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Programme

10.00–10.05	**Atklāšanas runa LU Atomfizikas un spektroskopijas institūta direktore I.Šīrante**	
Vadītājs/Chair: Inga Saknīte		
10.05–10.20	***Marta Laņģe*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Autofluorescence features can help dermatologists to evaluate skin cancer post-operative scars**
10.20–10.35	***Dr.Uldis Rubīns*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Intranazālās endoskopijas videoattēlu krāsu analīze objektīvākai diagnostikai**
10.35–10.50	***Krista Apšeniece*** *Department of Anesthesiology, Hospital of Traumatology and Orthopedics, Riga, Latvia, Residency Development Department, University of Latvia*	**Effect of intravenous lidocaine infusion in remote photoplethysmography**
10.50–11.05	***Emīlija Vija Ploriņa*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Multispectral imaging of rare skin diseases**
11.05-11.20	***Dr. Imants Bērsons*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Difrakcijas problēma fotona kvantu modelī**
11.20-11.35	***Dr.Nataļja Zorina*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Arsēna rezonanses spektrālo līniju pētījumi tālajā UV apgabalā**

11.35-11.50	***Antonija Rimša*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Asinssporaiņu parazītu izplatība, daudzveidība un hematoloģiskā ietekme Latvijas mājas strazdu (Sturnus vulgaris) populācijā**
11.50–13.00	**Kafijas pause/ Coffee break,**	
Vadītājs/Chair: Inga Brice		
13.00–13.15	***Dr.Teodora Kirova*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Numerical studies of the impact of electromagnetic field of radiation on valine**
13.15–13.30	***Artūrs Ciniņš*** *Institute of Atomic Physics and Spectroskopy, University of Latvia*	**Trijkāja tipa kvantu sistēmu koherenta kontrole**
13.30–13.45	***Kristians Draguns*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Dispersijas rēķinu metožu salīdzinājums**
13.45–14.00	***Lāse Mīlgrāve*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Integrētā fotonika: polimēra mikrogredzena rezonatori sensoru pielietojumiem**
14.00-14.15	***Vyacheslav Kim*** *Institute of Astronomy, University of Latvia*	**New Experimental Setup of Laser-Induced Breakdown Spectroscopy for Research and Teaching at University of Latvia**
14.15-14.30	***Dr. Uldis Bērziņš*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Collaboration with Large Scale Facilities**
14.30–14.45	**Noslēgums, diskusijas Conclusions, discussions**	

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 surround- ing 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.

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Status: ACCEPTED

Submitted by **LANGE, Marta 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 mērīju- mos. 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 iz- maina 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 diag- nozi 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 segmentā- cijas 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 tonī 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.

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

Abstract ID : 22

Effect of intravenous lidocaine infusion in remote photoplethysmography

Content

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.

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 re- ceived 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 con- tactless 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 in- duction 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.

Acknowledgments

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Status: ACCEPTED

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

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

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 atstarošanos, refrakciju un difrakciju. Elektromagnētiskā lauka kvantēšanas modelis tās neapraksta. Pēdējās mūsu publikācijās piedāvātais fotona trīsdimensionālais kvantu modelis sekmīgi apraksta fotona atstarošanos un refrakciju. Refraģētā un krītošā fotona transversālie izmēri atšķiras. Svarīgi būtu zināt, kāda ir fotonu transmisija caur spraugām un caurumiem, t.i. kāda ir to difrakcija. Par pa- matu difrakcijā tiek uzskatīta Zommerfelda problēma - difrakcija uz pusplakni - kuru viņš sekmīgi atrisināja plakana viļņu gadījumā. Mūsu uzdevums ir aprakstīt fotona difrakciju uz pusplaknes.

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

Abstract ID : 3

Arsēna rezonanses spektrālo līniju pētījumi tālajā UV apgabalā

Content

Lai spektrāllīnijas 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 līnijspektra 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 dobjā 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 rak- sturlielumu salīdzināšanai ar mērķi to izmantošanai augstas precizitātes atomu absorbcijas anal- izatoros. Īpaša uzmanība tiek pievērsta Arsēna spektrāllīnijām 189.4nm (4P5/2 →4S3/2) , 193.7nm (4P3/2 →4S3/2) un 197.2nm (4P1/2 →4S3/2), kas atrodas UV reģionā. Darba ietvaros tika analizē- tas relatīvās intensitāšu atkarības no jaudas, aparatūras funkcijas ietekme uz spektriem, starojuma stabilitāte un līniju pašabsorbcijas.

Spektrālie mērījumi tika veikti ar Furjē Bruker IFS HR125 un Yobin Jvon SPEX 1000M spektrome- triem. 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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Submitted by **ZORINA, Natalja on Wednesday, January 18, 2023**

Abstract ID : 18

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

Content

Vēsturiski putni ir bijuši svarīgs cilvēku malārijas modeļorganisms, tomēr pēdējos gados šo parazītu 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 īso distanču migranti, lai arī ir ziņas par Latvijā ziemojošiem putniem; tie labprāt ligzdo putnu būrīšos, atvieglojot to monitorēšanu un ķeršanu izpētes ietvaros, un pieau- gušu putnu izdzīvošanas un atgriešanās rādītāji ir pietiekami augsti, lai padarītu tos par ideālu modeļsugu pētījumiem par dažādu vides faktoru, tai skaitā asinssporaiņu parazītu, ietekmi uz put- niem (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 pieau- gušiem mājas strazdiem ar zināmu piederību ligzdai parauglaukumos Gulbenes novadā Zeltalejā un pie Engures ezera – Ķūļciemā un Bērzciemā. Visi ievāktie asins paraugi tika nosūtīti uz Ecogen- ics laboratoriju Šveicē uz PĶR analīzēm. 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 nejauši izvēlēti negatīvie paraugi ar līdzīgu vecumu un dzimumu kā pozitīvo paraugu put- niem.

Starp abu gadu inficētajiem paraugiem tika salīdzināts parazitēmijas līmenis Plasmodium, Haemo- proteus 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 parazitēmiju, kā arī starp jauno eritrocītu īpatsvaru un parauga infekcijas statusu. 2020. gadā novērota lielāka asinssporaiņu izplatība nekā 2021. gadā, tomēr netika novērota būtiskas parazitēmijas līmeņa atšķirības starp abiem gadiem.

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.

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

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 interme- diates, 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 ag- gregation. 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 trans- formations 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 ba- sis 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).

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Status: ACCEPTED

Submitted by **KIROVA, Teodora on Monday, January 9, 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 adiabātisku 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 imformācijas apstrādi.

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Abstract ID : 8

Dispersijas rēķinu metožu salīdzinājums

Content

Viena no galvenajām mikrorezonatorus aprakstošajām īpašībām ir to brīvais spektrālais apgabals un dispersija. Brīvais spektrālais apgabals apraksta frekvenču attālumu starp divām azimutāla- jām modām. Uzpumpējot rezonatoru par 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.

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Submitted by **DRAGUNS, Kristians on Monday, January 30, 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 el- ementus, uzlabojot veiktspēju, nodrošinot spēju darboties ekstrēmā vidē, elektromagnētisko imu- nitāti, kā arī mazus izmērus un iespēju uz viena fotoniskā čipa izvietot daudzas komponentes. Mēs esam izveidojuši mikrogredzena rezonatoru no SU-8 (polimērs, negatīvs fotorezists), sub- strātam 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 at- tīstīšanas ir mehāniski un ķīmiski stabils, tāpēc to var izmantot nepārklātu, taču iespējams virsmu funkcionalizēt ar dažādiem pārklājumiem, piemēram, organiskā stikla pārklājumu. Mēs eksperi- mentāli 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 pieli- etojumi ir plaši – dažādu gāzu jušana, optiskie filtri, viļņa garuma mērītājs.

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Status: ACCEPTED
Submitted by **MILGRAVE, Lase on Tuesday, January 31, 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 partic- ularly analytical chemistry [2].

New set up consists of following modules:

1) EKSPLA PL2230, Picosecond laser system produces short pulses with duration 28 ps. Max out- put 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 Optom- etry 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

This work was supported by ERDF project No. 1.1.1.5/19/A/003 “The Development of Quantum Optics and Photonics at the University of Latvia”

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4. https://www.oceaninsight.com/products/spectrometers/

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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 : 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 im- portant 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 l 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 runed by local stuff 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 cor- respond 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).

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Status: ACCEPTED

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

17.02.2023.

Programme

Vadītājs/Chair: Dr. Mindaugas Tamosiunas		
10.15–10.30	**Kalvis Salmiņš** *Institute of Astronomy, University of Latvia*	**The First Satellite Photometry Results at the Satellite Laser Ranging Station 1884**
10.30–10.45	***Dr.Uldis Bērziņš*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Development of Ion Sources on Ion beam Apparatus GRIBA**
10.45–11.00	***Dr. Roman Viter*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Structural, optical and photoelectrochemical properties of Fe2O3/ZnO core-shell nanofibers**
11.00–11.15	***Dr.Teodora Kirova*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Structural, electronic and optical properties of wurzite ZnO from first principles**
11.15- 11.30	***Danute Stivriņa*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Quality control of photoinitiators of UV-curable coatings using spectroscopy methods**
11.30-12.30	**Kafijas pause/ Coffee break,**	
Vadītājs/Chair: Dr.Maksym Pogorielov		
12.30–12.45	***Dr.Mindaugas Tamosiunas*** *Institute of Atomic Physics and Spectroscopy, University of Latvia*	**Ultrasonic cavitation reveals Candida albicans pathogen growth on polycaprolactone microfibers containing selenium nanoparticles**

12.45-13.00	***Iryna Tepliakova*** *University of Latvia, Institute of Atomic Physics and Spectroscopy; Odesa National I.I. Mechnikov University, Department of Experimental Physics*	**ZnO tetrapods/modified salan type ligands nanocomposites for optical detection of Cu^{2+} ions**
13.00–13.15	***Kateryna Diedkova*** *Institute of Atomic Physics and Spectroscopy, University of Latvia, Sumy State University*	**Polycaprolactone-MXene nanocomposites for cardiac tissue engineering**
13.15–13.30	***Ilya YANKO*** *Biomedical Research Center, Sumy State University*	**Antibacterial effectiveness of PCL-MXene electrospun membrane after plasma treatment**
13.30–13.45	***VARAVA, Yuliia*** *Biomedical Research Center, Sumy State University; Silesian University of Technology*	**Effect of silever nanoparticles on antibacterial properties of Ti13Nb13Zr alloy after plasma electrolytic oxidation**
13.45-14.00	**Noslēgums, diskusijas** **Conclusions, discussions**	

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.

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Presenter: SALMINS, Kalvis
Status: ACCEPTED
Submitted by **SALMINS, Kalvis on Monday, January 30, 2023**

Abstract ID : 16

Development of Ion Sources on Ion beam Apparatus GRIBA

Content

Development of Ion Sources on Ion beam Apparatus GRIBA Uldis Bērzīņš, 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 tech- nologies. 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 Uni- versity 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: “Tech- nologic 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.

Acknowledgments

Our work is supported by 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”

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Status: ACCEPTED

Submitted by **BĒRZIŅŠ, Uldis on Tuesday, January 31, 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 nanoma- terials. 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 electro- spinning. 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.

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Status: ACCEPTED

Submitted by **VITER, Roman on Monday, January 30, 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 wurtzite (B4), a cubic zincblende (B2), and cubic rocksalt (B1), with the wurtzite 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 wurtzite 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 E0, the equilibrium volume V0, the bulk modulus B0, the pressure derivative of bulk modulus B0′. 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 apvalka nano šķiedras, kas veidotas, izmantojot koaksiālu elektrisko vērpšanu fotokatalītiskiem lietojumiem".

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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 spec- trometers use a light source to illuminate a sample with light across the UV to the visible wave- length 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 visi- ble 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 350-4000cm-1, it is also used for qualitative and quantitative analysis of substances.

TRANSMITTANCE. To calculate transmittance, a measurement of the source is acquired by plac- ing 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. Re- flectance spectroscopy is an important method of measuring the absorption spectra and other prop- erties 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 applicated energy was 310nm 3miliwats and it was measured 350-800nm.

We measured transmittance and relectance 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 measurments we used four photoiniciators - 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. Pho- toinitiators 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 con- nection 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 ab- sorption 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.

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Status: ACCEPTED
Submitted by **STIVRINA, Danute on Friday, January 27, 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 crosssectional 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.

Acknowledgement. The research was funded by Vytautas Magnus University cluster research project P-G-22-08 “The resistance of pathogenic microbes and biofilms to antimicrobial compounds” (Kaunas, Lithuania). This work was also part of the activities of the Latvian Council of Science project LZP-2019/1-0254 “Multimodal imaging combining optical coherence tomography and photoacoustic microscopy for veterinary oncology” at University of Latvia.

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ZnO tetrapods/modified salan type ligands nanocomposites for optical detection of Cu^{2+} 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 chemi- cally 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 nanostruc- tured 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 Cu^{2+} ions have been performed. 12 mg ZnOtp and 450 μL50 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 mea- surements compounds were diluted in butanol and applied on glass substrates by drop casting and dried in the oven at 120º C. Structure properties of the ZnOtp/modified salan ligands nanos- tructures 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 mi- crofluidic 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 prop- erties were studied. The sensitivity of the obtained compounds to Cu^{2+} ions was found. Thanks to the nanostructured ZnOtp template, the intensity of photoluminescence increased tenfold, the minimum detectable concentration of Cu^{2+} 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.

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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 in- clude 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, poly- caprolactone (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. Electro- spun 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 differ- ent thicknesses of MXene layers. A group of samples after deposition with MXenes was addition- ally 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 decreas- ing 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 rep- etitions. 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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Antibacterial effectiveness of PCL-MXene electrospun membrane after plasma treatment

Content

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 struc- ture 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 epider- mal 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 sup- port, 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 inocu- lated 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 an- tibacterial 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.

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Effect of silever nanoparticles on antibacterial properties of Ti13Nb13Zr alloy after plasma electrolytic oxidation

Content

Titanium (Ti) alloys are widely used in implantology. Implants made of Ti alloys have high bioinertness, corrosion ability, 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 and 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 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 Log 10 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 allloy. Ti13Nb13Zr alloy with varying concentrations of AgNPs demonstrated a bacteriostatic effect on E. coli.

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