

**Atomfizika, optiskās
tehnoloģijas un medicīnas
fizika/ Atomic physics, optical
technologies and medical
physics**



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Report of Abstracts

Abstract ID : 1

Difrakcijas problēma fotona kvantu modelī

Content

Literatūrā tiek intensīvi diskutēts, ka kvantu datoros kā informācijas nesošais elements varētu būt atsevišķs fotons. Tādā gadījumā jāspēj aprakstīt fotona izplatīšanos sarežģītā vidē - tā atstarošanas, refrakciju un difrakciju. Elektromagnētiskā lauka kvantēšanas modelis tās neapraksta. Pēdējās mūsu publikācijās piedāvātais fotona trīsdimensionālais kvantu modelis sekmīgi apraksta fotona atstarošanas un refrakciju. Refrāģētā un krītošā fotona transversālie izmēri atšķiras. Svarīgi būtu zināt, kāda ir fononu transmisija caur spraugām un caurumiem, t.i. kāda ir to difrakcija. Par pamatu difrakcijā tiek uzskatīta Zommerfelda problēma - difrakcija uz pusplakni - kuru viņš sekmīgi atrisināja plakana viļņu gadījumā. Mūsu uzdevums ir aprakstīt fotona difrakciju uz pusplaknes.

Primary authors: Dr BĒRSONS, Imants (LU Atomfizikas un spektroskopijas institūts); Dr VEILANDE, Rita (Institute of Atomic Physics and Spectroscopy, University of Latvia)

Presenter: Dr BĒRSONS, Imants (LU Atomfizikas un spektroskopijas institūts)

Status: ACCEPTED

Submitted by VEILANDE, Rita on Tuesday, December 20, 2022

Abstract ID : 2

Numerical studies of the impact of electromagnetic field of radiation on valine

Content

Amino acids are the structural units of the proteins, i.e. by joining together they form peptides or polypeptides / proteins. Non-protein amino acids have important roles as metabolic intermediates, such as in biosynthesis, or are used to synthesize other molecules. Valine is an α -amino acid which is used in protein biosynthesis and thus is essential in humans. In sickle-cell disease it substitutes the hydrophilic glutamic acid, and the hemoglobin becomes prone to abnormal aggregation. Shortly after the deposition of high-energy ionizing quanta into a biological medium, electrons with different energies are formed and are able to destroy biological molecules, such as DNA and proteins, and cause chromosome aberrations, leading to cancer mutations, genetic transformations etc. [1].

In this work we present the results of the numerical calculations of the effect of electromagnetic field of radiation on valine and compare with experimental results available in the literature [2]. We specifically focus on the effects of the magnetic field of radiation by introducing modified basis sets which incorporate correction coefficients to the s-, p- or only the p-orbitals, following the method of Anisotropic Gaussian Type Orbitals [3].

By comparing the bond length, angle, dihedral angles, and condense to atom all electrons, obtained without and with the inclusion of dipole electric and magnetic fields, we conclude that while the charge redistribution occurs due to electric field influence, the changes in the dipole momentum projection onto the y- and z- axis are caused by the magnetic field. At the same time the values of the dihedral angles could vary up to 4 degrees due to the magnetic field effects. We further show that taking into account of the magnetic field in the fragmentation processes provides better fitting of the experimentally obtained spectra (e. g. the CHO₂ fragment is seen only when the magnetic field effects are included to the basis set of the p- orbitals). Thus, numerical calculations which include the magnetic field effects can serve as a tool for more accurate predictions, as well as analysis of the experimental outcomes.

This article is based upon work from COST Action CA18212-Molecular Dynamics in the GAS phase (MD-GAS), supported by COST (European Cooperation in Science and Technology).

References

- [1] A. F. Fuciarelli and J. D. Zimbrick, Radiation Damage in DNA: Structure/Function Relationship at Early Times, (Battelle Press, Columbus OH, 1995).
- [2] J. Tamuliene et al. High-energy electron impact influence on the amino acid fragmentation, Horizons in World Physics. 305, editor Albert Reimer, Nova Science Publishers, ISBN: 978-1-53619-951-2 (2021).
- [3] P. Schmelcher and L. S. Cederbaum, Phys Rev A 37(3), 672 (1988); W. Zhu and S. B. Trickey, J Chem Phys 147, 244108 (2017).

Primary authors: Dr KIROVA, Teodora (University of Latvia, Institute of Atomic Physics and Spectroscopy); Dr TAMULIENE, Jelena (Institute of Theoretical Physics and Astronomy, Vilnius University)

Presenter: Dr KIROVA, Teodora (University of Latvia, Institute of Atomic Physics and Spectroscopy)

Status: ACCEPTED

Submitted by **KIROVA, Teodora** on **Monday, January 9, 2023**

Abstract ID : 3

Arsēna rezonanses spektrālo līniju pētījumi tālajā UV apgabalā

Content

Lai spektrālīnijas varētu veiksmīgi izmantot atomu absorbcijas spektroskopijā (AAS), tām jāatbilst noteiktām prasībām – līnijām jābūt šaurām, intensīvām un bez pašabsorbcijas.

Augstfrekvences bezelektrodu gaismas avoti (ABL) - ir spoži līnījspektra starotāji, kam raksturīga augsta intensitāte un šauras līnijas. Tādu elementu kā arsēna (As), selēna (Se), dzīvsudraba (Hg) un fosfora (P) gadījumos ABL var nodrošināt ievērojami augstāku intensitāti, labāku stabilitāti un ilgāku kalpošanas laiku nekā dobajā katoda lampas [1].

AAS ļauj noteikt dažādu vielu koncentrāciju ar augstu jutību, bet liela nozīme ir gaismas avota parametru pareizai izvēlei. Šis darbs ir veltīts ABL ar As pildījumu izstaroto līniju galveno raksturlielumu salīdzināšanai ar mērķi to izmantošanai augstas precizitātes atomu absorbcijas analizatoros. Īpaša uzmanība tiek pievērsta Arsēna spektrālīnijām 189.4nm ($^4P_{5/2} \rightarrow ^4S_{3/2}$), 193.7nm ($^4P_{3/2} \rightarrow ^4S_{3/2}$) un 197.2nm ($^4P_{1/2} \rightarrow ^4S_{3/2}$), kas atrodas UV reģionā. Darba ietvaros tika analizētas relatīvās intensitāšu atkarības no jaudas, aparātūras funkcijas ietekme uz spektriem, starojuma stabilitāte un līniju pašabsorbcijas.

Spektrālie mērījumi tika veikti ar Furjē Bruker IFS HR125 un Yobin Jvon SPEX 1000M spektrometriem. Starojuma spektru reālo formu aprēķināšanai tika izmantota regularizācijas metode [2].

[1] Welz B and Sperling M 1998 Atomic Absorption Spectrometry 3rd edition Weinheim: Wiley-WCH p 109

[2] Sizikov V S 1999 Stable methods of processing of the results of measurement (St.Petersburg: SpetsLit) (krievu valodā)

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Primary authors: ABOLA, Anda (LU ASI); Prof. RĒVALDE, Gita (LU ASI); Dr SKUDRA, Atis (LU ASI); ZORINA, Natalja (Institute of Atomic Physics and Spectroscopy, University of Latvia)

Presenter: ZORINA, Natalja (Institute of Atomic Physics and Spectroscopy, University of Latvia)

Comments:

Prezentācija būs latviski.

Status: ACCEPTED

Submitted by ZORINA, Natalja on Wednesday, January 18, 2023

Abstract ID : 4

Collaboration with Large Scale Facilities

Content

The large-scale facilities make it possible to carry out top-level research and produce innovations. They have access to expensive equipment and complex infrastructure, which cannot be purchased and maintained by an individual laboratory or university, and sometimes even a small country such as Latvia. Conducting research in them opens up opportunities for us to conduct high-class research, work in international teams and publish results in top-level scientific journals. It is important for both: senior researchers and young scientists.

In this conference I'll report on my experience in collaboration with two facilities: ISOLDE [1] at CERN, and DESIREE [2] at Stockholm's University. The set-ups and methods what we use in our proposed experiments are described in publications [3,4]. The experimental set up in large scale facilities is run by local staff and running costs are covered by facility budget. But we have to find a way to cover our living expenses at the facility during experiment. This demands a bit different planning for experiment.

COST is a funding agency for research and innovation networks. Participation in COST actions opens a good option to apply for support for research visits to large scale facilities for us, especially in time when support from own projects is limited. In our case besides of fundings from ERDF projects one COST program [5] was used. Despite the fact that the name MD-GAS does not correspond well to the research directions of our laboratory, this Action is attractive for us because one working group is engaged in the development of instruments and the campaign tends to have the practical applications in the physics and photochemistry of the atmosphere.

The results of my experiments on atomic constants: lifetimes of positive ions and electron affinities and negative ions in both: CERN and DESIREE will be reported in my presentation.

Acknowledgments

During time, when our experiments were conducted, the multiple stay in Stockholm and CERN were supported from following projects: 1) ERDF project No. 1.1.1.5/19/A/003 "The Development of Quantum Optics and Photonics at the University of Latvia", 2) ERDF project No. 1.1.1.1/19/A/144 "Technologic research for elaborating the next generation boron ion implantation apparatus with TRL level near to 4". and 3) COST Action CA18212 - Molecular Dynamics in the GAS phase (MD-GAS), supported by COST (European Cooperation in Science and Technology).

References

1. <https://home.cern/science/experiments/isolde>
2. <https://www.desiree-infrastructure.com/desiree>
3. D.Leimbach, et al., The electron affinity of astatine. Nature communications, 11(1):1–9. (2020)
4. H T Schmidt, et al., First storage of ion beams in the Double Electrostatic Ion-Ring Experiment: DESIREE, Rev.Sci. Instr. 84, 055115 (2013).
5. <https://www.mdgas.eu/index.php>

Primary author: BĒRZIŅŠ, Uldis (Institute Of Atomic Physics And Spectroscopy, University of Latvia)

Presenter: BĒRZIŅŠ, Uldis (Institute Of Atomic Physics And Spectroscopy, University of Latvia)

Status: ACCEPTED

Submitted by **BĒRZIŅŠ, Uldis** on **Sunday, January 22, 2023**

Abstract ID : 5

Structural, electronic and optical properties of wurzite ZnO from first principles

Content

Zinc oxide (ZnO) has attracted much attention recently as a favourable semiconductor for various applications due to its wide band gap (~3.34 eV), large exciton binding energy (60 meV) [1], as well as being environmentally friendly and biocompatible. Its superior electronic and optical properties make it a perfect candidate for devices, such as visible and ultraviolet light emitters and detectors, nanolasers, solar cells, acoustic and piezoelectric devices, as well as various sensors [2]. ZnO has three different structures: a hexagonal wurzite (B4), a cubic zincblende (B2), and cubic rocksalt (B1), with the wurzite form being the most stable. In that configuration the zinc atom is surrounded by four oxygens located at the corner of a tetrahedron [3].

Over the years, a great deal of research has been devoted to the structural and optical properties of ZnO in the B4 phase [4].

In this work we perform first principle calculations on the structural and optical properties of wurzite ZnO. To obtain our results, we use the Goedecker-Teter-Hutter (GTH) pseudopotentials [5] with the Perdew-Burke-Ernzerhof (PBE) exchange correlation functional [6], as implemented in the CP2K code [7], which is based on the Density Functional Theory (DFT) [8].

We are currently performing calculations of the total energy as a function of the unit-cell volume within 10% around the equilibrium cell volume. These calculated energies will be fitted to a third-order Birch-Murnaghan's empirical function [9], from which we can obtain various structural properties, such as the ground state energy E_0 , the equilibrium volume V_0 , the bulk modulus B_0 , the pressure derivative of bulk modulus B_0' . We will compare the calculated structure parameters with previous experimental and theoretical studies [4], after which we will proceed to determine the band structure, density of states, linear and nonlinear optical susceptibilities of wurzite ZnO.

This work was supported by the Z-LZP103-ZF-N-109 project "Jaunas kodola apvaka nano šķiedras, kas veidotas, izmantojot koaksiālu elektrisko vēršanu fotokatalitiskiem lietojumiem".

References

- [1] Serrano, J. et al., Phys. Rev. B 69, 094306 (2004).
- [2] De la Olvera, M. L. and Asomoza R., Sensors and Actuators 45, 49 (1997); Gorla, C. R. et al., J. Appl. Phys. 85, 2595 (1999); Nomura, K. et al., Science 300, 1269 (2003); Huang, M. H. et al., Science 292, 1897 (2001).
- [3] Rodnyi, P.A. and Khodyuk, I.V., Opt. Spectrosc. 111, 776-785 (2011).
- [4] Schleife, A. et al., Phys. Rev. B 80, 035112 (2009); Kong, F. J. and Jiang, G. Physica B: Cond. Matt. 404, 2340 (2009); Smith, N.V., Phys. Rev. B 3, 1862 (1971); Sun, J. et al., Phys. Rev. B 71, 125132 (2005); Zhao, L. et al., Chin. Phys. B 19, 056104 (2010).
- [5] Goedecker, G. et al., Phys. Rev. B 54, 1703 (1996).
- [6] Perdew, J. P. et al., Phys. Rev. Letts. 77, 3865 (1996).
- [7] Kühne, Th. D. et al., J. Chem. Phys. 152, 194103 (2020).
- [8] Jones, R.O., Rev. Mod. Phys. 87, 897 (2015).
- [9] Murnaghan, F.D., Proc. Nat. Acad. Sci. U.S.A. 30, 244 (1944).

Primary authors: KIROVA, Teodora (University of Latvia, Institute of Atomic Physics and Spectroscopy); Dr GUĻĀNS, Andris (LU_FMOF); Dr VITER, Roman (LU_ASI)

Presenter: KIROVA, Teodora (University of Latvia, Institute of Atomic Physics and Spectroscopy)

Status: ACCEPTED

Submitted by **KIROVA, Teodora** on **Wednesday, January 25, 2023**

Abstract ID : 6

"Quality control of photoinitiators of UV-curable coatings using spectroscopy methods"

Content

The work investigated the absorption specifications of four photoinitiators - BAPO, TPO, TPO-L and IRG184, to achieve the result three research methods were used - UV-VIS-NIR spectroscopy, Photoluminescence spectroscopy and Fourier-transform infrared spectroscopy (FTIR). UV-Vis spectrometers use a light source to illuminate a sample with light across the UV to the visible wavelength range (typically 190 to 900 nm). With this spectrometer we measured transmittance and absorbance. Photoluminescence is a process in which a molecule absorbs a photon in the visible region, exciting one of its electrons to a higher electronic excited state, and then radiates a photon as the electron returns to a lower energy state, light is directed onto a sample, where it is absorbed and where a process called photo-excitation can occur. Fourier transform infrared spectroscopy (FTIR) uses the mathematical process to translate the raw data (interferogram) into the actual spectrum. Depending on the infrared absorption frequency range 350–4000 cm^{-1} , the specific molecular groups prevailing in the sample will be determined through spectrum data in the automated software of spectroscopy. With FTIR method we measured absorption in range of 350-4000 cm^{-1} , it is also used for qualitative and quantitative analysis of substances.

TRANSMITTANCE. To calculate transmittance, a measurement of the source is acquired by placing it in line with the detector without the sample in place. The sample then is placed between the source and detector, and the transmitted light is measured. Scans for both transmittance and reflectance were run in range of 250-1000nm and then were restricted to the different range of 350-600nm to specify the absorption area.

REFLECTANCE. Reflectance spectrophotometers measure color by flashing light onto the surface of the sample and measuring the percentage of spectral reflectance of different wavelengths. Reflectance spectroscopy is an important method of measuring the absorption spectra and other properties of solids. Because this type of measurement can be made without contacting the sample, it is a powerful technique for the remote determination of the composition of soils and regoliths on the surfaces of bodies of the solar system, as well as powders in the laboratory. Scans were run in the range of 250-1000nm and restricted to the range of 350-600 nm to specify the absorption area of the samples. For photoluminescence we measured emission, the applied energy was 310nm 3miliwats and it was measured 350-800nm.

We measured transmittance and reflectance which later were converted into absorbance using these formulas: $A = \ln(100/R(\%))$ or $A = \ln(100/T(\%))$

EMISSION. In essence, light is directed onto a sample, where it is absorbed and where a process called photo-excitation can occur. The photo-excitation causes the material to jump to a higher electronic state, and will then release energy, (photons) as it relaxes and returns to back to a lower energy level. The emission of light or luminescence through this process is photoluminescence, PL. Excitation was 310nm, 3mW, it was measured 350-800nm. The emission spectrum is created by exciting electrons at a fixed wavelength but observing emissions at different wavelengths. The data extracted from an emission spectrum is often the peak emission intensity of the material, which is used to compare electronic properties.

For measurements we used four photoinitiators - BAPO, TPO, TPO-L and IRG 184. All three (BAPO, TPO, TPO-L) are phosphorus-containing photoinitiators. TPO and TPO-L have almost similar molecular weight while BAPO has the largest and IRG has the smallest molecular weight.

The research on photoinitiators was carried out in cooperation with SIA Kinetics organization, which provided materials and gave instructions on the desired information to be obtained. Photoinitiators are compounds that produce radicals when exposed to UV light. These then react with monomers and / or oligomers to initiate polymer chain growth. They are essential ingredients

of all UV-curable adhesives, inks and coatings. The purpose of the study is to find out the connection between photoinitiators and their properties with the pharmaceutical industry and their application in medicine.

To carry out the research, the following materials were given from Kinetics: three photoinitiators in powder form and one in liquid form. Then these photoinitiators were given in a 2% dilution with monomer/oligomer and finally polymerized films that SIA Kinetics created themselves were also offered, but these polymerized films were too thick and it was impossible to make measurements with them, so we created a polymerized material ourselves. The preparation of the polymerized material consisted of 2% diluted photoinitiator drying in a lamp and in this way we obtained a thinner type of polymerized material with which we performed the measurements.

The results obtained in the study indicate the properties of photoinitiators - Photoinitiators have good optical properties in the range of 400-460 nm. Monomer-oligomer makes changes into absorption peak of photoinitiator and makes UV shift of the absorption. Significant changes were observed to IRG182 and BAPO (it is supposed that BAPO has absorption band in the range 360-420 nm). PL measurements showed good rate of photocharge conversion into chemical reaction. FTIR spectra of 2% photoinitiator showed composite forming only for TPO-L. Based on the data TPO-L and BAPO are the most compatible with this type of the monomer.

Primary authors: OSE, Arta; STIVRINA, Danute; BIRKS, Ingmars (R&D Director SIA Kinetics); Dr GRIGALE-SOROCINA, Zane (R&D Chemist SIA Kinetics); Prof. RIEKSTINA, Una; Dr VITER, Roman (Senior researcher)

Presenter: STIVRINA, Danute

Status: ACCEPTED

Submitted by **STIVRINA, Danute** on **Friday, January 27, 2023**

Abstract ID : 7

The First Satellite Photometry Results at the Satellite Laser Ranging Station 1884

Content

This paper discusses the first satellite photometry results at the satellite laser ranging station 1884. The satellite laser ranging station recently was upgraded with satellite photometry capability using the EM CCD camera. The camera is integrated in the Coudeax telescope focus visual tracking path and is equipped with the frame cropping device and filter wheel. The filter wheel has two astronomical Krons/Cousins system V and B filters for photometry. The EMCCD camera can record up to ten frames per second in full frame mode, 1024px by 1024px, FOV=11'x11' and up to 100 frames per second in cropping mode. The first measurements were done using satellites and rocket bodies as a target like Topex/Poseidon, Envisat, LCS4, and CZ2C2B. For each target, the satellite light curve is produced. The analysis of obtained light curves helps determine satellite orientation and rotation parameters. This information has use for precise orbit determination of satellites and space debris, space object reentry in atmosphere prognosis, and active space debris removal missions.

Primary author: Mr DEL PINO, Jorge (Institute of Astronomy)

Co-authors: ILGMĀRS, Eglītis (Institute Of Astronomy); JĀNIS, Kauliņš (Institute of Astronomy); Mr KRISTERS, Nagainis (Institute of Astronomy); SALMINS, Kalvis

Presenter: SALMINS, Kalvis

Status: ACCEPTED

Submitted by **SALMINS, Kalvis** on **Monday, January 30, 2023**

Abstract ID : 8

Dispersijas rēķinu metožu salīdzinājums

Content

Viena no galvenajām mikrorezonatoru aprakstošajām īpašībām ir to brīvais spektrālais apgabals un dispersija. Brīvais spektrālais apgabals apraksta frekvenču attālumu starp divām azimutālajām modām. Uzpumpējot rezonatoru ar frekvenču ķemmi, tiek ierosinātas dažkārt līdz simtiem azimutālo modu. Attālumi starp modām ir gandrīz ekvidistanti, un nobīdi no ekvidistantā režģa sauc par integrēto dispersiju. Dispersiju var nomērīt eksperimentāli ar augstu precizitāti nomērot rezonanses frekvences, un to var arī izrēķināt skaitliski izmantojot COMSOL Multiphysics. Tiek salīdzinātas dažādas metodes kā izrēķināt rezonatora dispersiju.

Primary author: DRAGUNS, Kristians (Zinātniskais asistents)

Presenter: DRAGUNS, Kristians (Zinātniskais asistents)

Status: ACCEPTED

Submitted by **DRAGUNS, Kristians** on **Monday, January 30, 2023**

Abstract ID : 9

Structural, optical and photoelectrochemical properties of Fe₂O₃/ZnO core-shell nanofibers

Content

Solar radiation is widely used as light source for excitation photoprocesses in a number of nanomaterials. Metal oxide core-shell nanofibers are new materials, which could be used for sensor, water splitting and photocatalysis applications under solar light. Core/Shell interface between two metal oxides forms p-n junction or heterostructure. This is important for separation of photogenerated charge.

Within different metal oxides, Fe₂O₃ has low band gap (2.2 eV), sufficient for absorption of solar radiation. ZnO is a low cost nanomaterial with high band gap (3.3 eV) and high surface catalytic activity.

Integration of Fe₂O₃ and ZnO into one core-shell nanofiber is a new challenge for development of photocatalytic materials.

In the present paper, Fe₂O₃ and ZnO were deposited as core-shell materials by co-axial electrospinning. Structural properties of the core-shell nanofibers have been studied by XRD, FTIR and TEM. Photoelectrochemical properties were studied by diffuse reflectance and cyclic voltammetry. Charge transfer in such nanostructures was discussed.

Primary author: Dr VITER, Roman (Institute of Atomic Physics and Spectroscopy, University of Latvia)

Presenter: Dr VITER, Roman (Institute of Atomic Physics and Spectroscopy, University of Latvia)

Status: ACCEPTED

Submitted by **VITER, Roman** on **Monday, January 30, 2023**

Abstract ID : 10

ZnO tetrapods/modified salan type ligands nanocomposites for optical detection of Cu²⁺ ions

Content

Optical sensors of metal ions, which could work in liquids are promising and important direction in agriculture and environmental protection industry. High sensitivity and selectivity are the most important requirements for sensor.

Salan type organic ligands is known as potential sensor for detection of metal ions, because they have free places in molecular structure, where can host metal ions. These ligands can be chemically modified to suite the purpose of the sensor. But salan type ligands have some disadvantages: previously they were used only in liquid solution (such way requires a large amount of ligand); photobleaching; low intensity of photoluminescence; sensitivity in concentration range from 50 μM/L. To solve these problems and improve sensitivity to metal ions, we propose to use nanostructured template.

ZnO nanostructures have advanced optical properties (room temperature photoluminescence at 378 and 530 nm). ZnO tetrapods (hereinafter ZnOtp) are new structures with a larger active surface area that could serve as a good template for ligands. Optical emission of ZnOtp overlaps with optical absorption of salan type ligands, what can induce new optical properties and change their electronic structure.

In this work, we report on improving of optical and sensitive properties of modified salan type ligands by integrating with ZnOtp. Sensor tests to Cu²⁺ ions have been performed.

12 mg ZnOtp and 450 μL 50 mM solution salan ligand/DMSO were added to 3 mL of acetonitrile, ultrasonicated and stirred at 350 RPM for 96 hours. The resulting compounds were washed with acetonitrile, methanol, ethanol, frozen and dried in vacuum for 24 hours. For sensitivity measurements compounds were diluted in butanol and applied on glass substrates by drop casting and dried in the oven at 120° C. Structure properties of the ZnOtp/modified salan ligands nanostructures have been investigated by XRD, SEM/EDX, FTIR, diffuse reflectance (300-800 nm) and photoluminescence (350-800 nm). Sensitivity measurements were carried out in home made microfluidic system.

The presence of salan ligands on the ZnOtp surface led to a redistribution of emission bands in the photoluminescence spectrum (there were two dominant peaks at 383 nm and 436 nm wavelengths) and intensity of PL increased more than 10 times. The sensitivity of the resulting compound to copper ions was studied. Main sensors parameters were calculated: limit of detection was about 1 μM/L, time of sensor response was about 10-15 minutes.

ZnO/modified salan ligand nanocomposites successfully synthesized, optical and structure properties were studied. The sensitivity of the obtained compounds to Cu²⁺ ions was found. Thanks to the nanostructured ZnOtp template, the intensity of photoluminescence increased tenfold, the minimum detectable concentration of Cu²⁺ ions in the solution decreased from 50 μM/L to 1 μM/L, which is confirmed by studies in various microfluidic systems. Based on these results, it can be concluded that ZnO/salan ligands nanocomposites are very promising for practical applications.

Primary author: TEPLIAKOVA, Iryna (University of Latvia, Institute of Atomic Physics and Spectroscopy; Odesa National I.I. Mechnikov University, Department of Experimental Physics)

Presenter: TEPLIAKOVA, Iryna (University of Latvia, Institute of Atomic Physics and Spectroscopy; Odesa National I.I. Mechnikov University, Department of Experimental Physics)

Comments:

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Submitted by **TEPLIAKOVA, Iryna** on **Tuesday, January 31, 2023**

Abstract ID : 11

Autofluorescence features can help dermatologists to evaluate skin cancer post-operative scars

Content

Skin cancer is the most commonly diagnosed type of cancer in the United States. In this work post-operative skin cancer scar evaluation with Light Emitting Diode (LED) screening device and how it can be an indicator for dermatology specialists in oncology has been described. The wavelength used for inducing autofluorescence (AF) of chromophores in the skin is 405nm. The green channel of the captured images is the best to calculate AF intensity ratio from the scar and the surrounding skin of 10 patients with healthy healing and scars with cancer recurrence. This non-invasive multispectral screening method can help dermato-oncologist to make a decision on evaluating if the scar is healing correctly and evaluate any pigmentation that could be suspected as a recurrent cancer.

Primary authors: LANGE, Marta (LU ASI); Dr BOZSÁNYI, Szabolcs (Semmelweis University, Department of Dermatology, Venerology and Dermatoooncology, Budapest, Hungary); PLORINA, Emilija Vija (University of Latvia); Dr KISS, Norbert (Semmelweis University, Department of Dermatology, Venerology and Dermatoooncology, Budapest, Hungary); Dr LIHACOVA, Ilze (Biophotonics Laboratory, Institute of Atomic Physics and Spectroscopy, University of Latvia, Riga, Latvia); Dr LIHACHEV, Alexey (Biophotonics Laboratory, Institute of Atomic Physics and Spectroscopy, University of Latvia, Riga, Latvia)

Presenter: LANGE, Marta (LU ASI)

Status: ACCEPTED

Submitted by **LANGE, Marta** on **Tuesday, January 31, 2023**

Abstract ID : 12

Integrētā fotonika: polimēra mikrogredzena rezonatori sensoru pielietojumiem

Content

Pēdējos gados integrētā fotonika tiek ļoti aktīvi pētīta – tā ir iespēja aizstāt dažādus elektronikas elementus, uzlabojot veiktspēju, nodrošinot spēju darboties ekstrēmā vidē, elektromagnētisko imunitāti, kā arī mazus izmērus un iespēju uz viena fotoniskā čipa izvietot daudzas komponentes. Mēs esam izveidojuši mikrogredzena rezonatoru no SU-8 (polimērs, negatīvs fotorezists), substrātam izmantojot mikroskopa stikliņu. Gaismas ievadei rezonatorā uz čipa ir izmantots liekts viļņvads, kas nodrošina to, ka ieejošā lāzera gaisma netraucē izejas signālam. SU-8 pēc tā attīstīšanas ir mehāniski un ķīmiski stabils, tāpēc to var izmantot nepārklātu, taču iespējams virsmu funkcionalizēt ar dažādiem pārklājumiem, piemēram, organiskā stikla pārklājumu. Mēs eksperimentāli testējām dažāda izmēra mikrogredzena rezonatorus, pie viena viļņvada piesaistītus vairākus (2–4) mikrogredzenus un ar organisko stiklu pārklātu mikrogredzenu. Rezonatori tika testēti mitruma un temperatūras mērīšanai, uzrādot labu jutību un augstu ātrdarbību. Potenciālie pielietojumi ir plaši – dažādu gāzu jušana, optiskie filtri, viļņa garuma mērītājs.

Primary author: MILGRAVE, Lase (UL Institute of Atomic Physics and Spectroscopy)

Co-authors: Dr ALNIS, Janis (UL Institute of Atomic Physics and Spectroscopy); Dr BUNDULIS, Arturs (UL Institute of Solid State Physics); Dr ATVARS, Aigars (UL Institute of Astronomy)

Presenter: MILGRAVE, Lase (UL Institute of Atomic Physics and Spectroscopy)

Status: ACCEPTED

Submitted by **MILGRAVE, Lase** on **Tuesday, January 31, 2023**

Abstract ID : 13

Polycaprolactone-MXene nanocomposites for cardiac tissue engineering

Content

Keywords: MXene, PCL, electrospun membrane, plasma oxygen treatment, biocompatibility
Cardiovascular diseases have remained the leading cause of death for the last 20 years, that include myocardial infarction, ischemic heart disease, etc., which lead to heart failure [1]. Various therapeutic strategies have been developed, but all have limited effects in treating patients in need of heart transplantation, which is limited by the scarcity of donor hearts [2]. Therefore, cardiac tissue engineering is a promising field in regenerative medicine [3].

The electrospinning method is widely explored in biomedicine for applications, including tissue engineering and regenerative medicine [4]. Due to its biodegradability and biocompatibility, polycaprolactone (PCL) has attracted considerable interest for cardiac tissue regeneration [5]. Some previous studies demonstrated the potential of MXenes (a new large family of two-dimensional nanomaterials) for the development of conductive fibers for heart tissue grafts but it still requires novel deposition technology to achieve optimal structural and functional properties of the scaffold. [6]

In our study, we determined the effect of oxygen plasma treatment as a pre-deposition technique for MXenes immobilization on the structure and cytotoxicity of electrospun membranes. Electrospun PCL mats were treated with oxygen plasma to ameliorate the hydrophilic properties. Then scaffolds were dipped in Mxene solution one to three times to obtain PCL membranes with different thicknesses of MXene layers. A group of samples after deposition with MXenes was additionally treated with oxygen plasma to improve the hydrophilicity of the PCL-MXene nanocomposites. The morphology of the treated mats was evaluated with a scanning electron microscope (SEM) and energy dispersive spectroscopy (EDS). The cytotoxicity of the membranes was determined using human dermal fibroblasts (D6P8).

SEM demonstrated increasing of nanofibers diameter after oxygen plasma treatment and decreasing of porosity after MXene deposition. The EDS analysis revealed an increase in the content of elements of MXene (Ti, F and C) in the treated samples depending on the number of procedure repetitions. The cells cultured on the samples demonstrated high biocompatibility and the ability to support cell proliferation during the 6 days of the experiment. Fluorescence microscopy provided visual evidence of cell adherence and proliferation with an aligned orientation towards nanofiber directions.

Based on our preliminary investigation, the oxygen plasma treatment allows a by-layer assembly of MXenes on electrospun nanofibrous membranes and maintaining cell viability and metabolic activity in the treated samples.

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References:

- [1] "Mortality and global health estimates.," <https://www.who.int/news/item/09-12-2020-who-reveals-leading-causes-of-death-and-disability-worldwide-2000-2019>.
- [2] M. Isomi, T. Sadahiro, and M. Ieda, "Progress and Challenge of Cardiac Regeneration to Treat Heart Failure," *J. Cardiol.*, vol. 73, no. 2, pp. 97–101, 2019, doi: 10.1016/j.jjcc.2018.10.002.
- [3] K. Tadevosyan, O. Iglesias-García, M. M. Mazo, F. Prósper, and A. Raya, "Engineering and assessing cardiac tissue complexity," *Int. J. Mol. Sci.*, vol. 22, no. 3, pp. 1–29, 2021, doi: 10.3390/ijms22031479.

- [4] K. Dziemidowicz et al., "Electrospinning for healthcare: recent advancements," *J. Mater. Chem. B*, vol. 9, no. 4, pp. 939–951, 2021, doi: 10.1039/d0tb02124e.
- [5] I. Tiyek, A. Gunduz, F. Yalcinkaya, and J. Chaloupek, "Influence of Electrospinning Parameters on the Hydrophilicity of Electrospun Polycaprolactone Nanofibres," *J. Nanosci. Nanotechnol.*, vol. 19, no. 11, pp. 7251–7260, 2019, doi: 10.1166/jnn.2019.16605.
- [6] T. N. Kołtunowicz et al., "Investigation of ac electrical properties of mxene-pcl nanocomposites for application in small and medium power generation," *Energies*, vol. 14, no. 21, 2021, doi: 10.3390/en14217123.

Primary author: Mrs DIEDKOVA, Kateryna (University of Latvia, Sumy State University)

Co-authors: Mrs HUSAK, Yevheniia (Silesian University of Technology, Faculty of Chemistry); Mrs BEBRE, Evelina (University of Latvia); Mrs ZAHORODNA, Veronika (Materials Research Centre); Mr GOGOTSI, Oleksiy (Materials Research Centre); Mr KYRYLENKO, Sergiy (Sumy State University); Prof. RIEKSTINA, Una (University of Latvia); Prof. POGORIELOV, Maksym (University of Latvia, Sumy State University)

Presenter: Mrs DIEDKOVA, Kateryna (University of Latvia, Sumy State University)

Status: ACCEPTED

Submitted by **DIEDKOVA, Kateryna** on **Tuesday, January 31, 2023**

Abstract ID : 14

Intranazālās endoskopijas videoattēlu krāsu analīze objektīvākai diagnostikai

Content

Pētījuma mērķis ir izstrādāt jaunu deguna gļotādas slimību neinvazīvas diagnostikas metodiku, balstītu uz endoskopisko attēlu augstas izšķirtspējas krāsu analīzi, un to aprobēt klīniskajos mērījumos. Patoloģisku procesu dēļ deguna gļotāda maina savu struktūru un sastāvu, parādās dažādu citu šūnu klātbūtne, mainās ķīmiskais sastāvs, paplašinās vai sašaurinās asinsvadi; visi šie procesi izmaina gļotādas krāsu. Piemēram, cianotiska jeb zilgana gļotāda visbiežāk ir pacientiem ar alerģisku rinītu, savukārt spilgti sarkana gļotāda vairāk ir sastopama pacientiem ar akūto virālo rinītu vai ar vazomotoro rinītu. Apskatot deguna dobuma gļotādu caur endoskopu, spriest par iespējamo diagnozi pēc patoloģijas apgabala krāsas pagaidām iespējams tikai subjektīvi – to ietekmē gan konkrētā monitora krāsu izšķirtspēja, gan katra ārsta individuālās krāsu uztveres īpatnības un iepriekšējā pieredze.

Šajā darbā ar krāsu (RGB) videokameru uzņemto endoskopisko attēlu analīzei no kopējā datu masīva tiek izdalīti trīs krāsu joslu (R, G un B) attēli un pēc bojāto audu apgabalu segmentācijas noteikti attiecīgās patoloģijas krāsu raksturojoši parametri, piemēram, R un G krāsu joslu signālu attiecība. Lai noteiktu šādu parametru korelāciju ar kvalificētu LOR ārstu diagnozēm, klīniskos mērījumos uzkrāti 20 veselu cilvēku deguna gļotādas videoattēli un 20 diagnosticētu pacientu dati. Vizuāli vesela deguna dobuma gļotāda ir gaiši rozā toni bez izteiktiem plankumiem, savukārt gļotāda akūta respiratora vīrusa infekciju gadījumos - ar tumši sarkaniem plankumiem. Hroniska/akūta rinosinusīda gadījumos gļotāda ir izteikti sarkanāka, ar tumši violetu nokrāsu. Tiks prezentēti izstrādātie endoskopisko videofailu apstrādes algoritmi un ar tiem iegūtie pirmie rezultāti par minēto patoloģiju raksturīgajiem krāsu parametriem.

Primary authors: Dr RUBĪNS, Uldis (LU ASI vadošais pētnieks); Ms KRIEVIŅA, Agate Kristena (LU MF studente); Ms VĪGANTE, Elīna Eliasa (LU MF pasniedzēja); Dr PEKSIS, Kaspars (Klīnikas "Headline" vadītājs); Prof. SPĪGULIS, Jānis (LU ASI vadošais pētnieks)

Presenter: Dr RUBĪNS, Uldis (LU ASI vadošais pētnieks)

Status: ACCEPTED

Submitted by **SPĪGULIS, Janis** on **Tuesday, January 31, 2023**

Abstract ID : 15

New Experimental Setup of Laser-Induced Breakdown Spectroscopy for Research and Teaching at University of Latvia

Content

New Experimental Setup of Laser-Induced Breakdown Spectroscopy for Research and Teaching at University of Latvia

Vyacheslav Kim, Aigars Atvars, Artūrs Zenons Bunkas, Kalvis Kalniņš
Institute of Astronomy, University of Latvia
and Uldis Bērziņš
Institute of Atomic Physics and Spectroscopy

The new ERA Chair project “Development of Quantum Optics and Photonics in University of Latvia” was started few years ago [1]. Within this project the new equipment was purchased, and new experimental setup was built for Laser-Induced Breakdown Spectroscopy (LIBS) studies. In this setup the intense laser beam is focused on surface of solid target or inside the gas or liquid. Plasma plume is created in around the interaction region and spectra of plasma is observed. The interaction of intense laser light with matter is an active topic of research in different areas of science and technologies, such as: plasma physics, material science, chemical physics, and particularly analytical chemistry [2].

New set up consists of following modules:

- 1) EKSPLA PL2230, Picosecond laser system produces short pulses with duration 28 ps. Max output pulse energies for fundamental @1064nm = 30 mJ, second harmonics @532 = 15 mJ, and third harmonics @355 nm = 7 mJ. Repetition rate is up to 50 Hz. [3]
- 2) Various compact Ocean Optics Spectrometers for measurements in range 200nm to 1600 nm [4]
- 3) Setup for Nonlinear Refraction/Absorption measurements in colloids and films.

Following studies are conducted currently in the laboratory:

- 1) LIBS - study of plasma spectra from laser plumes.
- 2) Laser assisted direct writing, micro-cutting, scribing, structuring.
- 3) Producing nanoparticle containing colloidal solutions via laser ablation.

On this setup the new lab work for master students of faculty of Physics, Mathematics and Optometry in Master of Physics course- Fizi5134 Research laboratory works. The aim of this lab work is: To improve the knowledge on the lasers, a spectrometers and plasma properties. Improve the practical skills in work with pulsed laser, and spectrometer and the ablated plasma.

Acknowledgments

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References:

1. <https://www.lu.lv/en/astr/projects/the-development-of-quantum-optics-and-photonics/>
2. L.J. Radziemski, D.A. Cremers, Laser-Induced Plasma and Applications, Marcel Dekker, New York, 1989.
3. <https://ekspla.com/products/picosecond-lasers/>
4. <https://www.oceaninsight.com/products/spectrometers/>

Primary authors: Dr ATVARS, Aigars (Institute of Astronomy); BĒRZIŅŠ, Uldis (Institute Of Atomic Physics And Spectroscopy, University of Latvia); BUNKAS, Arturs Zenons (Institute of As-

tronomy); Mr KALNIŅŠ, Kalvis (Institute of Astronomy); Mr KIM, Vyacheslav (Institute of Astronomy)

Presenter: Mr KIM, Vyacheslav (Institute of Astronomy)

Status: ACCEPTED

Submitted by BĒRZIŅŠ, Uldis on **Tuesday, January 31, 2023**

Abstract ID : 16

Development of Ion Sources on Ion beam Apparatus GRIBA

Content

Development of Ion Sources on Ion beam Apparatus GRIBA

Uldis Bērziņš, Aleksandrs Švarcs,

Institute of Atomic Physics and Spectroscopy. University of Latvia

The development of ion sources is motivated by needs in both: fundamental research and technologies. We are using our ion sources on ion beam apparatus GRIBA. The construction of GRIBA (Gothenburg Riga Ion Beam Apparatus) is a collaboration between University of Latvia and University of Gothenburg. It was started in frame work of FP7 FOTONIKA-LV in the beginning of year 2012. Our main idea was to build an apparatus from few easy transportable modules: 1) ion source with mass selector, 2) experimental chamber with electron spectrometer, and 3) Laser system. The apparatus was developed in Gothenburg but now it is placed in Riga in the Laboratory of Atomic Physics, Atmospheric Physics and Photochemistry.

Now we are work on ion sources for two projects. One is the B⁺ ion source for project: “Technologic research for elaborating the next generation boron ion implantation apparatus with TRL level near to 4” in collaboration with Baltic Scientific Instruments. The second is the source of negative ions in collaboration with CERN. In both the positive ions will be extracted from plasma discharge and then ion beam formatted and measured, For production of negative ions the cell with Cs vapor will be placed in beam line and the negative ions will be produced in this cell by electron attachment to positive ions and then to neutrals via charge exchange process.

In our presentation the details of experimental set up and some solutions for ion sources will be reported.

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Primary authors: BĒRZIŅŠ, Uldis (Institute Of Atomic Physics And Spectroscopy, University of Latvia); Mr ŠVARCS, Aleksandrs (institute of Atomic Physics and Spectroscopy)

Presenter: BĒRZIŅŠ, Uldis (Institute Of Atomic Physics And Spectroscopy, University of Latvia)

Status: ACCEPTED

Submitted by BĒRZIŅŠ, Uldis on **Tuesday, January 31, 2023**

Abstract ID : 17

Antibacterial effectiveness of PCL-MXene electrospun membrane after plasma treatment

Content

Introduction.

Some material properties are essential to find appliance in biomedical field. The implants must closely resemble the biological environment's porosity, permeability, and mechanical stability to assure complete host tissue acceptance. Heart muscle is the second largest electrically active structure in the human body, after nervous tissue [1]. Recent research has already shown that MXene may be used to create flexible interfaces with potential clinical applications for multiscale epidermal sensing and neuromodulation [2]. Withal, there are polycaprolactone (PCL) electrospun fibers that have good biocompatibility, safety and biodegradation abilities but lack in hydrophilicity. By incorporating MXenes into PCL fibers we could acquire material with sufficient mechanical support, biocompatibility as well as high conductivity level.

The aim of current research was to test the bacterial growth rate in case of infection of PCL and MXene-incorporated PCL membranes as well as test whether any chemical residuals are present in the materials after plasma treatment.

Materials and methods

To test the development of bacterial inoculation Gram-positive (*Staphylococcus aureus*) and Gram-negative (*Escherichia coli*) bacteria were used.

PCL fibers made by electrospun were cut into 0,5 cm in diameter membranes. PCL membranes that had not been treated were used as the control, whereas membranes filled with MXenes in three different ways (PCL-MX1, PCL-MX2, PCL-MX3) and membranes treated with plasma (PCL-PL, PCL-MX1-PL, PCL-MX2-PL, and PCL-MX3-PL) were designated as the test membranes. In order to estimate the total bacterial metabolic activity resazurin reduction assay was used [3].

Results and discussion

In the case of *St. aureus* samples PCL-MX2 after 24 hours show the highest peak of resazurin reduction although this difference compared to others is not sufficient. Samples PCL-MX1-PL, PCL-MX2-PL, and PCL-MX3-PL after 4,6, and 8 hours have the lowest peaks. On the other hand samples after 24 hours has no significant difference compared to others. Data on samples inoculated with *E. coli* shows that values from each time as well as sample type groups were roughly even. On the other hand no difference between PCL and plasma treated samples proves the fact all residuals of acids and alkali used in sample's preparation were eliminated.

Conclusion. To summarize, neither MXene addition nor oxygen plasma treatment influence antibacterial qualities of PCL membranes. On the other hand, results also show that method of filling PCL fibers with MXenes is still incomplete and requires modifications which could further change the antibacterial properties.

Acknowledgments.

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References:

1. Alegret N, Dominguez-Alfaro A, Mecerreyes D. 3D Scaffolds Based on Conductive Polymers for Biomedical Applications. *Biomacromolecules*. 2019;20(1):73-89.
2. Driscoll N, Erickson B, Murphy BB, et al. MXene-infused bioelectronic interfaces for multiscale electrophysiology and stimulation. *Sci Transl Med*. 2021;13(612).
3. Korniienko, V., Husak, Y., Radwan-Pragłowska, J., Holubnych, V., Samokhin, Y., Yanovska, A., Varava, J., Diedkova, K., Janus, L., & Pogorielov, M. (2022). Impact of Electrospinning Parameters and Post-Treatment Method on Antibacterial and Antibiofilm Activity of Chitosan Nanofibers.

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Primary authors: YANKO, Ilya (Sumy State University, 2 Rymkogo-Korsakova St, 40007 Sumy, Ukraine); Mr ROSHCHUPKIN, Anton (Sumy State University, 2 Rymkogo-Korsakova St, 40007 Sumy, Ukraine); DIEDKOVA, Kateryna (Sumy State University, University of Latvia)

Co-authors: POGORIELOV, Maksym (University of Latvia, Sumy State University); KORNIENKO, Viktoriia (University of Latvia, Sumy State University); KYRYLENKO, Sergiy (Sumy State University); GOGOTSI, Oleksiy (Materials Research Centre); ZAHORODNA, Veronika (Materials Research Centre)

Presenter: YANKO, Ilya (Sumy State University, 2 Rymkogo-Korsakova St, 40007 Sumy, Ukraine)

Status: ACCEPTED

Submitted by **YANKO, Ilya** on **Tuesday, January 31, 2023**

Abstract ID : 18

Asinssporaiņu parazitū izplatība, daudzveidība un hematoloģiskā ietekme Latvijas mājas strazdu (*Sturnus vulgaris*) populācijā

Content

Vēsturiski putni ir bijuši svarīgs cilvēku malārijas modeļorganisms, tomēr pēdējos gados šo parazitū un putnu savstarpējo attiecību izpēte kalpo kā unikāls modelis, lai izprastu šīs slimības ekoloģiju un evolūciju (Levin and Parker 2012). Mājas strazdi *Sturnus vulgaris* (Linnaeus 1778) ir bieži sastopami Latvijā ligzdojoši putni, tie ir iso distanču migranti, lai arī ir ziņas par Latvijā ziemojošiem putniem; tie labprāt ligzdo putnu būrīšos, atvieglot to monitorēšanu un ķeršanu izpētes ietvaros, un pieaugušu putnu izdzīvošanas un atgriešanās rādītāji ir pietiekami augsti, lai padarītu tos par ideālu modeļsugu pētījumiem par dažādu vides faktoru, tai skaitā asinssporaiņu parazitū, ietekmi uz putniem (LOB 1998).

Pētījumā tika mikroskopiski apskatīti un savstarpēji salīdzināti asins uztriepju paraugi, kas iegūti 2020. un 2021. gadā no Latvijā ligzdojošiem mājas strazdiem. Asins paraugi tika ņemti pieaugušiem mājas strazdiem ar zināmu piederību ligzdei parauglaukumos Gulbenes novadā Zeltalejā un pie Engures ezera – Ķūļciemā un Bērzciemā. Visi ievāktie asins paraugi tika nosūtīti uz Ecogenics laboratoriju Šveicē uz PĶR analizēm. 2020. gadā bija 16 PĶR pozitīvi, savukārt 2021. gadā – 6 PĶR pozitīvi paraugi, kas tika iekļauti pētījumā. Salīdzināšanai pētījumā arī tika iekļauti attiecīgi 16 un 6 nejausi izvēlēti negatīvie paraugi ar līdzīgu vecumu un dzimumu kā pozitīvo paraugu putniem.

Starp abu gadu inficētajiem paraugiem tika salīdzināts parazitērijas līmenis *Plasmodium*, *Haemoproteus* un *Leucocytozoon* ģinšu asinssporaiņiem, kā arī salīdzināts leikocītu un jauno eritrocītu īpatsvars starp inficētajiem un neinficētajiem paraugiem. Tika novērots paaugstināts leikocītu īpatsvars inficēto putnu asinīs. Netika novērota saistība starp asinssporaiņu ģinti un parazitēriju, kā arī starp jauno eritrocītu īpatsvaru un parauga infekcijas statusu. 2020. gadā novērota lielāka asinssporaiņu izplatība nekā 2021. gadā, tomēr netika novērota būtiskas parazitērijas līmeņa atšķirības starp abiem gadiem.

Atslēgas vārdi: putnu malārija, asinssporaiņi, leikocitēmija, polihromatofili, *Sturnus vulgaris*

Atsauces:

Levin I.I. and Parker P.G. 2012. Haemosporidian parasites: Impacts on Avian Hosts. In: Fowler M. and Miller R.E. (eds) *Fowler's Zoo and Wild Animal Medicine: Current Therapy*. First Edition: 356–363. Saunders.

LOB 1998. *Latvijas lauku putni*. Jāņa sēta, Rīga. 208 lpp.

Primary author: RIMSA, Antonija

Presenter: RIMSA, Antonija

Status: ACCEPTED

Submitted by **RIMSA, Antonija** on **Tuesday, January 31, 2023**

Abstract ID : 19

The effect of silicate and phosphate additives on anodization of magnesium

Content

Magnesium, a degradable biomaterial, has been widely used in many biomedical engineering products. However, due to its highly reactive and relatively poor corrosion resistance, it has limitations in its applications. Therefore, plasma electrolytic oxidation methods have been placed in the first position to prevent magnesium based materials from corrosion. In recent years, authors focused on comparing the silicates and phosphates solutions for creating protective coatings. While our investigation aims to find the chemical composition of electrolytes containing both types of components (silicates and phosphates) and solve not only protective function but has and biocompatible properties.

We used the following electrolyte composition for experimental group samples: Sol1 - 10 g/L Na_2SiO_3 , 10g/L Na_2HPO_4 , 5g/L $NaOH$; Sol2 - 10g/L Na_2SiO_3 , 5g/L Na_2HPO_4 , 5g/L $NaOH$. Pure magnesium samples with cubic shapes were anodized at the constant current density of 100 mA/cm² under different voltages. The effect of voltage and phosphate concentration in the electrolyte on the final properties of the coatings was observed by scanning electron microscopy (SEM).

All obtained coatings had typical porose structure. However, the high value of voltage played a critical influence in forming the perfect texture of the PEO layer. For the first type of solution, this amounted to 225 V for the second – 200 V. The coatings Sol1 revealed a smaller number but larger-size pores on its surface, while Sol2 revealed a higher number of smaller-size pores. These differences in surface morphology could be related to the differences in dibasic sodium phosphate concentrations.

Our results indicated that the electrolyte composition influences the PEO process on pure magnesium. The increasing concentration of dibasic sodium phosphates additives changed the surface morphology and the value of the applied voltage. Our next step will include checking the chemical composition, corrosive and potential biocompatible properties of the obtained coatings.

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Primary author: HUSAK, Yevheniia (Sumy State University, Medical Institute, Sumy, 40018, Ukraine)

Co-authors: SKOCZYLAS, Anna (Silesian University of Technology, Faculty of Chemistry, Gliwice, 44-100, Poland); POGORIELOV, Maksym (University of Latvia, Institute of Atomic Physics and Spectroscopy, 3 Jelgavas St, Riga LV- 1004, Latvia.); WOJCIECH , Simka (Silesian University of Technology, Faculty of Chemistry, Gliwice, 44-100, Poland)

Presenter: HUSAK, Yevheniia (Sumy State University, Medical Institute, Sumy, 40018, Ukraine)

Status: ACCEPTED

Submitted by **HUSAK, Yevheniia** on **Tuesday, January 31, 2023**

Abstract ID : 22

Effect of intravenous lidocaine infusion in remote photoplethysmography

Content

Background

Regional anesthesia is the golden standard for perioperative analgesia and anesthesia, but it has its limits and complications. Intravenous lidocaine infusion for perioperative analgesia is a known alternative and the analgetic effect wears off slowly and exceeds its half-life, but isn't widely used because of cardiovascular side effects, which are reduced when the appropriate dosage is used. In current clinical practice, only indirect markers can estimate a patient's pain level during the maintenance of general anesthesia.

Aim

The aim of the study is to objectively evaluate the intravenous lidocaine effect with remote photoplethysmography (rPPG) and analgesia nociception index (ANI) in high-risk anesthesia patient.

Methods

The pilot study reviewed one patient with oncological illness and pathological fracture of the humerus while inserting a humerus prosthesis. Before general anesthesia induction, the patient received an intravenous lidocaine infusion of 1,5mg/kg over a 10-minute period. During this period we monitored heart rate, blood pressure, oxygen saturation and took measurements with rPPG and ANI. Remote photoplethysmography (rPPG) is a simple and cost-effective technique for contactless skin perfusion monitoring, using visible or near-infrared light and a video camera. The perfusion index was measured from different sites (1-5) on the dorsal side of the palm before induction of general anesthesia was started. During surgery, another lidocaine infusion was at the rate of 2mg/kg/h till the end of the surgery, while measurements were taken.

Results

A paired samples t-test was conducted to determine the effect of lidocaine infusion. The mean perfusion index during baseline was 0.18 (SD=0.03), and the mean perfusion index after manipulation [infusion] was 0.374 (SD=0.07) [t(4) = -4.289, p = 0.013].

Conclusions

There were statistically significant perfusion index changes during lidocaine infusion. To validate photoplethysmography findings in this pilot study more extensive research should be done.

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Primary authors: APŠENIECE, Krista (1 Department of Anesthesiology, Hospital of Traumatology and Orthopedics, Riga, Latvia, 2 Residency Development Department, University of Latvia, Riga, Latvia); Prof. MIŠČUKS, Aleksejs (1 Department of Anesthesiology, Hospital of Traumatology and Orthopedics, Riga, Latvia 2Laboratory of Biophotonics, Institute of Atomic Physics and Spectroscopy, University of Latvia, Riga, Latvia); RUBĪNS, Uldis (LU ASI vadošais pētnieks)

Co-authors: Dr GOLUBOVSKA, Iveta (Department of Anesthesiology, Hospital of Traumatology and Orthopedics, Riga, Latvia); REPŠA, Lauris (Dr.)

Presenter: APŠENIECE, Krista (1 Department of Anesthesiology, Hospital of Traumatology and Orthopedics, Riga, Latvia, 2 Residency Development Department, University of Latvia, Riga, Latvia)

Status: ACCEPTED

Submitted by **APSENIECE, Krista** on **Wednesday, February 1, 2023**

Abstract ID : 23

New Experimental Setup of Laser-Induced Breakdown Spectroscopy for Research and Teaching at University of Latvia

Content

The new ERA Chair project “Development of Quantum Optics and Photonics in University of Latvia” was started few years ago [1]. Within this project the new equipment was purchased, and new experimental setup was built for Laser-Induced Breakdown Spectroscopy (LIBS) studies.

In this setup the intense laser beam is focused on surface of solid target or inside the gas or liquid. Plasma plume is created in around the interaction region and spectra of plasma is observed. The interaction of intense laser light with matter is an active topic of research in different areas of science and technologies, such as: plasma physics, material science, chemical physics, and particularly analytical chemistry [2].

New set up consists of following modules:

1)EKSPLA PL2230, Picosecond laser system produces short pulses with duration 28 ps. Max output pulse energies for fundamental @1064nm = 30 mJ, second harmonics @532 = 15 mJ, and third harmonics@355 nm = 7 mJ. Repetition rate is up to 50 Hz.[3]

2)Various compact Ocean Optics Spectrometers for measurements in range 200nm to 1600 nm [4]

3)Setup for Nonlinear Refraction/Absorption measurements in colloids and films.

Following studies are conducted currently in the laboratory:

1.LIBS - study of plasma spectra from laser plumes.

2)Laser assisted direct writing, micro-cutting, scribing, structuring.

3)Producing nanoparticle containing colloidal solutions via laser ablation.

On this setup the new lab work for master students of faculty of Physics, Mathematics and Optometry in Master of Physics course- Fizi5134 Research laboratory works. The aim of this lab work is: To improve the knowledge on the lasers, a spectrometers and plasma properties. Improve the practical skills in work with pulsed laser, and spectrometer and the ablated plasma.

Acknowledgments

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References:

1. <https://www.lu.lv/en/astr/projects/the-development-of-quantum-optics-and-photonics/>
2. L.J. Radziemski, D.A. Cremers, Laser-Induced Plasma and Applications, Marcel Dekker, New York, 1989.
3. <https://ekspla.com/products/picosecond-lasers/>
4. <https://www.oceaninsight.com/products/spectrometers/>

Primary authors: ATVARS, Aigars (Institute of Astronomy, University of Latvia); KIM, Vyacheslav (University of Latvia, Institute of Astronomy, Laboratory of Nonlinear Optics); BĒRZIŅŠ, Uldis (Institute of Atomic Physics and Spectroscopy); KALNIŅŠ, Kalvis (Institute of Astronomy, University of Latvia); ZENONS, Artūrs (Institute of Astronomy, University of Latvia)

Presenter: KIM, Vyacheslav (University of Latvia, Institute of Astronomy, Laboratory of Nonlinear Optics)

Status: ACCEPTED

Submitted by **KIM, Vyacheslav** on **Thursday, February 2, 2023**

Abstract ID : 24

Multispectral imaging of rare skin diseases

Content

A multispectral imaging device that uses four sets of narrow-band LEDs - 526nm, 663nm and 964nm for diffuse reflectance imaging and 405nm LEDs filtered through a 515nm long-pass filter for autofluorescence imaging - has been previously tested on pigmented lesions with high accuracy.

This research is funded by the European Regional Development Fund project “Rare skin diseases efficient identification and multi-modal diagnostic system” (agreement No.1.1.1.1/20/A/072) and “Strengthening of the capacity of doctoral studies at the University of Latvia within the framework of the new doctoral model”, identification No. 8.2.2.0/20/I/006.

Primary author: PLORINA, Emilija Vija (University of Latvia)

Presenter: PLORINA, Emilija Vija (University of Latvia)

Status: REJECTED

Submitted by **PLORINA, Emilija Vija** on **Sunday, February 5, 2023**

Abstract ID : 25

Trijkāja tipa kvantu sistēmu koherenta kontrole

Content

Ierosmes shēmas, kurās viens ierosinātais līmenis optiski saistīts ar trim citiem enerģijas līmeņiem, mēdz saukt par trijkāja sistēmām, jo rotējoša viļņa tuvinājumā tās atgādina trijkāji. Izmantojot intuitīvu ģeometrisku modeli adiabatisku procesu aprakstam šādās sistēmās, esam radījuši jaunu analītisku metodi optimālu STIRAP (*Stimulated Raman Adiabatic Passage*) lāzeru impulsu sēriju iegūšanai. Metode ļauj īstenot gan pilnīgu, gan daļēju līmeņu apdzīvotības koherentu pārslēgšanu starp kvantu stāvokļiem ar augstu efektivitāti, tādēļ nozīmīgs tās pielietojumu virziens saistāms ar kvantu informācijas apstrādi.

Primary author: CININS, Arturs

Co-author: MICULIS, Kaspars (University of Latvia, Institute of Atomic Physics and Spectroscopy, LV-1586 Riga, Latvia)

Presenter: CININS, Arturs

Status: ACCEPTED

Submitted by **CININS, Arturs** on **Monday, February 6, 2023**

Abstract ID : 26

Multispectral imaging of rare skin diseases

Content

Fabry disease and Neurofibromatosis type I are rare multi-systemic diseases with characteristic skin manifestations [1, 2]. Both these diseases are associated with worsening symptoms as the patient ages, as well as an increase in the rate of potentially life-threatening complications. Therefore, early diagnosis is necessary in order to start preventative treatments before more serious effects occur.

Multispectral imaging measurements were conducted on patients affected by these diseases. They were invited by PCSUH Cabinet of Rare Diseases. Image acquisition was done using an imaging prototype utilizing 526 nm, 663 nm and 964 nm multispectral LEDs for diffuse reflectance imaging and 405 nm LEDs for autofluorescence excitation, as well as a Nuance camera with spectral range 450 – 950 nm.

Image analysis was done using MATLAB and Python programming languages. The images were analysed with the goal to create a method for the assessment of rare skin disease multispectral images.

This research is funded by projects “Rare skin diseases efficient identification and multi-modal diagnostic system” (agreement No.1.1.1.1/20/A/072) and “Strengthening of the capacity of doctoral studies at the University of Latvia within the framework of the new doctoral model”, identification No. 8.2.2.0/20/I/006.

[1] Luna, P. C., Boggio, P. and Larralde, M. ‘Dermatologic Aspects of Fabry Disease’, Journal of Inborn Errors of Metabolism and Screening. <https://doi.org/10.1177/2326409816661353> (2016).

[2] Boyd, K. P., Korf, B. R., & Theos, A., 2009, J Am Acad Dermatol, 61(1), 1–16. <https://doi.org/10.1016/j.jaad.2008.12.051>.

Primary authors: PLORINA, Emilija Vija (University of Latvia); Dr KISS, Norbert (Department of Dermatology, Venerology and Dermat oncology, Semmelweis University); Dr RUDZITIS, Ainars (Pauls Stradiņš Clinical University Hospital, Cabinet of Rare Diseases); Dr LIHACHEV, Alexey (University of Latvia); Dr SYUNDYUKOV, Emil (LTD Longogenesis); Dr BLIZNUKS, Dmitrijs (Riga Technical university); Dr LIHACOVA, Ilze (University of Latvia)

Presenter: PLORINA, Emilija Vija (University of Latvia)

Status: ACCEPTED

Submitted by **PLORINA, Emilija Vija** on **Wednesday, February 8, 2023**

Abstract ID : 27

EFFECT OF SILVER NANOPARTICLES ON ANTIBACTERIAL PROPERTIES OF Ti13Nb13Zr ALLOY AFTER PLASMA ELECTROLYTIC OXIDATION

Content

Introduction. Titanium (Ti) alloys are widely used in implantology. Implants made of Ti alloys have high biocompatibility, corrosion resistance, and strength [1]. Despite the high osteointegrative capacity of polished Ti implants, surface modifications are required to provide better cell adhesion, proliferation, and maturation. Nowadays, different technologies, including plasma electrolytic oxidation (PEO), are utilized to provide an optimal property for bone implant surfaces. PEO is a new technology for the formation of metal oxide coatings of a certain thickness, on metals, to increase corrosion resistance [2].

The goal is a new strategy for manufacturing implants based on Ti alloys with improved antibacterial properties with use of the PEO process and silver nanoparticles (AgNPs).

The aim is to study the time-dependent antibacterial effect of different concentrations of AgNPs incorporated into treated PEO surfaces.

Materials and methods. The PEO process of Ti13Nb13Zr alloy was performed in H₃PO₄ solution (voltage – 250 V, current density – 100 mA/cm²). After PEO the samples were covered by a suspension of AgNPs with different concentration (0,125; 0,25; 0,50 g/dm³). Determining the colony count was carried out using the streak plate technique at different time intervals of incubation (2, 4, 6, and 8 h) in the suspension of *S. aureus* and *E. coli* (final density of 1x10⁵ colony forming units (CFUs)/mL) after ultrasonication of the samples.

Results and discussion. The Ti13Nb13Zr alloy samples with varying concentrations of AgNPs, which were incubated with *E. coli*, showed decreasing in the number of bacteria within 2-4 hours of incubation to 2.9-4 Log₁₀ CFU, however after 4-8 hours intensive attachment of bacteria up to 8 Log₁₀ CFU was observed. *S. aureus* did not show time-dependent sensitivity within the experiment.

Conclusion. The surface properties of differently treated samples influence the antibacterial properties of the alloy. Ti13Nb13Zr alloy with varying concentrations of AgNPs demonstrated a bacteriostatic effect on *E. coli*.

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References:

[1] M. Babaei, C. Dehghanian, M. Vanaki, "Effect of additive on electrochemical corrosion properties of plasma electrolytic oxidation coatings formed on CP Ti under different processing frequency", *Appl. Surf. Sci.*, 357, 712–720, 2015, doi: 10.1016/j.apsusc.2015.09.059.

[2] M. Kaseem, S. Fatimah, N. Nashrah, Y. G. Ko, "Recent progress in surface modification of metals coated by plasma electrolytic oxidation: Principle, structure, and performance", *Prog. Mater. Sci.*, 117, 100735, 2021, doi: 10.1016/J.PMATSCI.2020.100735.

Primary authors: PŁOSKA, A. (Faculty of Chemistry, Silesian University of Technology); VARAVA, Yuliia (Biomedical Research Center, Sumy State University, R.-Korsakova, 2, 40007, Sumy, Ukraine); KORNIENKO, V. (Biomedical Research Center, Sumy State University, R.-Korsakova); SIMKA, W. (Faculty of Chemistry, Silesian University of Technology); WALOSZCZYK, N. (Faculty of Chemistry, Silesian

University of Technology)

Presenter: VARAVA, Yuliia (Biomedical Research Center, Sumy State University, R.-Korsakova, 2, 40007, Sumy, Ukraine)

Status: ACCEPTED

Submitted by **VARAVA, Yuliia** on **Thursday, February 9, 2023**

Abstract ID : 28

Ultrasonic cavitation reveals *Candida albicans* pathogen growth on polycaprolactone microfibers containing selenium nanoparticles

Content

Selenium nanoparticle-coated surfaces have been reported to inhibit the microbial adhesion and pathogen biofilm formation [1, 2]. This makes use of selenium nanoparticles (SeNPs) as an attractive ingredient to improve the antimicrobial properties of medical devices and body implant surfaces. The interruption of the pathogen cell membrane integrity, increased production of ROS [3] and the increased protein absorption [4] had been suggested as the mechanisms for SeNPs toxicity.

SeNPs and the surfaces containing selenium have been also reported to produce antifungal effect against variety of species, including *Candida albicans* fungi [5, 6]. Nevertheless, the contradictory results were discovered, as the post-inhibitory effect on fungus growth was not detected when *Aspergillus niger* or *Candida albicans* were pre-exposed to 2× or 4× above the minimum inhibitory concentrations of SeNPs [7]. The pathogen's attachment to a biomaterial is also facilitated (or inhibited) by the unique characteristics of the surface. Currently, polycaprolactone (PCL)-based porous surfaces are used to create the microbial biofilm scaffolds. These surfaces have undergone significant research to validate their microbial loading capacity [8].

Our study was motivated by the need to comprehend the protective effect of SeNPs in antibacterial and antibiofilm applications. The objective of the study was to fabricate PCL microfibers through the electrospinning technique, and to investigate the influence of SeNPs on *Candida albicans* cell adhesion and cell survival on PCL microfibers surface.

SeNPs were synthesized via the chemical reduction of sodium selenite by ascorbic acid in the presence of polysorbate-80 as a stabilizing agent. Dynamic light scattering was used to assess the size distribution and zeta potential of SeNPs. Throughout the preparation process, SeNPs were initially added to a PCL solution that had been dissolved in dimethylformamide (DMF), and then electro-spun onto an aluminium foil to deposit them on the surface of the PCL. Optimized annealing conditions were selected to eliminate the DMF solvent from PCL-SeNPs microfibers. We acquired scanning electron microscopy images of the thermally treated microfibers to check if the deposition was successful.

Candida albicans clinical isolate (11017) was obtained from a patient's ascitic fluid at the Republican Hospital of Panevėžys (Lithuania) and used to prepare in-vitro biofilm model, as described in [9]. For *Candida albicans* biofilm growth on PCL microfibers w/o SeNPs, the microfiber samples were cut into 1x0.5 cm strips, then deposited into the tissue culture plates containing mature biofilm, and incubated for 1, 2, 4, 12 and 24 hours respectively. After the incubation period, the strips were transferred to PBS, then sonicated to remove the attached cells, using 300 kPa peak negative pressure, 880 MHz, 100% DC ultrasound for 5 minutes. The colony formation assay was employed to assess the microorganism survival in sonicated (or in control strip samples washed with PBS only) after 48 h incubation on Sabouraud dextrose agar at 30 deg.C. To maintain the integrity of the biofilm prior to optical and ultrasonic detection, it was fixed with 95% ethanol.

The deposition of *Candida albicans* cells on three-dimensional PCL surface (w/o SeNPs) was visualized by using B-scan optical coherence tomography imaging (sd-OCT, Telesto II, Thorlabs, USA). High frequency acoustic microscope (Kibero, Germany) was additionally used to obtain the cross-sectional images of PCL samples in higher (< 5 μm) axial resolution, highlighting the microfiber scaffold structure, microfiber porosity, and fungus cell deposition pattern in square amplitude/ or time-of-flight imaging modes.

The results demonstrated that *Candida albicans* cells were able to attach efficiently to PCL microfibers. The pathogen incorporation to PCL microfibers was not inhibited by deposition of SeNPs on PCL surface. In conclusion, PCL-SeNPs microfibers are only recommended to be used as the microbial scaffold material.

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References

1. Tran PA, et al. Selenium nanoparticles as anti-infective implant coatings for trauma orthopedics against methicillin-resistant *Staphylococcus aureus* and *epidermidis*: in vitro and in vivo assessment. *Int J Nanomedicine*. 2019;14:4613-4624.
2. Liang X, Zhang S, Gadd GM, McGrath J, Rooney DW, Zhao Q. Fungal-derived selenium nanoparticles and their potential applications in electroless silver coatings for preventing pin-tract infections. *Regen Biomater*. 2022;9(1):rbac013.
3. Wang Q, et al. Inhibition of various gram-positive and gram-negative bacteria growth on selenium nanoparticle coated paper towels. *Int J Nanomedicine*. 2015;10:2885-2894.
4. Tan VLC, et al. Nanostructured biomedical selenium at the biological interface . *Biointerphases*. 2018; 13(6):06D301.
5. Yip J, et al. Investigation of Antifungal and Antibacterial Effects of Fabric Padded with Highly Stable Selenium Nanoparticles. *J Appl Polym Sci*. 2014; 131:40728.
6. Shakibaie M, et al. Antifungal Activity of Selenium Nanoparticles Synthesized by *Bacillus* species Msh-1 Against *Aspergillus fumigatus* and *Candida albicans*. *Jundishapur J Microbiol*. 2015;8:e26381.
7. Kazempour ZB, et al. Sub-inhibitory concentration of biogenic selenium nanoparticles lacks post antifungal effect for *Aspergillus niger* and *Candida albicans* and stimulates the growth of *Aspergillus niger*. *Iran J Microbiol*. 2013;5:81-5.
8. Tamayo-Ramos JA, et al. Analysis of Polycaprolactone Microfibers as Biofilm Carriers for Biotechnologically Relevant Bacteria. *ACS Appl Mater Interfaces*. 2018;10(38):32773-32781.
9. Tamošiūnas M, et al. Assessment of *Candida albicans* biofilm growth by laser speckle contrast imaging. *Proc. SPIE 11585, Biophotonics—Riga 2020*; 1158509.

Primary author: Dr TAMOSIUNAS, Mindaugas (dr.)

Co-authors: Mr MIKUS, Melders; VITER, Roman (Institute of Atomic Physics and Spectroscopy, University of Latvia)

Presenter: Dr TAMOSIUNAS, Mindaugas (dr.)

Comments:

Mindaugas Tamošiūnas affiliations 1.Institute of Atomic Physics and Spectroscopy, University of Latvia, Jelgavas 3, Rīga, LV-1004, Latvia 2. Faculty of Natural Sciences, Vytautas Magnus University, Vileikos 8, Kaunas LT-44404, Lithuania

Status: ACCEPTED

Submitted by TAMOSIUNAS, Mindaugas on Friday, February 10, 2023