

Department of Foreign Languages TSC RAS SB
May 27, 2020
12.00 PM

SESSION 1

12.00 PM – 14.00 PM

Chair: **Dmitrii Genin** (IHCE)

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

Welcome address: **prof. Aleksandr Konoshonkin** (IAO)

1. **Dmitry Filatov**

*Institute of Monitoring of Climatic and Ecological Systems
Laboratory of Ecological Instrumentation*

Optical device for measuring the parameters of a snowstorm

Traditional and modern instruments for measuring snow characteristics are considered. The features of measuring the characteristics of precipitation in the form of snow accompanied by wind are considered. The main ideas for the development of a new meter of snowstorm parameters that meet modern requirements are outlined.

Keywords: *snowstorm, snowstorm meter.*

2. **Tatyana Koshikova**

Institute of Monitoring of Climatic and Ecological Systems

Characteristics of mesoscale convective complexes over the south of western Siberia

A spatial and temporal assessment of mesoscale convective complexes (MCCs) were carried out; relevant characteristics of MCCs in the south of Western Siberia were analyzed. The maximum number of MCC events was recorded in 2016, and the minimum happened in 2019. The spatial distribution of the MCCs, in general, can be considered uniform. In years with severe forest fires in Siberia, there were fluctuations in the uniformity of distribution. A two-year characteristics variability cycle for the period 2010-2019 was traced.

Keywords: *convective cloudiness, microphysical characteristics, south of Western Siberia, hazardous phenomena.*

3. **Tatyana Parezheva**

Institute of Monitoring of Climatic and Ecological Systems

Distribution of incoming total solar radiation, taking into account the influence of the topography on the basis of GIS

The distribution of total solar radiation in the short-wave part of the spectrum in the basins of the South-Western Pribaikalye was studied; the change in the obtained values was analyzed. The data obtained using the ArcGIS program was compared against actinometric measurements.

Keywords: *short-wave spectrum, total radiation, reflected radiation, annual variation.*

4. **Anton Selin**

*V.E. Zuev Institute of Atmospheric Optics
Laboratory of Coherent and Adaptive Optics*

Adaptive optic systems for horizontal atmospheric paths

The presentation is devoted to the complexity the working on horizontal atmospheric paths in adaptive optics. The basic scheme of the adaptive optical system, as well as the wavefront sensor operation scheme will be shown. Then, the examples of astronomical observatories, like Lick Observatory's, Hale telescope, Keck Telescope, will be shown, along with the outcome work of their adaptive optic systems. Next, an adaptive system designed to operate on a horizontal atmospheric path will be demonstrated together with the results provided by this system. Also, the problems

arising when working on a horizontal atmospheric path will be shown. We are planning to deal with problems (such as a wavefront sensor, a calculating system etc.) based on the previous experience and future works.

Keywords: *adaptive optic, horizontal atmospheric path.*

5. Egor Poznakharev

V.E. Zuev Institute of Atmospheric Optics

Laboratory of Optical Signals Propagation

Estimation of communication device characteristics non-line-of-sight atmospheric optical communication on scattered radiation

A model of channel non-line-of-sight atmospheric optical communication is considered based on the Monte Carlo algorithm with a modified double local estimate. The results show that for the baselines up to 2-3 km the largest value of the atmospheric impulse response corresponds to the wavelengths in the UV range, for the baselines from 3 to 20 km it corresponds to the wavelengths in the visible range, for the baselines from 20 to 75 km it corresponds to the wavelengths in near infrared range and for the baselines of more than 75 km corresponds to the wavelengths in the infrared range. Also the range of optimal wavelengths was determined. For PMTs UFK 4G-2 the optimal wavelength is in the range from 425 to 605 nm, and for PMTs UFK 4G-4 the optimal wavelength is in the range from 225 to 365 nm.

Keywords: *atmospheric optical communication, scattered radiation, non-line-of-sight, Monte-Carlo method, impulse response.*

6. Shuo Zhang

V.E. Zuev Institute of Atmospheric Optics

Laboratory of Atmospheric Absorption Spectroscopy

Automatic 3D mapping of aerosol plumes according to LIDAR sensing data

For the need of to measure the atmosphere parameters, the team of Institute of Atmospheric Optics SB RAS is developing a new Lidar measurement system. The system consists of four parts: the Lidar measurement module-obtaining backscattered signals, the GPS module-obtaining the coordinates of the measurement point, the INS module determines the elevation and azimuth, and finally combines the three data streams and overlays with the map through the data processing module, so as to realize the real-time monitoring of aerosol and plume.

Keywords: *Lidar measurement, GPS, INS, aerosol, plume.*

7. Anton Pochufarov

V.E. Zuev Institute of Atmospheric Optics

Laboratory of Aerosol Optics

The development and test results of a sun sensor for solar photometers

For measuring aerosol and solar radiation characteristics a wide range of different devices is used. For example, the expedition equipment usually includes: an aerosol particle counter, an aetalometer, an aerosol filter sampling devices, a solar photometer and a sun sensor. The presentation discusses the primary results of the development of a supportive device so called a solar sensor (SS). The development is aimed at improving the effectiveness of the research.

Keywords: *solar sensor, sunshine duration, sunshine recorder.*

8. Olesya Marchenko

V.E. Zuev Institute of Atmospheric Optics

Studying the distribution of the air gas composition in the surface air layer

The study of tropospheric ozone is currently of considerable interest from the point of view of its influence, not only on the climate, but also on the biosphere as a whole. In the troposphere, ozone negatively affects biological objects, plants, human health, and is one of the main greenhouse gases. The study is based on measurements of ozone concentration in the surface layer of the troposphere of a station located in the city of Tomsk.

Keywords: *ozon, concentration, air, atmosphere.*

9. Alisa Trifonova-Yakovleva

V.E. Zuev Institute of Atmospheric Optics

Laboratory of Atmospheric Absorption Spectroscopy

The retrieval of greenhouse gases concentrations from the measured solar spectrum

The remote sensing measurements of greenhouse gases concentrations in atmosphere provide information about the concentration changes and their results may be used for modelling of greenhouse gases sources and sinks. In this study the approach to the gas concentration retrieval from the measured solar spectrum using SFIT4 software is considered. The results of the retrieval with different spectroscopic parameters are compared.

Keywords: *atmosphere, remote sensing, spectroscopy, GHG.*

10. Andrey Udalov

V.E. Zuev Institute of Atmospheric Optics

Laboratory of Radiophotonics

Rad-hard PIN photodiode design studying

This work dedicated to AlGaAs/GaAs/AlGaAs PIN photodiode design for operating wavelength 1550 nm. The transmitter path for the optical communication range includes an optical source, an optical modulator, an optical receiver. As an optical receiver, pin photodiodes are used. However, in space, as well as in the lower atmosphere is a large flow of cosmic radiation that can cause interference. The selected material has long been used in the production of photo-sensors and semiconductor lasers, basic conditions of operation and the optimal parameters are presented here. The simulation was carried out using the COMSOL Multiphysics package, in which the simulation paid attention to the response of the heterostructure to irradiation with a high flux of ionizing radiation, which is observed outside the Earth's atmosphere and magnetic field. As a result of this work, the maximum effective parameters were selected for two integration methods.

Keywords: *PIN photodiode, semiconductor heterostructure, optical receiver.*

11. Sergey Doroshkevich

Institute of High Current Electronics

The wide-aperture electron accelerator based on ion-electron emission with beam outputting in the ambient atmosphere

This work presents the principle of operation, design, and basic parameters of a wide-aperture electron accelerator based on secondary ion-electron emission. Current-voltage characteristics of the auxiliary glow discharge and dependences of the current in the accelerating gap, voltage and discharge current on the high voltage value are determined.

Keywords: *electron accelerator, electron beam, ion-electron emission, glow discharge.*

12. Aleksandr Kokovin

Institute of High Current Electronics

Laboratory of Theoretical Physics

Theoretical simulation of electric breakdown development in high-pressure gases under conditions of high-spatial electric field inhomogeneity

To describe in detail the gap breakdown development with a sharply inhomogeneous electric field, an original high-pressure gas discharge hydrodynamic model was formulated. The paper presents the results of numerical simulation of a high-voltage corona streamer discharge and a pulse-periodic corona discharge. Comparison of the theoretical results and experimental data shows good correlation of spatial structures discharge.

Keywords: *gas discharge plasma simulation, high-voltage switches, Trichel pulse mode.*

13. Daniil Zuza

Institute of High Current Electronics

Laboratory of Vacuum Electronics

Deposition of dielectric coating from plasma

We offer to deposit a dielectric coating from gas phase using plasma.

Here we present a setup, which was created especially for the deposition of the dielectric coatings from plasma, and discuss some of its subtleties. Also we show the coating, which was deposited using this setup, can withstand an applied voltage of 400 V. As a result we present several principles that should not be ignored when creating such setups.

Keywords: *plasma polymerization, coatings deposition, dielectric coatings, plasma chemistry.*

14. Svetlana Ermakova

Institute of Strength Physics and Materials Science

The effect of feed speed on the quality of titanium- aluminium bimetal formed by friction stir welding

The work investigates the features of bimetal formation of commercially pure titanium alloy and aluminum alloy 5056 using lap friction stir welding. The structure of the bimetal and the quality of joint depending from the change of tool feed rate is studied. The tensile tests were carried out to determine mechanical properties. The structure of bimetals was studied by methods of light optical and scanning electron microscopy. The results showed that the quality of titanium-aluminum bimetals in general is inversely proportional to the feed rate of the tool.

Keywords: *stir friction welding, dissimilar materials, lap welding, bimetal, intermetallic compounds.*

15. Marina Panchenko

Institute of Strength Physics and Materials Science

Laboratory of Physics of Structural Transformations

The effect of interphase (austenite/ferrite) and intergranular boundaries on hydrogen embrittlement of a high-nitrogen austenitic steel

The effect of a δ -ferrite volume fraction and grain size of austenite and δ -ferrite on hydrogen embrittlement and fracture micromechanism of a high-nitrogen austenitic steel Fe-23Cr-17Mn-0.1C-0.6N (wt. %) was investigated. Different solid-solution treatments (SST) in the temperature range $T_{sst}=1050-1200^{\circ}\text{C}$ allowed obtaining various contents of the δ -ferrite and grain sizes in the high-nitrogen steel. With increasing T_{sst} , the δ -ferrite volume fraction and grain sizes of both phases increase which contribute to the decrease in the density of interphase (austenite/ferrite) and intergranular boundaries. It has been established that the increase in the density of interphase and intergranular boundaries and the decrease in the δ -ferrite volume fraction in the high-nitrogen steel reduce the bulk diffusion of hydrogen atoms into the specimens and suppress the effects of hydrogen embrittlement.

Keywords: *hydrogen embrittlement, high-nitrogen steel, austenite, ferrite.*

16. Valentina Moskvina

Institute of Strength Physics and Materials Science

Laboratory of Physics of Structural Transformations

The characterization of surface layers produced by ion plasma treatment in CrNiMo austenitic stainless steel with different microstructures

In this work the phase composition, elemental composition and nanohardness of the surface layers obtained by ion-plasma treatment in a stable austenitic stainless CrNiMo steel (Fe-17Cr-13Ni-2.7Mo-1.7Mn-0.6Si-0.01C, mass. %) with different initial microstructures were studied. Different microstructures in stainless steel specimens were obtained using preliminary thermomechanical treatment in two regimes (R1-cold-rolling / R2-cold-rolling + annealing). In cold-rolled steel specimens (R1) a misoriented grain-subgrain structure with a high density of deformation defects (dislocations, subboundaries, twins, localized bands, etc.) and both high- and low-angle misorientations between structural elements were obtained. In cold-rolled and annealed steel specimens (R2) slightly higher average size of the grain-subgrain elements with high-angle misorientations were obtained. It has been established that the main differences in structure of R1- and R2-specimens lie in dislocation density, microstresses and fraction of low-angle boundaries.

Keywords: *austenitic stainless steel, ion-plasma treatment, nitrogen, carbon, microstructure.*

17. Kseniya Osipovich

Institute of Strength Physics and Materials Science

Laboratory for Local Metallurgy in Additive Technologies

Regularities in formation of polymetallic materials using electron-beam additive technology

This report describes the results of an investigation into a microstructure formation on a wire-feed electron-beam additive manufactured "steel-copper" bimetallic sample. The advantages of polymetals in comparison with monometals in practical application are given. With the help of literature analysis, the materials and method of manufacturing a polymetallic sample are selected. Experimentally the peculiarities of a gradient zone structure with a smooth change of components' concentration are revealed. The heterogeneity of copper and steel distribution in the gradient zone is provided by copper solidification and precipitation mechanisms. Both solidification of coarse copper inclusions and precipitation of fine Cu-based particles at the cooling stage are the main factors of structure formation during the double wire gradient zone deposition. The shape of steel particles and/or grains is mainly determined by the peculiar-

ities of the crystallization zone.

Keywords: *wire-feed electron-beam additive manufactured, bimetallic sample, copper, stainless steel, particles, gradient zone.*

18. Olga Novitskaya

Institute of Strength Physics and Materials Science

Laboratory of Physics of Surface Hardening

Deformation of Hadfield steel single crystals by dry sliding friction with the normal load $[\bar{1}\bar{1}0]$ /friction force orientations $[\bar{1}10]$ and $[001]$

This paper studies the friction and wear of single crystals of Hadfield steel with the normal load/friction force orientations $[\bar{1}\bar{1}0]/[\bar{1}10]$ and $[\bar{1}\bar{1}0]/[001]$. Due to the different friction force orientation, deformation occurs by twinning in the first case and by slip in the second case. The shear stresses were estimated and correlated with the observed slip band systems. The dislocation structure evolution depending on the distance to the worn surface was considered.

Keywords: *Hadfield steel, sliding friction, wear, deformation.*

19. Kirill Kalashnikov

Institute of Strength Physics and Materials Science

Laboratory for Local Metallurgy in Additive Technologies

The influence of the wire feed geometry on the process of the electron-beam freeform fabrication of Ti-6Al-4V components

The work is devoted to the study of two different ways of the complex-shaped bell-type sample formation from the titanium alloy Ti-6Al-4V. It is shown that the process of manufacturing the samples on the three-axis table is sensitive to the wire feed geometry as depended on four such geometry zones. These zones are characterized by the angles between the wire feed direction and the tangent to the printing path. On the contrary, samples obtained on a rotary four-axis table are not sensitive to the wire feed geometry. Each of the two ways provides the formation of its own specific type of the structure and different mechanical characteristics. In this work, the structure of geometry affected zones is determined and the differences in mechanical properties and phase-compositions of samples produced by various methods are studied.

Keywords: *titanium alloy, additive manufacturing, electron beam, wire.*

20. Filipp Dyachenko

Institute of Strength Physics and Materials Science

Laboratory of Nanotechnology and Materials Science of Coatings

The mechanical properties of Ti-Ni-Ta-based surface alloys on the NiTi substrate formed by the additive thin-film electron beam synthesis

An important factor limiting the wide application of thin-film metallic glasses (TFMGs) for improving the surface-sensitive properties of structural and functional alloys is the poor adhesion of TFMGs to metallic substrates. This problem can be overcome via the synthesis of surface alloys (SAs) by additive pulsed electron-beam melting of film/substrate systems. In this work, this approach is applied to the [film (Ti-Ta, 50 nm)/substrate (TiNi alloy)] systems using a low energy, high current electron beam ($\sim 2.5 \mu\text{s}$, $\sim 15 \text{ keV}$, $\sim 2 \text{ J/cm}^2$) at 20, 30 synthesis cycles and 5 pulses per cycle. Using cross-sectional transmission electron microscopy analyses it has been found that $\sim 2 \mu\text{m}$ thick SAs have nanocrystalline and nanocomposite structure. The SAs are followed by the intermediate sublayer with the eutectic columnar nano-grain B2-structure, which provides the diffusion bonding of SAs with unmelted TiNi substrate.

Keywords: *thin-film metallic glasses, pulsed electron beam melting, Ti-Ni-Ta surface alloy, TiNi SMA, instrumented indentation.*

21. Grigoriy Dankovtsev

Institute of Petroleum Chemistry

Laboratory of Physical and Chemical Methods of Research

Olefin C3-C4 oxidation under the action of barrier discharge in plasma-chemical reactor with cryogenic cooling

Oxidation of gaseous olefins C3-C4 for the synthesis of oxides is an important task in industrial organic synthesis. Liquid or gas-phase catalysts are used for that in chemical industry. However, these have essential limitations (prepara-

tion, regeneration of catalysts, high temperature and pressure requirements) which make researchers look for alternative ways to produce gaseous olefins. In this work, we report on a new method of obtaining olefins by their liquefaction at -50 °C under the influence of barrier discharge.

Keywords: *olefins oxidation, dielectric barrier discharge, plasma-chemical reactor.*

22. Natalya Volkova

Institute of Petroleum Chemistry

The chemical composition of soils in the territory of an oil refining facility

To determine the composition of micro- and macroelements in the soil, the samples under study were dried at 1050C for one hour, sieved, then pressed with boric acid to get hard-packed tablets. The analysis was performed on an ARL-9900 XP X-ray fluorescence spectrometer. The composition of trace elements is represented by Ni, Co, Zn, Sn, Cu, As, Cd, V, Se, Te, Rb, Ag, Hg, Pb, Sb, Cs. Macronutrients include the elements that exceed 0.1% in the earth crust, their composition includes Si, Al, Fe, K, Ca, Na, Mg, Ti, Mn, P, S, Zr. Organic matter was extracted from the soil with vapors of 7 % solution of methanol in chloroform. The compositional analysis of the extracts was performed via gas chromatography-mass spectrometry using a Trace DSQ instrument from Thermo Scientific Company (Germany). Among the organic compounds n-alkanes (Alk), aromatic hydrocarbons (AHC), carboxylic acids (CA) and their methyl (ME) and isopropyl (IPE) esters, ketones (Ket), tocopherols (TF), oil hopanes (OH), triphenyl phosphates (TPP) have been identified.

Keywords: *chemical analysis, microelements, macroelements, toxic elements, organic matter, GC-MS, X-ray fluorescence analysis.*

23. Stanislav Boyar

Institute of Petroleum Chemistry

Laboratory of Hydrocarbons and High-molecular Compounds

Combined conversion of petroleum residue and vegetable oil

Combined conversion of petroleum residue (initial boiling point 350°C) produced from highly paraffinic heavy oil from the Zuunbayan oil field (Mongolia) and unrefined vegetable oil have been studied. The possibility of utilizing vegetable oil in the process of thermal conversion of petroleum residue to gain additional amount of distillate fractions (IBP–360°C) has been shown. The physico-chemical characteristics and composition of the products as a function of the amount of vegetable oil used have been studied.

Keywords: *fuel oil residue, vegetable oil, microspheres, thermolysis, thermal cracking, resin-asphaltene components, structural and group characteristic of resins and asphaltenes.*

END OF SESSION 1

Closing word: Chair