density, zirconium, CNT, BN.*

END OF Q&A SESSION

Closing word: Chair