

Department of Foreign Languages  
Council of Young Investigators

**30<sup>TH</sup> INTERDISCIPLINARY  
CONFERENCE  
ON RECENT ADVANCES  
IN SCIENCE  
AND TECHNOLOGY**

Tomsk 2018



Department of Foreign Languages TSC SB RAS  
May 18, 2018  
11.00 AM, Room 1

## SESSION 1

11.00 AM – 1.00 PM

Chairman: **Tania Rakhmatulina** (ISPMS)

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

Welcome address (**Mikhail Eremin**, PhD in Physico-mathematical sciences, staff scientist, ISPMS SB RAS; **Dmitrii Sorokin**, PhD in Physico-mathematical sciences, staff scientist, IHCE SB RAS; **Mikhail Burkov**, Ph.D. in Engineering, junior researcher, ISPMS SB RAS; **Andrei Ocheredko**, Ph.D. in Chemistry, staff scientist, IPC SB RAS.)

### 1. Vitaliy Alekseenko

*Institute of Strength Physics and Materials Science*

#### **Wettability of zirconia powder**

The influence of high-frequency plasma treatment on properties of zirconia powder is shown in the work. It has been shown that the plasma processing changes the acidity of water-powder suspensions from 8.1 pH to 4.3 pH which signifies the improvement of wettability of powders. It has been found that more intensive mixing using ultrasound influences acidity level, reducing it in comparison with propeller mixing. It is shown that these changes of surface properties have relaxation by 4% per day and extrapolation of this dependence shows that the powder will have initial properties after 400 hours storage at room conditions.

Keywords: *plasma treatment, zirconia powder, surface properties, wettability.*

### 2. Ilja Scherbakov

*Institute of Strength Physics and Materials Science*

**Strength of elements and blocks of radio-electronic equipment under dynamic load.**

The response of the elements of the radio-electronic apparatus of a spacecraft to external dynamic loads is analyzed. The most critical elements of assembly and stresses arising on them are determined. A method for modernizing the device is proposed. Based on the results of the simulation, it was found that after the upgrade, the device became more rigid, the vibration zones are moved to safe zones, the stresses on the electronic products decreased several times. To confirm the results of the simulation, laboratory tests were carried out which proved the results obtained.

Keywords: *dynamic load, spacecraft, simulation, modal analysis, random vibration analysis.*

### 3. Aleksandr Rygin

*National Research Tomsk Polytechnic University*

#### **Structure, physics and mechanical properties of heteromodulus ZrC/C composites**

Structure phase conditions and physical & mechanical properties of heteromodulus composite ceramic materials based on high-modulus zirconium carbide (ZrC) matrix and low-modulus inclusions of carbon black are shown. Increase in fracture toughness was reached by incorporation of carbon black into carbide matrix with the aim of improving materials resistance to shock damages. Heteromodulus composite systems were obtained by hot-pressing method under protective argon atmosphere at 1 atm pressure. Investigation of structure & phase condition features were carried out by X-ray diffraction method and scanning electron microscopy. Hardness was performed by Vickers and nanoindentation method, elastic modulus was obtained from nanoindentation and ultrasound transition data.

Keywords: *ceramic, composite, sintering, heteromodulus material, hot-pressing method, zirconium carbide, ZrC, carbon black, C.*

### 4. Vadim Chazov

*Institute of High Current Electronics*

#### **Bulk resonance of symmetric hybrid waves in overmode biperiodic slow-wave structure (SWS)**

Electrodynamics characteristics of a biperiodic SWS that might promote stable oscillation are discussed. The results of calculations of

the dispersion characteristics are presented for biperiodic corrugated waveguides with different geometric parameters. Also, an example of the eigenfield for an open-structure resonator designed as a section of biperiodic corrugated waveguide is given. The calculations are performed using the method of scattering matrix for a round waveguide with symmetric modes scattered by the waveguide irregularities.

**Keywords:** *dispersion characteristic, method of scattering matrix, biperiodic waveguide, resonance.*

## 5. Ilya Zyatikov

*Institute of High Current Electronics*

*Laboratory of gas lasers*

### **Transient electroluminescence in thin films based on organic light-emitting diodes**

The results of charge carriers mobility measurements in organic semiconductor materials (Alq<sub>3</sub>, Jak-203) based on the analysis of transient electroluminescence relaxation curves of organic light-emitting diodes (OLED) are given. OLED based on Alq<sub>3</sub> and Jak-203 have the same transport model according to the analysis of the transient electroluminescence curves. The hole transport layer has no significant effect on the charge carriers transport behavior in OLED. Physical interpretation of the specific times based on the analysis of the transient electroluminescence kinetics is given.

**Keywords:** *organic semiconductors, OLED, charge carriers mobility, electroluminescence, Alq<sub>3</sub>, Jak-203.*

## 6. Vladimir Kuznetsov

*Institute of High Current Electronics*

*Laboratory of optical radiation*

### **Optical properties of the apokamp discharge in Ar-CO<sub>2</sub> mixtures**

In Ar-CO<sub>2</sub> mixtures, plasma jet is formed at the bend of pulse-periodic barrier discharge channel. Spectral composition analysis of the discharge in apokamp mode for Ar-CO<sub>2</sub> mixtures was conducted. A theory whether electronegative gases should be used in gas mixtures for apokamp formation in gaseous media was confirmed. Apokamp decay dynamics in argon after several cycles of pumping out the gas from the chamber is shown.

**Keywords:** *plasma jet, argon, dioxide oxygen, apokamp.*

## 7. Nikita Prokopenko

*Institute of High Current Electronics*

*Laboratory of plasma emission electronics*

### **Synthesis of multilayer coatings by vacuum arc plasma-assisted technique.**

The possibility of obtaining multilayer metal/ceramic coatings using an original method is described. The originality of the method is in the deposition of multilayer metal/ceramic coatings with relatively sharp boundaries. For this purpose, the deposition was carried out at a constant working pressure and the ratio of gases and the arc discharge current of the evaporator. A transition from the metallic to the nitride layer was carried out by changing plasma parameters of a non-self-sustaining arc discharge with a combined heated and hollow cathode. Such method is of low inertia, which made it possible to increase the repeatability of thickness and composition of the layers. It also allowed for deposition at a lower operating pressure to produce coatings with denser packaging and lower porosity.

**Keywords:** *arc deposition, multilayer coatings, Ti / TiN.*

## 8. Evgenii Ostroverkhov

*Institute of High Current Electronics*

*Laboratory of plasma emission electronics*

### **Nitrating of titanium VT1-0 in a non-self-sustaining glow discharge with a titanium large area hollow cathode**

Developed in the IHCE SB RAS electrode system, in which a non-self-sustaining glow discharge with a large area hollow cathode (with electron injection) is generated, has the necessary electrophysical parameters and the ability to independently adjust working pressure, ignition and burning voltage of a glow discharge, ion energy and the density of the ion current supplied to the sample. This is a promising system for processing complex large-sized parts without rotation.

**Keywords:** *non-self-sustaining glow discharge, hollow cathode, nitriding, titanium t 1-0.*

## 9. Anton Vosmerikov

*Institute of Petroleum Chemistry*

*Laboratory of catalytic conversion of light hydrocarbons*

**Aromatization of propane over element-alumosilicate catalysts with ZSM-5 structure**

A method of hydrothermal crystallization of alkaline alumosilicagels is used to manufacture element-alumosilicates with ZSM-5 structure. Their physicochemical and acid properties are investigated and their catalytic activity in the course of propane conversion to aromatic hydrocarbons is determined. The Ga-alumosilicate is found to be the most efficient zeolite catalyst for propane aromatization.

*Keywords: propane, aromatization, element-alumosilicates, conversion, aromatic hydrocarbons.*

**END OF SESSION 1  
COFFEE BREAK (30 min)**

**SESSION 2**

1.30 PM – 3.30 PM

Chairman: **Aleksandr Solodov** (PhD in Physico-mathematical sciences, staff scientist, IAO SB RAS)

Welcome address (**Aleksandr Konoshonkin**, head of the Lab, Prof., Laboratory of Atmospheric Radiation, IAO SB RAS; **Andrei Ocheredko**, Ph.D. in Chemistry, staff scientist, IPC SB RAS; **Aleksei Kobzev**, Ph.D. in Engineering, staff scientist, IMCES SB RAS.)

**10. Dmitrii Tolstov**

*Institute of Atmospheric Optics*

*Laboratory of Atmosphere Composition Climatology*

**The hydrocarbon component of the atmospheric aerosol in the troposphere over Western Siberia**

The change in the concentration of many organic components under the influence of anthropogenic emissions and wildfires can cause unpredictable changes in the composition of the atmospheric aerosol. To determine the transformation of hydrocarbons in the atmosphere studies were carried out onboard the Tu-134 aircraft. It is established that the maximum concentration of the hydrocarbon component in the surface air layer is observed for nonadecane, in the boundary layer and free atmosphere it's maximum concentration is observed for heptadecane. The highest concentration of organic matter in the composition of the aerosol is in spring, the lowest in autumn.

*Keywords: atmospheric aerosol, transformation of hydrocarbons.*

**11. Nikolai Vasnev**

*Institute of Atmospheric Optics*

*Division of Atmospheric Spectroscopy, laboratory of Quantum Electronics*

**Bistatic laser monitor for visual-optical diagnostics of high-speed processes**

The paper presents the results of the development of a control system for a bistatic laser monitor. The bistatic laser monitor is an active optical system which is used for visual-optical diagnostic of high-speed processes. In this case one active element is used as an illumination source and the other as a brightness amplifier. The operation of such device requires a control system to synchronize two active elements. The developed system includes a digital control circuit and a high-voltage modulator. The operating principle of the system and the main circuitry solutions are described. The laboratory model of the bistatic laser monitor was implemented. Whether it can be used for amplification of the radiation power and obtaining images is discussed. Imaging results of the test objects are presented.

**Keywords:** *bistatic laser monitor, illumination source, brightness amplifier, amplification, imaging, high-voltage modulator.*

## 12. Anna Simonova

*Institute of Atmospheric Optics*

### **Continuum absorption of water vapour and water dimers in 0.94 and 1.13 micron bands**

The continuum absorption of pure water vapour in poorly studied 0.94 and 1.13  $\mu\text{m}$  (10600 and 8800  $\text{cm}^{-1}$ ) absorption bands of the near-IR range is considered. Continuum water vapour absorption spectra obtained earlier on the basis of high-resolution Fourier spectra of water vapour absorption at temperatures from 400 to 470 K and pressures from 1 to 5 atm were used as experimental data. The model of water dimers proposed earlier for the near-IR bands was parametrized to describe the spectra of the water continuum investigated here. It was shown that the water dimers are responsible approximately for 50 % of the observed continuum value in the studied absorption bands.

**Keywords:** *continuum absorption, water vapour, absorption bands, water dimers, near-IR spectral range.*

## 13. Nikita Emelyanov

*Institute of Atmospheric Optics*

*Laboratory of Molecular Spectroscopy*

## **Low-temperature vacuum cell for studying the absorption spectra of atmospheric gases**

The methane vapor spectrum, which predominates in some planets and moons, is constantly being studied to obtain the exact spectral line parameters needed for calculations of radiation transfer. The temperature dependences of the broadening parameters of gases are necessary for modeling the atmosphere whose temperature can reach below 100 K. The purpose of this work is to develop and to manufacture such cell that allows to record the methane spectra in higher energy areas. Subsequently, with the help of this cell, absorption spectra of methane  $\text{CH}_4$  will be obtained in a wide spectral range from 500 to 20,000  $\text{cm}^{-1}$ .

**Keywords:** *fourier spectroscopy, absorption spectrum, methane.*

## 14. Evgenii Sandabkin

*Institute of Atmospheric Optics*

*Laboratory of coherent adaptive optics*

### **Mesospheric sodium monitoring for laser guide star**

The experimental study of sodium layer is relevant to fields such as adaptive optics, in particular for laser guide star generation. The measurement provides information about sodium layer: the medium altitude, the columnal abundance, the density profile and temporal evolution. These observations are important to design the new generation of adaptive optics instruments. Great part of the astronomical objects of scientific interest was left far from the observation capabilities in high resolution due to it was not possible to find a reference object in the proximities.

**Keywords:** *mesospheric sodium, laser guide star, adaptive optics.*

## 15. Daria Kalashnikova

*Institute of Monitoring of Climatic and Ecological Systems*

*Laboratory of Bioinformation Technologies*

### **Isotope composition of mosses and lichens as marker of air pollution in Prokopyevsk**

Lichens and mosses are widely used in the studies of natural and anthropogenic pollution. To evaluate the atmospheric air pollution in Tomsk and Prokopyevsk (Russia, Siberia), the  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  in mosses and lichens were analyzed using isotope mass spectrometry. The  $\delta^{13}\text{C}$  has indicated the effect of mine methane on the atmospheric air in Prokopyevsk. A comparison of the average  $\delta^{15}\text{N}$  values for studied cities has shown that Tomsk has a more anthropogenic load in terms of emissions of N-containing compounds.

Keywords: epiphytic mosses, epiphytic lichens, stable carbon isotope composition, stable nitrogen isotope composition, mass-spectrometry.

#### 16. Evgenii Makeev

*Institute of Monitoring of Climatic and Ecological Systems*

*Laboratory of Physics of Climatic Systems*

##### **Calculation of thermal diffusivity of the snow cover using snow temperature measurement data**

An algorithm for calculating the depth of snow cover based on temperature measurements data has been developed. The results of the calculation of the thermal diffusivity coefficient will be assessed and compared to that reported in the literature.

Keywords: *snow cover, temperature, thermal diffusivity coefficient.*

#### 17. Maxim Kiselev

*Institute of Monitoring of Climatic and Ecological Systems*

##### **Temperature characteristics of biologically active period of Bakchar bog peat soils**

The results of the study of the temperature regime in the five basic ecosystems of oligotrophic bogs in south Taiga of Western Siberia carried out in 2011-2016 are presented. All sites were divided into two groups according to the bog water level: flooded sites (hollow and open fen) and low-water sites (ridge, tall and low ryam). The analysis of the annual cycle of temperature are considered.

Keywords: *temperature regime, oligotrophic bogs, micro-climatology, Tomsk region, south Taiga.*

## **END OF SESSION 2**

## **OPEN FLOOR FOR FINAL COMMENTARY**

Closing word (Chairman)