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

Infoday 'Research and Innovation programme Horizon Europe and Nordforsk call news and COST activities'

Workshop 'Horizon Europe programme projects (MSCA-SE in IAPS)'

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Tēžu krājums

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jaunākie rezultāti, kurus sasnieguši LU EZTF ASI pētnieki un sadarbības partneri pētniecības jomās:

- optiskie procesi gāzēs, šķidrumos, cietās vielās un bioloģiskos paraugos,
- optikas metodes diagnostikai, ķīmiskai analīzei un optisko sensoru tehnoloģijas,
- kvantu optika un telekomunikācijas,
- modelēšana,
- jauni materiāli un to biomedicīniskie pielietojumi.

Poster section

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recent results achieved by IAPS researchers and collaboration partners in the following research fields:

- optical phenomena in gas, liquid, solid state and biological samples,
- optical methods for diagnostics, chemical analysis and optical sensor technologies,
- quantum optics and telecommunication,
- modelling,
- novel nanomaterials and their biomedical applications.

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Abstract ID: **1**

Elektrons kvantētā elektromagnētiskā lauka vakuumā

BĒRSONS Imants, VEILANDE Rita

LU EZTF Atomfizikas un spektroskopijas institūts

Mūsu mērķis ir apskatīt elektrona mijiedarbību ar kvantētā elektromagnētiskā lauka vakuumu, kad nav reālu fotonu. Pieņemot, ka kvantētais lauks k-telpā ir lokalizēts lodē parastā kuba vietā, ir iespējams veikt mainīgo transformāciju un vienādojumu ar n^3 mainīgajiem reducēt uz n mainīgajiem.

Presenter: Prof. BĒRSONS Imants (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **VEILANDE Rita** on **Thursday, December 19, 2024**

Abstract ID: **2**

Izglītība ilgtspējīgai attīstībai Baltijas valstu universitātēs

BĒRZIŅA Dina

LU EZTF Atomfizikas un spektroskopijas institūts

Pētījuma mērķis bija atrast universitāti Baltijas valstīs, kuras mācību programmas, pētniecība un sadzīve balstīta uz ilgtspējības principiem; un šai universitātē atrast mācību programmu (latviski vai angliski), kuras kursi ne tikai saskan ar 'zaļo domāšanu' šodien, bet, kam ir arī vīzija par mācību priekšmeta un atbilstošās tautsaimniecības nozares ilgtspējīgu nākotni.

Darbā apskatīts Baltijas (Igaunija, Latvija, Lietuva) universitāšu ieguldījums izglītībā ilgtspējīgai attīstībai. Pētījumā izvēlētās tās universitātes, kuras piedalās *Times Higher Education* (THE) un/vai *Quacquarelli Symonds* (QS) ilgtspējas reitingos: Igaunijā – 3 universitātes, Latvijā – 5, Lietuvā – 7. Analizēti to uzstādītie ilgtspējīgas attīstības mērķi (SDG) un mācību programmas, kurās ietverti ilgtspējas jautājumi.

Pētījuma metodika ir balstīta uz brīvpieejas informāciju, kas atrodama augstskolu tīmekļa vietnēs, un tas veikts 2024.g sākumā, kad vadošajās Latvijas universitātēs notika konsolidācijas procesi. Publiski pieejamā informācija par ilgtspējas jautājumiem mācību programmās ir dažāda un ir atkarīga no valsts/universitātes. Papildus apskatītie dokumenti ir universitāšu stratēģiskie/attīstības plāni un nospraustie ilgtspējīgas attīstības mērķi.

Viens no pētījuma secinājumiem – nevar izveidot vienotu pārskatu par studiju programmām/kursiem Baltijas valstu universitātēs, jo katra valsts un augstskola studiju katalogu veido dažādi. 2025.g Latvijā IZM ir uzsākusi veidot Augstākās izglītības un zinātnes informācijas tehnoloģiju vienoto pakalpojumu centru (VPC), kurā viens no rezultātiem paredz vienviet sistematizēt augstskolu mācību kursus, lai potenciālajam studentam vairs nebūtu jāpārlūko daudz dažādas datu.

Saskaņā ar universitāšu politikas dokumentiem, ilgtspēja ir svarīga stratēģiskā joma, kas ir integrēta studijās, pētniecībā un universitātes dzīvē visās apskatītajās Baltijas universitātēs. Taču studiju programmu/kursu brīvpieejas informācijas skrīnings augstskolu mājaslapās nav tik pārliecinošs: tikai daļā skaidri norādīts uz sasaisti ar ilgtspējas jautājumiem; vairāku augstskolu mācību programmu aprakstā ir tikai vispārīgs apgalvojums 'ilgtspēja ir katras mācību programmas sastāvdaļa'.

Tiesa, šī problēma raksturīga arī citās valstīs. Valensijā (Spānija) 2024.gadā notikušajā konferencē par izglītību ilgtspējīgai enerģētikai (*Sustainable Energy Education* - SEED 2024) prezentētajos referātos konkrēti 'atslēgas vārdi' ne vienmēr bija iekļauti mācību programmu/kursu nosaukumos/aprakstos.

Šajā konferencē autore ziņoja par pētījuma rezultātiem:

Education for Sustainable Development at Baltic Universities[1]

Estonia: ***University of Tartu*** offers a selection of courses related to the sustainable development goals and traineeship opportunities to help students enhance their future skills in solving complex problems. ***Tallinn University of Technology*** offers an inter- and trans-disciplinary programme on Technology Governance and Sustainability where all key components of a sustainable socio-

[1] Dina Bērziņa (2024) – Education for Sustainable Development in Baltic Universities. Proceedings of the 'First International Conference on Sustainable Energy Education (SEED 2024)', pp 531-539. https://doi.org/10.4995/SEED2024.2024.19007

economic future are linked. According to Vice-Rector for Sustainable Development of ***Tallinn University***, sustainability is a component in every curriculum.

Latvia is in the process of university restructuring. All ***University of Latvia*** merged faculties intend to realise programmes/courses containing a sustainability component; LU is a member of European School of Sustainability Science and Research (ESSSR) where teaching and research within the remit of sustainability science is further developed. All ***Riga Technical University*** merged faculties teach sustainability issues, particularly intensively – sustainable energy education and environmental technologies; RTU has joined the Sustainable Development Solutions Network (SDSN). ***Riga Stradiņš University*** primarily trains health-care specialists; Faculty of Social Studies realises a study programme on International Business and Sustainable Economy. ***Latvia University of Life Sciences and Technologies*** provides knowledge and skills necessary for sustainable development of the society and has included sustainability issues in the study programmes of all faculties; LBTU has elaborated a set of promotional materials 'Climate-friendly agricultural practice in Latvia'. Although participating in THE Impact rankings, ***Transport and Telecommunication Institute*** does not refer to sustainability in the description of the study programmes/courses.

Lithuania. Among different ***Kaunas University of Technology*** programmes there are courses with a sustainability component; the Institute of Environmental Engineering trains leaders in sustainable development. ***Mykolas Romeris University*** is the leading Lithuanian university in social sciences promoting sustainability and social innovations while contributing to the decision-making process; MRU takes part in the International Association of University Cluster Higher Education for Sustainable Development (HESD). Most of the ***Vytautas Magnus University*** study programmes include courses on sustainability; VDU implements pan-university project 'Go Green', which seeks bringing people together and encouraging them for taking care of the environment. ***Lithuanian University of Health Sciences*** pays considerable attention to sustainability issues in the curricula, especially in the field of veterinary medicine and food science. ***Vilnius University*** has several programmes on sustainable development/finance management and a course devoted to SDGs. ***Vilnius Gediminas Technical University*** is upgrading curricula of BSc/specialists, MSc, and PhD programmes with new modules on energetically and ecologically sustainable, affordable and healthy built environment. ***Klaipeda University*** programmes include courses on sustainability paying attention to the renewable energy sources, renewable energetics, and energy efficiency; KU is a part of pan-university project European University for Smart Urban Coastal Sustainability (EU-CONEXUS).

Presenter: BĒRZIŅA Dina (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)
Status: ACCEPTED
Submitted by **BĒRZIŅA Dina** on **Monday, January 6, 2025**

Abstract ID: **3**

Optoplasmonic doped WGM microresonators

BRICE Inga[1], ALNIS Jānis[1], SEDULIS Arvīds[1,2]

[1]Institute of Atomic Physics and Spectroscopy, FST, University of Latvia,
[2]Riga Technical University

Whispering gallery mode (WGM) resonators can reach ultra-high quality factors that lend a hand to enhance light-matter interaction, making them suitable for different both passive (sensing, filters, resonators) and active (lasing, nonlinear effects) applications. The surface of a WGM resonator can be functionalized with nanomaterials to enhance desirable optical properties, tailoring it from sensitivity to any perturbations of the surrounding environment, or to the generation of nonlinear effects at relatively low powers. Silica doped with erbium is widely used for optical amplification while metal nanoparticles act like nano-antennas and increase sensitivity to surrounding media via localized surface plasmon resonances. The majority of research focuses on each aspect of passive applications and active applications of WGM resonators separately. The possibilities to combine the two types of application creating a hybrid active/passive system has not been widely explored.

Tests have shown that performing deposition of Er ions via dip coating on a clean prepared optical fiber before sphere fabrication provides better quality microspheres. We have observed lasing at 1530 - 1560 nm at a threshold of 2 dBm (1.6 mW) when pumping doped microspheres with 1470 - 1500 nm. Microsphere samples emit green light when pumped with 1530 - 1560 nm light. For higher concentrations of Er, the emission is more intense. Optimal concentration of Er ions is vital for generation of lasing signal, as both too high and too low concentration of Er ions incorporated into silica microspheres will not generate any lasing signal. Lasing was also observed when additionally functionalising the sphere surface with gold nanoparticles (Au-NPs). When functionalizing with microsphere surface with Au NPs, it appears multiple (3-5) deposition cycles using 1:10 diluted colloidal solution of 10-13 nm Au NPs might be beneficial.

Acknowledgements: The research is financed by the Recovery and Resilience Facility project “Internal and External Consolidation of the University of Latvia” (No.5.2.1.1.i.0/2/24/I/CFLA/007).

Presenter: Dr BRICE Inga (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **BRICE Inga** on **Tuesday, January 21, 2025**

Abstract ID: **7**

Towards high-Q integrated polymer ring resonators

MĪLGRĀVE Lāse, ALNIS Jānis

Institute of Atomic Physics and Spectroscopy, FST, University of Latvia

Polymer photonics is a growing research area with many potential applications in sensing and communication technologies. Polymers can be customized for specific applications, are relatively cheap, and are environmentally friendly and biocompatible. We are researching polymer ring resonators for integrated photonic chips for various applications. We need to develop a fabrication process that yields high-Q resonators. To achieve this, we have switched from glass substrate to Si wafers, allowing easy optoelectronic integration. In addition, two waveguide-resonator gap control methods are tested. In this work, we compare the free spectral range, the Q factors, and the overall quality of the fabricated chips.

Presenter: MĪLGRĀVE Lāse (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)
Status: ACCEPTED
Submitted by **MĪLGRĀVE Lāse** on **January 29, 2025**

Abstract ID: **11**

Development of tantalum pentoxide (Ta_2O_5) microresonators

DRAGUNS Kristians[1], ALNIS Jānis[1], ATVARS Aigars[2]

[1]Institute of Atomic Physics and Spectroscopy, FST, University of Latvia

[2]Institute of Astronomy, FST, University of Latvia

Tantalum pentoxide (Ta_2O_5) is an attractive material for integrated photonics due to its high refractive index and wide transparency window. In our study, we designed and tested Ta_2O_5 microresonators using three different coupling methods: edge coupling (where the light is coupled to the side of the chip), grating coupling (where the light is coupled perpendicularly to the chip with a grating), and total internal reflection (TIR) coupling (where the light is coupled perpendicularly to the chip trough printed polymer lens). The devices were first numerically simulated using COM-SOL Multiphysics software to ensure the anomalous dispersion regime for nonlinear applications. Our experiments showed that TIR coupling resulted in lower insertion losses and a simpler integration process compared to the other approaches. The resonance spectra and quality factors we measured show a promising potential of Ta_2O_5 platform for applications in sensing and nonlinear optics.

Presenter: DRAGUNS Kristians (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **DRAGUNS Kristians** on **February 4, 2025**

Abstract ID: **6**

Pilna ķermeņa ādas spektrālā attēlošana pie 850 nm

KVIESIS-KIPGE Edgars, TIHOMIROVA Jekaterina, RUBĪNS Uldis, IRBE Ilze, SKRASTIŅA Marta, SPĪGULIS Jānis

LU EZTF Atomfizikas un spektroskopijas institūts

Pēdējos gados strauji attīstās pilna ķermeņa ādas attēlošanas tehnoloģijas, ar kuru palīdzību iespējams veikt ādas jaunveidojumu skrīningu, lai identificētu potenciāli bīstamus audzējus, t.sk. ādas melanomu. ASI Biofotonikas laboratorijā 2024.gadā tika izveidota un klīniski aprobēta prototipa ierīce pilna ķermeņa ādas spektrālai attēlošanai pie trim redzamā diapazona viļņu garumiem 450 nm, 520 nm un 638 nm [1]. Šajā darbā tiks ziņots par prototipa ierīces pilnveidojumiem, nodrošinot papildus spektrālās attēlošanas iespējas tuvajā infrasarkanajā (NIR) diapazonā pie viļņu garuma 850nm, kas paver iespējas atpazīt ādas dziļākos (dermālos) veidojumus.

Šim nolūkam izveidotas divas NIR apgaismojuma sistēmas, izmantojot 850nm lāzera starojumu, kas ievadīts sānstarojošā optiskajā šķiedrā, un starojošās diodes (LED) ar emisijas maksimumu pie 850nm. NIR attēlu uztveršanai izmantota modificēta augstas izšķirtspējas SONY fotokamera, kurai standarta infrasarkanais filtrs ar caurlaidību līdz 700 nm nomainīts ar 860nm "*short-pass*" filtru. Tiks prezentēti un analizēti pirmie iegūtie 850 nm spektrālie attēli.

Pateicība: Šo pētījumu finansē Atveseļošanas un noturības mehānisma atbalstīts projekts "Latvijas Universitātes iekšējā un ārējā konsolidācija" (Nr. 5.2.1.1.i.0/2/24/I/CFLA/007).

Atsauces:

1. J.Spigulis, U.Rubins, E.Kviesis-Kipge, I.Saknite, I.Oshina, E.Vasilisina, "Triple spectral line imaging of whole-body human skin: equipment, image processing, and clinical data", Sensors 24, 7348 (2024). DOI:10.3390/s24227348. https://www.mdpi.com/1424-8220/24/22/7348.

Presenter: Dr KVIESIS-KIPGE Edgars (LU EZTF Atomfizikas un spektroskopijas institūts)

Status: ACCEPTED

Submitted by **KVIESIS-KIPGE Edgars** on **Monday, January 27, 2025**

Abstract ID: **5**

Solid State Triple Wavelength Illumination Systems for Diagnostic Applications

SPĪGULIS Jānis, IRBE Ilze, KVIESIS-KIPGE Edgars, RUBĪNS Uldis, SAKNĪTE Inga

Institute of Atomic Physics and Spectroscopy, FST, University of Latvia

White continuous spectrum illumination (e.g. by LED) is widely used for diagnostic imaging in dermatology and endoscopy. We propose to replace it by combined triple discrete spectral line illumination using RGB laser emission launched into an optical fiber. This allows extracting three ultra-narrowband spectral line images from single-snapshot image data captured by a consumer-grade color camera [1 - 5] and opens new challenges for improved clinical diagnostics.

A prototype device comprising side-emitting optical fiber illuminator was developed for large-area skin spectral imaging at 450 nm, 520 nm and 628 nm wavelengths. Another prototype device combined three spectral lines for white illumination of intranasal cavities using a low power RGB laser-fiber system attached to the lighting channel of endoscope. Three spectral line images for diagnostic applications were extracted from single snapshot RGB image data in both cases.

Acknowledgements: This research was funded by the Latvian Council of Science, project “Smart Materials, Photonics, Technologies and Engineering Ecosystem”, No. VPP-EM-FOTONIKA-2022/1-0001 (MOTE), and the EU Recovery and Resilience Facility project “Internal and External Consolidation of the University of Latvia” (No.5.2.1.1.i.0/2/24/I/CFLA/007).

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3. D.Pfafrods, M.Stafeckis, J.Spigulis, D.Boucher, “Side-emitting optical fiber”, patent LV 11644 B (1995).
4. J.Spigulis, I.Oshina, Z.Rupenheits, M.Matulenko, “Device for uniform surface illumination simultaneously by several laser spectral lines”, patent LV 15491 B (2020).
5. J.Spigulis. Ultra-Narrowband Multipectral Imaging: Techniques and Applications., CRC Press, Boca Raton, USA / Abingdon, UK (2024).

Presenter: Prof. SPĪGULIS Jānis (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **SPĪGULIS Jānis** on **Monday, January 27, 2025**

Abstract ID: **16**

Applications of time-resolved spectroscopy measurements in biological tissues

LUKINSONE Vanesa, APAĻKA Santa

Institute of Atomic Physics and Spectroscopy, FST, University of Latvia

The photon time-of-flight is one of the measurement methods of time-resolved. This measurement method allows us to study photon travel time and path length through tissue. As well as to determine absorption and scattering coefficients.

In this work, the research was carried out on cow brain, pig skin, pig adipose tissue, and pig muscles. The measurements were done in the spectral range from 600 nm to 800 nm. The photon path length, scattering, and absorption coefficients will be presented as the result of the measurements.

Acknowledgements: The research is financed by the Recovery and Resilience Facility project “Internal and External Consolidation of the University of Latvia” (No.5.2.1.1.i.0/2/24/I/CFLA/007).

Presenter: Dr. LUKINSONE Vanesa (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **LUKINSONE Vanesa** on **Tuesday, February 11, 2025**

Abstract ID: **8**

Investigation of Pulsed Mode Operation in Low Temperature Arsenic Plasma Light Sources

GUDERMANIS Rolands, RĒVALDE Gita, SKUDRA Atis, ĀBOLA Anda

Institute of Atomic Physics and Spectroscopy, FST, University of Latvia

In this work we investigate arsenic-containing high-frequency electrodeless lamps (HFEDLs). Such light sources are often used in atomic absorption spectroscopy (AAS), as they provide the necessary narrow and intense spectral lines, stability and long lifespan. Additionally, arsenic discharge lamps have potential applications in disinfection because the arsenic spectrum in the far ultraviolet region includes three resonance lines at 189.0 nm, 193.7 nm, and 197.3 nm. While HFEDL use in AAS demands, that radiation emission of the light source is continuous and with negligible fluctuations, for disinfection applications pulsed irradiation mode has been proven to be more effective.

We have found that arsenic electrodeless lamps may be operated in a pulsed mode under certain preparation and working conditions. In this study, we investigate the behaviour of arsenic lamps in the pulsed mode focusing on thermal data. We used thermal camera to record temperature changes during the pulse mode and obtained data for several excitation generator voltage values.

Our results showed that pulse period depends on voltage, as it decreases with higher voltage values. Temperature difference between maximum and minimum values was about 80 degrees. We also observed that the radial distribution across the central diameter of the lamp was not even. Due to the skin effect, temperature in the lamp centre was lower than closer to the lamp walls.

Presenter: Dr ĀBOLA Anda (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **ĀBOLA Anda** on **Monday, February 3, 2025**

Abstract ID: **10**

New methods and equipment for processing and disinfection of surfaces

KOĻČS Guntis[1], MARTINOVS Andris[1], MARTINOVS JR. Andris[1], RĒVALDE Gita[2], RUDEVICA Žanna[3], SKUDRA Atis[2], SPUNDE Karina[3], TRETJAKOVA Rasma[1], ZAJAKINA Anna[3], ĀBOLA Anda[2]

[1]Rezekne Academy of Technologies,
[2]Institute of Atomic Physics and Spectroscopy, FST, University of Latvia,
[3]Latvian Biomedical Research and Study Centre

While the antimicrobial properties of ultraviolet light from mercury lamps with a wavelength of 254 nm are well known, the pandemic has prompted research into other ultraviolet light wavelengths. Cold atmospheric pressure plasma applications in disinfection, surface treatment, coating, and biostimulation are also promising. Our goal is to study different methods, such as UV-A, UV-C, plasma, and ozone to find the optimal operation modes to develop technologies for various applications, for example, surface disinfection, creation of protective coatings, stimulation of grain germination, etc.

We studied the effects of UV-A and UV-C light sources on several bacteria and viruses such as E.Coli, Semliki Forest virus, etc. A prototype equipment for disinfection with UV light and ozone was created, for whom the mapping of UV light intensity was performed. Additionally, a prototype and technology for surface processing with cold atmospheric plasma was developed.

Presenter: Dr. SKUDRA Atis (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **ĀBOLA Anda** on **Tuesday, February 4, 2025**

Abstract ID: **9**

Radioaktīvā 221Fr un RaF- spektrosokpija CERN, ISOLDE laboratorijā

SNIĶERIS Jānis

LU EZTF Atomfizikas un spektroskopijas institūts; Gēteborgas Universitāte, Zviedrija

ISOLDE (*Isotope Separator On Line Device*) laboratorija ir CERN organizācijas daļa un unikāls radioaktīvo nuklīdu zemas enerģijas staru kūļa avots. CRIS (*Collinear Resonance Ionization Spectroscopy*) ir viens no pastāvīgajiem eksperimentiem, kas atrodas ISOLDE laboratorijā, un viens no pionieriem meklējumos ārpus fizikas standarta modeļa.

Francijs, (it īpaši tā 7S1/2 → 6D3/2,5/2 pārejas) ir daudzsološs izpētes objekts atomu paritātes pārkāpumam. 221Fr+ tika iegūts no iepriekš apstarota urāna karbīda avota un tika neitralizēts lādiņu apmaiņas kamerā. 9P1/2,3/2, 10P1/2,3/2 un 6D3/2,5/2 līmeņi 221Fr tika izmērīti ar lāzera spektroskopijas palīdzību, un pirmo reizi tika veiksmīgi ieviesta jauna, eksperimentāla bezfona noteikšanas shēma.

Radioaktīvās molekulas ir ārkārtīgi aizraujošas izpētes objekts, lai izzinātu lielākos jautājumus par Visumu, taču līdz šim tās nav plaši pētītas to ražošanas un mērīšanas tehnisko grūtību dēļ. RaF joni tika ražoti no tā paša urāna karbīda avota, pēc tam kad tas tika fluorēts. Sākotnēji iegūtie RaF+ joni tika pārveidoti par RaF-, izmantojot dubulto lādiņu apmaiņu. Radioaktīvas molekulas (RaF-) fotoatdalīšana pirmo reizi tika veiksmīgi demonstrēta ISOLDE laboratorijā. Turpmākajos pētījumos ir plānots izmantot negatīvo molekulāro jonu fotoatdalīšanu, lai iegūtu neitrālas molekulas ar kontrolētiem ierosmes līmeņiem. Tas ļautu daudz precīzāk kontrolēt enerģijas stāvokļus, salīdzinot ar molekulām, kas iegūtas tieši no karsta jonu avota, vai lādiņu apmaiņas šūnām, kur populācija ir sadalīta pa daudziem enerģijas līmeņiem.

***Pateicība*:** Tēzes iesniegtas CRIS sadarbības vārdā

Presenter: Dr. SNIĶERIS Jānis (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **SNIĶERIS Jānis** on **Monday, February 3, 2025**

Abstract ID: **12**

Negatīvo jonu lāzeru fotoatraušanas spektroskopija

BĒRZIŅŠ Uldis

LU EZTF Atomfizikas un spektroskopijas institūts

Es ziņošu par pirmā darba gada rezultātiem un secinājumiem Latvijas Zinātnes padomes projektā (Nr. lzp-2023/1-0199) “Negatīvo jonu lāzeru fotoatraušanas spektroskopija”. Galvenais mērķis ir iegūt vairāk informācijas un labāk saprast atomāro sistēmu struktūru un dinamiku tajās. To mēs darām sadarbībā ar zinātniekiem no CERN [1] Šveicē un trim zviedru universitātēm no Gēteborgas [2], Malmes [3] un Stokholmas [4]. Projekta pamatideja ir augstas klases eksperimentu veikšana īsu zinātnisko vizīšu laikā lielajās laboratorijās CERN un DESIREE. Sagatavošanās darbi un rezultātu apstrāde tiek veikti Atomfizikas un spektroskopijas Institūtā [5].

Augstākā līmeņa pētniecība un inovācijas visintensīvāk attīstās lielajās zinātniskajās laboratorijās. Tajās ir pieejama dārga tehnika un sarežģīta infrastruktūra, kādu Latvijai nav pa spēkam iegādāties un uzturēt. Pētījumu veikšana uz šādām modernām iekārtām ļauj augt un sasniegt pasaules klases rezultātus, gan pieredzējušiem pētniekiem, gan jaunajiem zinātniekiem.

Darbs lielajos centros stipri atšķiras no ierastās rutīnas. Tajās mums ar savu eksperimenta ideju ir jāiztur konkurss par pieeju iekārtai. Veiksmes gadījumā šāda pieeja tiek dota viena vai divas nedēļas plānoto eksperimentu veikšanai Šajā laikā eksperimentālās iekārtas darbību, gan finansiāli, gan ar personālu nodrošina uzņemošā laboratorija. Mums tikai jāatrod budžets ceļam un naktsmītnēm. Bet ļoti svarīgi ir sagatavot pilnīgi skaidru darba plānu, jo, kad beidzas atvēlētais laiks, otrā iespēja var būt tikai pēc gada, vai arī nebūt vispār.

Ziņojumā tiks parādīti nesen veikto eksperimentu rezultāti par pozitīvo jonu dzīves ilgumu un elektronu atraušanas enerģijām no negatīvajiem joniem. 3 šobrīd izdarāmie secinājumi ir:

- ļoti svarīgi, lai visi projekta dalībnieki ir spējīgi piedalīties eksperimentālajās misijās.
- par maz izplānots ir finansējums komandējumiem
- kā problēma ir sarežģītā un lēnā iepirkumu procedūra LU.

***Pateicības*:** Projekts saņem atbalstu no Latvijas Zinātnes padomes granta (Nr. lzp-2023/1-0199): “Negatīvo jonu lāzeru fotoatraušanas spektroskopija”.

Liela pateicība projekta komandai par piedalīšanos eksperimentos, sevišķi Arturam Ciniņam un Jānim Alnim, un tiem, kuri nav tieši nodarbināti projektā, sevišķi Arnoldam Ūbelim un Aleksandram Kapralovam.

Atsauces:

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3. https://mau.se/en/persons/henrik.hartman/
4. https://www.desiree-infrastructure.com/desiree
5. https://www.lu.lv/par-mums/struktura/instituti/lu-atomfizikas-un-spektroskopijas-instituts.

Presenter: Dr.Hab. BĒRZIŅŠ Uldis (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **BĒRZIŅŠ Uldis** on **Sunday, February 9, 2025**

Abstract ID: **13**

Periodisku virsmas nanostruktūru līniju veidošana uz GaAs ūdenī, izmantojot azimutāli un radiāli polarizētus lāzera starus

KALNIŅŠ Kalvis

LU EZTF Atomfizikas un spektroskopijas institūts

Pētījuma mērķis ir izveidot kvalitatīvas virsmas struktūru (LIPSS, *Laser Induced Periodic Surface Structures*) līnijas, izpētīt atkarību no materiāla pārvietošanas ātruma, lāzera polarizācijas un enerģijas. Kvalitatīvu LIPSS līniju veidošana ir nepieciešama, lai tālākos pētījumos varētu veidot virsmas struktūru laukumus, kas ļautu analizēt materiāla īpašību maiņu, piemēram krāsa, slapināmība.

Šim pētījumam tika izveidota x-y motorizētā platforma un uzrakstīta programma, kas bija nepieciešama līniju veidošanai paraugu pārvietojot lāzera fokālajā plaknē. Izmantojot S-*waveplate*, lineāri polarizētais lāzera starojums tika pārveidots par azimutāli vai radiāli polarizētu spirālveida staru, atkarībā S-*waveplate* leņķa.

Eksperimentos tika izmantoti 30 ps 532 nm lāzera pulsi. Ar S-*waveplate* tika pārveidota polarizācija un tad staru fokusēja ar 200 mm lēcu uz parauga, kas atradās ūdenī uz x-y motorizētās platformas. Tika noteikta optimālā enerģija un parauga pārvietošanas ātrums, kas nepieciešams optimālām virsmas struktūrām. Fokālajā plaknē novietojot CMOS kameru, varēja uzņemt stara profila attēlus un aprēķināt apstarotās virsmas laukumu. Virsmas struktūras tika analizētas, uzņemot attēlus ar SEM.

Tiks prezentēti iegūtie struktūru attēli.

***Pateicības*:** Autors saņēma atbalstu no Latvijas Zinātnes Padomes Fundamentālās un Praktisko pētījumu programma projekta (Nr zp-2023/1-0199): “Negatīvo jonu lāzeru foto atraušanas spektroskopija“.

Liela pateicība Rašidam Gaņejevam un Vjačeslavam Kimam par eksperimenta idejām un rezultātu interpretāciju, kā arī Kalvim Salmiņam par S-*waveplate* nodrošināšanu un Anatolijam Šarakovskim par SEM izmantošanas iespēju Cietvielu fizikas institūtā.

Presenter: KALNIŅŠ Kalvis (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **KALNIŅŠ Kalvis** on **Monday, February 10, 2025**

Abstract ID: **14**

Gadolīnija spektra emisijas līniju potenciālo avotu izpēte

ČAKŠS Matīss[1], BOKTA Valērijs[2]

[1]LU EZTF Atomfizikas un spektroskopijas institūts,

[2]Fizikas nodaļas pirmais kurss, EZTF, Latvijas Universitāte

Šī darba ietvaros ir aplūkot potenciāli avoti gadolīnija (Gd) jonu emisijas spektra līniju iegūšanai. Izpētes mērķis ir attīstīt metodi Gd jonu iegūšanai. Darba rezultāti ir nozīmīgi negatīvo Gd jonu avota izveidošanai, un negatīvo Gd jonu pētījumiem. Negatīvo jonu izpēte notiek sadarbībā ar CERN un Stokholmas, Gēteborgas un Malmes universitātēm. Šajā prezentācijā mēs demonstrējam izmantotās metodes Gd spektru iegūšanai un jaunākos mērījumu rezultātus.

Darba ietvaros tika aplūkotas divas metodes Gd emisijas spektru iegūšanai: lāzera inducēta sabrukšanas spektroskopija (LIBS) un dobā katoda izlāde ar induktīvi saistītas plazmu (HC-ICP).

Lāzera inducēta sabrukšanas spektroskopijā izmanto impulsu lāzeru, lai ablācijas procesā pārvērstu daļu parauga plazmā. LIBS tika veikta ar gadolīnija oksīda (Gd_2O_3) paraugiem. Citos pētījumos izmantojot LIBS ir novērotas gan Gd atomu, gan jonu līnijas [1]. Dobā katoda (HC) izlāde ir plaši izmantota metode, kas ļauj iegūt atomu un jonu emisijas spektra līnijas. Induktīvi saistīto plazma (ICP) spektroskopijā izmanto, lai iegūtu ļoti intensīvas atomu emisijas līnijas. Iepriekšējiem pētījumiem Latvijas Universitātes Atomfizikas un spektroskopijas institūta pētnieki izveidoja jonu avotu, kas kombinē HC un ICP. Šajā ierīcē HC emitētos atomus un jonus papildus ierosina izmantojot ICP. Rezultātā tika iegūtas intensīvas atomu un jonu emisijas līnijas [2]. Mūsu pētījuma ietvaros ierīci sagatavoja spektru iegūšanai no Gd_2O_3 parauga, un veica pirmos mērījumus.

Darba ietvaros ir veikti Gd spektra mērījumi izmantojot LIBS un HC-ICP. Stendā demonstrēti jaunāko mērījumu rezultāti. Analizējot jaunākos rezultātus, nav iespējams pārliecinoši identificēt Gd jonu vai atomu līnijas. Balstoties uz iegūtajiem rezultātiem, tiks veikti turpmāki mērījumi un izmantoto spektru metožu uzlabojumi.

***Pateicības*:** Izsakām pateicību Kalvim Kalniņam par palīdzību LIBS mērījumu veikšanā, Arnoldam Ūbelim un viņa kolēģiem: Jānim Kļaviņam, Austrim Pumpuram, Aleksandram Koļesņikam un Jurim Silamiķelim, par palīdzību darbā pie dobā HC-ICP jonu avota, kā arī Uldim Bērziņam par darba vadību un diskusijām.

Darbu atbalsta Fundamentālo un lietišķo pētījumu projekts (Nr. lzp-2023/1-0199): “Negatīvo jonu lāzeru fotoatraušanas spektroskopija”.

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1. Khumaeni, Ali & Tampo, M. & Katsuaki, Akaoka & Miyabe, Masabumi & Ikuo, Wakaida. (2013). Enhancement of LIBS emission using antenna-coupled microwave. Optics Express. 21. 29755-68. 10.1364/OE.21.029755.
2. A. Ūbelis, U. Bērziņš, A. Apsītis, A. Bžiskjans, and A. Pumpurs, Ion source based on combined RF frequency powered inductively coupled plasma and hollow cathode discharge, Institute of Atomic Physics and Spectroscopy, University of Latvia.

Presenter: ČAKŠS Matīss (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **ČAKŠS Matīss** on **Monday, February 10, 2025**

Abstract ID: **15**

Molekulāro absorbcijas spektru līniju pētījumi

ČAKŠS Matīss[1], BILZĒNS Alberts[2]

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Darba uzdevums ir atrast piemērotas metodes lāzera viļņu garumu vai frekvenču kalibrēšanai diviem viļņu garumu diapazoniem spektra infrasarkanajā daļā: ap 1535 nm un ap 1410 nm. Mērķis ir izmantot atrastās metodes augstas precizitātes elektrona atraušanas enerģijas mērījumiem alvas un irīdija negatīvajiem joniem. Prezentācijā mēs sīkāk pastāstīsim par izmantoto metodi un eksperimentālo iekārtu un uz šo brīdi iegūtajiem rezultātiem.

Molekulu absorbcijas spektri ar precīzi zināmiem absorbcijas līniju viļņu garumiem tika izvēlēti kā atskaites spektri, kurus salīdzina ar fotoatraušanas spektriem. Molekulu absorbcijas spektru pielietošana kalibrēšanai tika attīstīta astoņdesmitajos gados, un tika izmantota par pamatu skenējošo krāsvielu lāzeriem [1, 2]. Molekulu absorbcijas spektru mērījumiem Latvijas universitātē tika iz-gatavotas un uzpildītas kivetes ar izvēlēto vielu. Viena kivete jau tika uzpildīta ar acetilēnu (C_2H_2) un izmantota gala eksperimentā ar alvas anjonu 1535 nm lāzera kalibrēšanai. Otra kivete ne-pieciešama 1410 nm lāzera kalibrācijai gala eksperimentā ar irīdiju. Otrās kivetes izgatavošana ir izpētes stadijā, bet plānojam to uzpildīt ar ūdens (H_2O) tvaiku [5]. Gala eksperiments tiek veikts kopā ar pētnieku uz jonu iekārtas DESIREE [4] sadarbībā ar pētnieku grupām no Stokholmas un Gēteborgas universitātēm.

***Pateicības*:** Izsakām pateicību stikla pūtējam Aleksandram Kapralovam par kivešu izgatavošanu, Uldim Bērziņam par darba vadību, Jānim Alnim un Arturam Ciniņam par līdzdalību mērījumos.

Izsakām pateicību arī pētniekiem no Daga Hanstorpa grupas Gēteborgā un Henninga Šmita (Schmidt) grupas Stokholmā, un DESIREE apkalpes grupas.

Darbu atbalsta Fundamentālo un lietišķo pētījumu projekts (Nr. lzp-2023/1-0199): “Negatīvo jonu lāzeru fotoatraušanas spektroskopija”.

Atsauces:

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2. S Gerserkorn, P.Luc Atlas du Spectre dAbsorption de la Molekule de Tellure Laborotatiore AimeCotton CNRS II”, Orsay, France (1980)
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Presenter: ČAKŠS Matīss (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **ČAKŠS Matīss** on **Monday, February 10, 2025**

Infoday
Research and Innovation programme Horizon Europe and NordForsk call news

https://conferences.lu.lv/event/737

LU EZTF Atomfizikas un spektroskopijas institūts sadarbībā ar 'Apvārsnis Eiropa' Nacionālo kontaktpunktu rīkoja *Zoom* tiešsaistes sesiju – informācijas dienu '*Horizon Europe* un *NordForsk* projektu konkursu jaunumi'.

Infoday 'Horizon Europe and NordForsk call news' was co-organised by the Institute of Atomic Physics and Spectroscopy of the FST, University of Latvia and Latvian National Contact Point for Horizon Europe.

Programme

Chair: Inga Šīrante, Latvian Council of Science (LCS), Horizon Europe NCP senior expert

10.00–10.20	***Ingrīda Lavrinoviča***, LCS, Horizon Europe NCP senior expert	Horizon Europe Cluster 4: Empowering Europe with Next-Generation Raw & Innovative Materials
10.20–10.40	***Jānis Ancāns***, LCS, Horizon Europe NCP senior expert	Cluster Health and Mission Cancer participation opportunities
10.40–11.00	***Lāsma Brenča*** / ***Aiga Salmiņa***, LCS, Horizon Europe NCP senior experts	Horizon Europe Cluster 6: Advancing Biotechnology for a Sustainable Future
11.00–11.20	***Liga Lice da Costa***, LCS, Horizon Europe NCP senior expert	Marie Skłodowska-Curie Actions: general overview and funding opportunities
11.20–11.40	***Ļubova Tihomirova***, LCS, senior expert	NordForsk calls
11.40–13.00	Conclusions, discussions	

Workshop
Horizon Europe programme MSCA-SE projects at the Institute of Atomic Physics and Spectroscopy, FST, University of Latvia

https://conferences.lu.lv/event/629/

Programme

Chair: *Inga Šīrante*, Acting Director, IAPS, FST University of Latvia

13.00–13.15	**Inga Šīrante**, Institute of Atomic Physics and Spectroscopy, FST, University of Latvia	Opening of the workshop
13.15–13.30	**Valentina GARGIULO**, CNR-STEMS	**Production of core-shell Metal Organic Frameworks (MOFs) Hybrids for Sensing Applications** HE MSCA project no 101086364 – **Sens4Corn**
13.30–13.45	**Viktor ZABOLOTNII**, Institute of Atomic Physics and Spectroscopy, FST, University of Latvia	**Investigation of polymorphism in organic luminophores** HE MSCA project no 101086364 – **Sens4Corn**
13.45–14.00	**Iryna TEPLIAKOVA,** Institute of Atomic Physics and Spectroscopy, FST, University of Latvia	**Photochemical sensor application of Salan-type ligands TFA salts for Cu^{2+} and Fe^{3+} detection in aqueous media** HE MSCA project no 101086364 – **Sens4Corn**
14.00–14.15	**Ambra FIORAVANTI,** CNR-STEMS	**Hydrothermal synthesis and characterization of h-WO3 pure and doped with transition metal ions** HE MSCA project no 101086364 – **Sens4Corn**
14.15–14.30	**Maksym Pogorielov,** Institute of Atomic Physics and Spectroscopy, FST, University of Latvia	**Biocompatibility of MXenes: influence of flake size and surface terminations** HE MSCA project no 101086184 – **MX-MAP**, MSCA4Ukraine project no 1232462
14.30–14.45	**Anastasia KONIEVA,** University Hospital Essen, Department of Anatomy, Germany	**Photothermal Targeted Ablation of Melanoma Using MXene-PDA-anti-CEACAM1 Complex** HE MSCA project no 101086184 – **MX-MAP**, MSCA4Ukraine project no 1232462

14.45–15.00	**Irfan HANIF,** NanoBioMedical Centre, Adam Mickiewicz University in Poznan, Poland	**Harnessing Hybrid Nanoarchitectures for Next-Generation Photoelectrochemical Energy conversion** HE MSCA project no 101131147 – **ESCULAPE**; SONATA BIS project 2020/38/E/ST5/00176 (Poland)
15.00-15.15	**Anton POPOV,** NanoTechnas – Center of Nanotechnology and Materials Science, Faculty of Chemistry and Geosciences, Vilnius University, Vilnius, Lithuania	**Development of $Ti_3C_2T_x$ MXene-Based Electrochemical Biosensor for Glucose Detection** HE MSCA project no 101131147 – **ESCULAPE**
15.15-15.30	**Teodora Velcheva KIROVA**, Institute of Atomic Physics and Spectroscopy, FST, University of Latvia	**Quantum control via the Autler-Townes effect** HE MSCA project no 101131418 – **Q-DYNAMO**
15.30-15.45	**Johannes Hecker DENSCHLAG,** Institute for Quantum Matter, Ulm University, Germany	**Experiments with ultracold atoms and molecules in Ulm** HE MSCA project no 101131418 – **Q-DYNAMO**
15.45-16.00	**Arunas RAMANAVICIUS**, State Research Institute Center for Physical and Technological Sciences; NanoTechnas – Center of Nanotechnology and Materials Science, Faculty of Chemistry and Geosciences, Vilnius University, Lithuania	**Development of Molecularly Imprinted Polymer based Affinity Sensors** HE MSCA project 101086441 – **ARGO**
16.00-16.15	**Anna BUTSYK,** Dept. Medical Biochemistry and Biophysics, Umeå University, Sweden; Ukrainian-Swedish Research Center SUMEYA, Medical Institute, Sumy State University, Ukraine	**Application of Silver Nanoparticles in Root Canal Treatment** HE MSCA project no 101086441 – **ARGO**
16.15-16.30	**Viktoriia HOLUBNYCHA,** Sumy State University, Ukraine	**Silver Nanoparticles Antibiofilm Activity Against ESKAPE Bacteria** HE MSCA project no 101086441 – **ARGO**
16.30–17.00	***Questions and Answers, Discussion, Conclusions***	

Abstract ID: **4**

Production of core-shell Metal Organic Frameworks (MOFs) Hybrids for Sensing Applications

GARGIULO Valentina[1], CLEMENTE Claudio[2], CIMINO Luciana[1], ALFE Michela[1]

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[2]University of Naples "Federico II", Italy

MOFs are top notch candidates for sensing applications due to their high porosity, large sur-face area, and highly exposed surface sites, which are prone to specific interactions with target molecules, ions or gases. MOFs are produced by the self-assembly of multidentate organic ligands connecting with multivalent metal nodes through strong coordination interactions. The unlimited combinations of metals and ligands allow the design and preparation of ad-hoc structures. Surface chemistry and microstructure (i.e. exposed facets, surface defects, polarity) have a significant impact on surface and bulk interaction process. The MOF flexibility for pre- and post-processing can be exploited to enhance the performance toward sensing applications, particularly by combining with organic and inorganic materials to produce composite materials. Polymers, metal oxides, metal nanoparticles, carbon nanotubes, quantum dots and GRMs are the most commonly used materials for the preparation of MOF composites and hybrids 1. In this work, core-shell hybrid materials obtained allowing the MOF structure to growth onto the surface of zinc oxide nanoparticles are reported. In the synthesis strategy adopted here, zinc oxide serves as both the core-shell structure and the metal source for the growth of MOF structures. Zinc-based zeolitic imidazolate frameworks (ZIFs) are chosen for the MOF shell due to their robust porosity, resistance to thermal changes, and chemical stability. Different types of imidazole-based linkers have been explored to fabricate ZIF-based hybrids.

The obtained materials have been full characterized from the morphological, structural and textural points of view highlighting the instauration of synergistic effects between the hybrid components. A selection of the produced materials has been also tested for the detection of metal ions in solution.

Presenter: GARGIULO Valentina, ALFE Michela (CNR-STEMS)

Status: ACCEPTED

Submitted by **ALFE Michela** on **Monday, February 3, 2025**

Abstract ID: **2**

Investigation of polymorphism in organic luminophores

ZABOLOTNII Viktor[1], KINĒNS Artis[1], VITER Roman[1], SAHUL Martin[2]

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Synthesis of organic nanomaterials requires precise control on many technological parameters. For instance, drying and crystallization speed define conformation of the chemical structure and main fundamental properties of the organic luminophores. Deviation from the fabrication proto-col results in forming of polymorphous structures with same chemical composition but different structural, electronic and optical properties.

In the present work, 1-(2-(3,6-dimethyl-9H-carbazol-9-yl) benzyl) pyridin-1-ium methanesulfonate (KL1421) has been crystallized with different drying rates. Structure and electronic properties of the polymorphous samples have been studied by NMR, XRD, FTIR and Raman spectroscopy. Investigation of optical properties by photoluminescence showed changes of the quantum yield and emission peak position. Activation energies have been studied by temperature quenching of the photoluminescence. Correlation between structure, optical and technological parameters have been proposed.

Presenter: ZABOLOTNII Viktor (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **ZABOLOTNII Viktor** on **Friday, January 31, 2025**

Abstract ID: **3**

Photochemical sensor application of Salan-type ligands TFA salts for Cu^{2+} and Fe^{3+} detection in aqueous media

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Ligands with chelating properties, such as Schiff bases, imines, and Salan-type ligands, are promising materials for photochemical sensors of metal ions, which require good sensitivity and selectivity. The ability of such ligands to host metal ions in their molecular structure and specific optical properties, such as high intensity photoluminescence, create new opportunities to define metal ion concentration in aqueous media by optical methods with fairly high accuracy. In addition, the structure of the ligand could be chemically tuned according to the requirements of the sensor [1]. In this work, the sensitivity and selectivity of Salan ligands TFA salts were investigated by photo-luminescence (PL) and transmittance (TM) methods.

Salan ligands were synthesized in salt form to make them soluble in water and alcohols. For sensor testing, the ligands and metal salts were dissolved in ethanol at a concentration of 100 mkM/L. Sensor testing was performed in a home-built system with a quartz cuvette equipped with a magnetic stirrer, Fiber optic spectrometer, system of lenses and filters, Fiber optic cables, and a portable 325 nm UV light source with detector.

During the measurement steady-state PL and TM spectra were saved after each metal ion probe. The kinetics of local PL and TM peaks were recorded. The sensitivity to Cu^{2+} and Fe^{3+} ions in sub micromolar range was observed. Complex formation of ligand with Cu and Fe was proofed by FTIR. Mechanisms of interaction were proposed, main sensors parameters were calculated.

Key words: photochemical sensors, metal ions detection, chelators.

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Presenter: TEPLIAKOVA Iryna (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

Status: ACCEPTED

Submitted by **TEPLIAKOVA Iryna** on **Sunday, February 2, 2025**

Abstract ID: **1**

Hydrothermal synthesis and characterization of h-WO3 pure and doped with transition metal ions

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In the field of hydrogen (H_2) production, the fabrication of the materials with high pseudocapacitance is fundamental. Existing electrodes for this goal are mainly based on platinum making them very expensive. Therefore, the design and develop of nanomaterials with high pseudocapacitance to replace platinum electrodes become an essential task.

Tungsten trioxide in hexagonal phase (h-WO3) is a good candidate to solve this issue because of its high electrochemical stability in acidic environment, good resistance to electrochemical corrosion, low cost and toxicity and earth abundance. However, when stoichiometric it suffers of a poor electron conductivity, which can be enhanced by metal-doping, which in principle changes also their electrochemical properties.

In the present work, we present recent results of h-WO3 synthesis pure and doped by transition metals (WO3-Me) for electrocatalytic applications.

h-WO3 and h-WO3:Me have been fabricated by hydrothermal method ensuring several advantages such as simplicity of the procedure, high efficiency, low costs and good reproducibility of the samples. For doping, following metals have been used Co, Cr, Ni, Mo, Ti. The doping concentration was M[Me]/M[WO3] = 5% for all used metals.

Structure, electronic and optical properties of the h-WO3 samples have been studied by SEM, TEM, BET, XRD, FTIR, Raman, and diffuse reflectance methods.

Electrochemical properties of the h-WO3 samples have been studied by cyclic voltammetry. Specific capacity of each sample was calculated. Comparative analysis of doping to structure, optical and electrochemical properties has been discussed. Samples with the higher stability and higher specific capacitance, those doped with Ti and Mo, represent good candidates to develop new electrodes suitable for applications in the field of H_2 production.

Presenter: FIORAVANTI Ambra (CNR-STEMS)

Status: ACCEPTED

Submitted by **FIORAVANTI Ambra** on **Friday, January 31, 2025**

Abstract ID: **7**

Biocompatibility of MXenes: influence of flake size and surface terminations

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The groundbreaking discovery of graphene in 2004 sparked a surge of interest in the search for novel two-dimensional (2D) materials. Among these, MXenes, first identified by Yury Gogotsi and Michel Barsoum at Drexel University in 2011, have emerged as particularly promising. To date, more than fifty MXene variants have been synthesized, with many more predicted through theoretical models. Over the past decade, MXenes have demonstrated remarkable versatility, with potential applications spanning lithium and sodium-ion batteries, electrocatalysis, optoelectronics, flexible electronics, and various biomedical fields, including cancer treatment, antimicrobial therapies, immunomodulation, targeted drug delivery, and tissue regeneration.

With the growing interest in MXenes for biomedical applications, it is imperative to thoroughly investigate their biocompatibility to ensure both safety and efficacy. In addition, evaluating their biosafety is critical, given the potential environmental risks that may arise from widespread use. Despite numerous studies, defining consistent toxicity profiles for MXenes remains a challenge. This difficulty largely stems from variability in experimental outcomes, even when similar MXene compositions are analysed. Such inconsistencies are often attributed to differences in chemical purity, levels of oxidation, and the characteristics of surface terminations (Tx) in the materials.

To clarify the influence of MXene properties on biological systems, we conducted an in-depth assessment of how flake size, surface terminations, and oxidation states affect cell viability and metabolic activity over varying exposure durations. Our research revealed a clear connection between the dimensions of Ti_3C_2, V_2C, and Nb_2C MXene flakes, their surface chemistry, and the corresponding cellular responses. These responses encompass the uptake of MXene particles by cells, as well as the activation of pathways leading to apoptosis, necrosis, and genotoxicity. The results emphasize that fine-tuning the structural and chemical features of MXenes is crucial for tailoring their performance in biomedical contexts.

Acknowledgements: This research is supported from the HORIZON-MSCA-2021-SE-01 (Project #101086184) and MSCA4Ukraine project (Project #1232462)

Keywords: MXenes, biocompatibility

Presenter: POGORIELOV Maksym (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)

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Submitted by **BĒRZIŅA Dina** on **Friday, February 7, 2025**

Abstract ID: **5**

Photothermal Targeted Ablation of Melanoma Using MXene-PDA-anti-CEACAM1 Complex

KONIEVA Anastasia[1,2], DEINEKA Volodymyr[2,3], AGUILAR-FERRER Daniel[4,5], ZAHORODNA Veronika[6], GOGOTSI Oleksiy[2,6], KUBE-GOLOVIN Irina[1], IATSUNSKYI Igor[4], WENNEMUTH Gunther[1], POGORIELOV Maksym[2,3]

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[6]Materials Research Centre, Ukraine

We examine MXenes as optical absorption agents for photothermal treatment (PTT) in this study. To ensure targeted delivery of MXenes, we linked them to the monoclonal anti-CEACAM1 antibody (mAb).

Our study uses an NIR-I laser to evaluate the targeted photothermal effect in vitro and to offer biological characterization of the MXene-anti-CEACAM1 antibody combination. After polydopamine (PDA) of varying thicknesses was added to delaminated Ti3C2Tx MXenes, human anti-CEACAM1 mAb was immobilized. The complex's specificity, affinity, biocompatibility, and selective photothermal ablation were all examined.

Our findings show that after 4 and 24 hours of incubation with various melanoma cell types and keratinocytes, the MXene-anti-CEACAM1 complex and its constituent parts (MXenes, MXene-PDA, and anti-CEACAM1 mAb) do not exhibit any cytotoxicity. Our findings show that thickening the PDA layer decreases photothermal conversion but has no effect on biocompatibility, specificity, or affinity. Modes of laser irradiation were chosen experimentally to safely affect non-targeted cells while also successfully influencing the complex. When target cells are loaded with MXene-PDA-anti-CEACAM1 mAb complexes, highly selective tumor cell ablation utilizing near-infrared irradiation (NIR) is seen.

We concluded that the use of a combination of MXene-anti-CEACAM1 mAb for selective PTT of tumor cells has significant potential for creating a new model of targeted treatment of melanoma.

Acknowledgements: This research is supported from the HORIZON-MSCA-2021-SE-01 (Project #101086184) and MSCA4Ukraine project (Project #1232462).

Keywords: MXenes, cancer treatment, targeted photothermal ablation.

Presenter: KONIEVA Anastasia (University Hospital Essen, Department of Anatomy)

Status: ACCEPTED

Submitted by **BĒRZIŅA Dina** on **Friday, February 7, 2025**

Abstract ID: **6**

Harnessing Hybrid Nanoarchitectures for Next-Generation Photoelectrochemical Energy conversion

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NanoBioMedical Centre, Adam Mickiewicz University in Poznan, Poland

The global energy crisis and environmental concerns have intensified the search for sustainable and renewable energy sources. Among various strategies, solar-assisted water splitting has emerged as a promising approach for producing clean hydrogen fuel. However, the efficiency of this process is largely dependent on the development of advanced materials that can effectively absorb sunlight, generate charge carriers, and minimize recombination losses. One-dimensional semiconductor nanowires and two-dimensional conductive materials offer a unique combination of properties that can significantly enhance charge transport and interfacial charge separation [1].

In this study, we investigate the synergistic effects of zinc oxide (ZnO) nanowires and layered Ti3C2 (MXene) as hybrid photoelectrodes for solar-driven hydrogen production. ZnO, known for its wide bandgap (3.37 eV) and excellent stability in aqueous environments, suffers from rapid charge carrier recombination, limiting its efficiency in photocatalysis. To overcome this challenge, the integration of ZnO with MXene an emerging class of two-dimensional transition metal carbides offers a promising strategy due to its high electrical conductivity, excellent charge transport properties, and tuneable surface chemistry23. The optimized ZnO/MXene exhibited the highest solar-to-hydrogen (STH) efficiency compared to pure ZnO, highlighting the critical role of interfacial engineering in maximizing solar energy conversion. By leveraging the combined advantages of semiconductor nanowires and highly conductive nanosheets, this work provides valuable insights into the design of next generation photoelectrodes for scalable and efficient hydrogen production.

Acknowledgements: The authors acknowledge the financial support provided by the National Science Centre of Poland (SONATA BIS project 2020/38/E/ST5/00176). This work was also supported by the HORIZON-TMA-MSCA-SE project (A-21563-ZR-N-109 - ESCULAPE 101131147).

Keywords: MXene; photoelectrochemical water splitting; composite photoelectrode; photocatalysis; charge separation.

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Presenter: HANIF Irfan (NanoBioMedical Centre, Adam Mickiewicz University in Poznan)

Status: ACCEPTED

Submitted by **BĒRZIŅA Dina** on **Friday, February 7, 2025**

Abstract ID: **14**

Development of $Ti_3C_2T_x$ MXene-Based Electrochemical Biosensor for Glucose Detection

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Glucose is a vital energy source for cellular functions in living organisms, making it crucial to regulate its concentration within a healthy range in the bloodstream. Elevated glucose levels can cause extensive tissue damage, impacting organs such as the heart, eyes, kidneys, and nerves, potentially leading to severe and life-threatening complications. Currently, glucose biosensors constitute over 85% of the biosensor market, with electrochemical biosensors being particularly effective for glucose detection [1]. The integration of nanomaterials into electrochemical biosensors has been shown to enhance their analytical capabilities significantly. MXenes exhibit exceptional potential due to their high surface area, superior electrical conductivity, and hydrophilic nature, making them well-suited for biosensing applications [2].

This study explores the use of $Ti_3C_2T_x$ MXenes in the development of a glucose biosensor. MXenes and glucose oxidase deposition on the electrode surface was optimized, and different electron transfer mediators were evaluated. The biosensor's analytical performance was then assessed through key performance parameters.

Acknowledgements: This project has received funding from EU Horizon Europe research program project # 101131147 "ESCULAPE".

Keywords: Glucose, MXenes, Glucose oxidase.

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Presenter: POPOV Anton (NanoTechnas – Center of Nanotechnology and Materials Science, Faculty of Chemistry and Geosciences, Vilnius University)

Status: ACCEPTED

Submitted by **BĒRZIŅA Dina** on **Monday, February 10, 2025**

Abstract ID: **10**

Quantum control via the Autler-Townes effect

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Quantum control is based on applying unitary transformations to various quantum systems in order to drive the population evolution into a target state. In a multilevel system with intrinsic interactions between the atomic/molecular levels (specifically spin-orbit interaction), the laser excitation may play a different indirect role. Namely, in the presence of strong electromagnetic fields, the energy levels in atoms/molecules experience shifts in their positions due to the so called Autler-Townes effect [1] (see Fig.1).

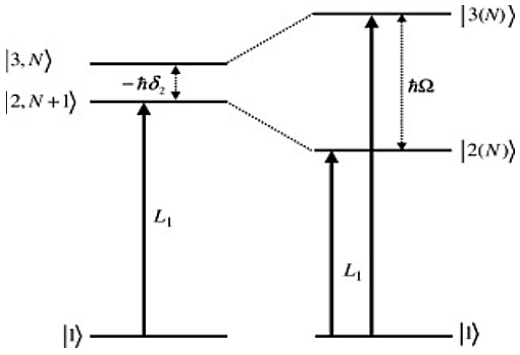

Fig.1. Illustration of Autler-Townes effect in the dressed-states picture (figure reproduced from [2])

Thus, the control of the spin-orbit interaction can be realized by using resonant or nonresonant laser fields with various parameters as an external control mechanism [3, 4].

By extending the scheme presented in [4] we explored the Autler-Townes control of spin-orbit coupling in an original four-level system aiming at large transfer efficiency to a final triplet state [5]. Our findings confirm the interesting features of probe-coupling excitation laser scheme, assisted by the intermediate spin-orbit coupling. The quantum control is based on the energy separation between the singlet and triplet states, modified by the Autler-Townes effect. The detuning and intensity of the control laser are proven to be key parameters of the control protocol.

This work is further developed into a theoretical description of an all-optical spin switch within the "Q-DYNAMO: Quantum Dynamic Control of Atomic, Molecular and Optical Processes" project.

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Presenter: KIROVA Teodora (Institute of Atomic Physics and Spectroscopy, FST, University of Latvia)
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Submitted by **KIROVA Teodora** on **Monday, February 10, 2025**

Abstract ID: **9**

Experiments with ultracold atoms and molecules in Ulm

DENSCHLAG Johannes Hecker

Institute for Quantum Matter, Ulm University, Germany

I will present a brief overview of current research activities in my group at the Institute for Quantum Matter at the University of Ulm. A main focus point of our experiments is cold chemistry where ultracold atoms combine to form diatomic molecules or more general bound states. We have developed experimental methods to precisely determine the quantum states of these bound states. Using these methods, we can learn how the cold reactions work on a fundamental level and we can test novel ways to coherently control the reaction processes. Tools for this control can be, e.g., magnetically tuneable scattering resonances, laser radiation, as well as optical cavities. The types of bound states we produce and study range from weakly-bound dimeric molecules in the electronic ground state, to highly-excited ultralong-range Rydberg molecules, to many-body bound states in a fermionic atomic gas. Finally, I will also introduce an additional project of ours where we want to use holography for imaging atoms in an optical lattice.

Presenter: DENSCHLAG Johannes Hecker (Institute for Quantum Matter, Ulm University)

Status: ACCEPTED

Submitted by **KIROVA Teodora** on **Monday, February 10, 2025**

Abstract ID: **11**

Development of Molecularly Imprinted Polymer based Affinity Sensors

RAMANAVICIUS Arunas[1,2], LIUSTROVAITE Viktorija[2], KARNITSKAYA Yana[2], DROBYSH Maryia[1], BRAZYS Ernestas[2], RUCINSKIENE Alma[2], RATAUTAITE Vilma[2], PLIKUSIENE Ieva[1], SERVUTIENE Julija[2], PRENTICE Urte[1], ZUKAUSKAS Sarunas[2], RAMANAVICIENE Almira[1]

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Affinity sensors are important diagnostics tools used for various biomedical applications. Various technologies are used for the development of biosensors. In some particular cases conducting polymers can be applied for the modification of surfaces used in biological recognition parts of biosensors. Recently conducting polymers are synthesized by several different methods: electrochemical [1], chemical [2], and biochemical [3-4]. Electrochemically generated conducting polymer-based layers are frequently applied in the design of various types of electrochemical molecularly imprinted polymer-based sensors for protein determination [5, 6]. The incorporation of proteins, which is flowed by the extraction of these proteins from conducting polymer matrix [7], is a very important issue during the development of molecularly imprinted polymer-based sensors. The applicability of electrochemically generated polymers in the design of various electrochemical affinity sensors [1] including molecularly imprinted polymer-based sensors [5, 6] will be discussed during the presentation.

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Presenter: RAMANAVICIUS Arunas (State Research Institute Center for Physical and Technological Sciences)

Status: ACCEPTED

Submitted by **BĒRZIŅA Dina** on **Monday, February 10, 2025**

Abstract ID: **12**

Application of Silver Nanoparticles in Root Canal Treatment

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Root canal treatment (RCT), or endodontic treatment, is a dental procedure for the treatment of infected and inflamed pulp and for protection from future bacterial contamination. Although endodontic treatment is a common dental procedure, failure occurs in ~20% of cases, caused by the remaining bacteria left in the root canal or endodontic failure with secondary leakage and infection. The most frequent bacteria, isolated from the infected root canals in cases of secondary infections or endodontic failure, is Enterococcus faecalis, from the oral microbiota. E. faecalis bacteria remain in the root canals or dental tubules due to the technical complexity of the root canal preparations with limitations of the disinfection agents to reach all tooth morphological structures during RCT. These secondary infections often require the dentist to prescribe antibiotic treatment, which stimulates the development of antibiotic resistance in the bacterial infections. New endodontic materials should reduce the incidence of secondary infections by application of non-antibiotic antimicrobial agents. Silver nanoparticles (AgNPs) have proven to be an effective antimicrobial agent due to their unique properties, such as large surface-to-volume ratio, different ways of antibacterial action and importantly, low cytotoxicity. Here, we explore how AgNPs can be used in root canal therapy to eliminate bacteria in the root canal after the RCT-treatment and, thus, reduce the incidence of endodontic failure. The project aims to develop novel silver nanoparticle applications for root canal treatment.

AgNPs' morphology was investigated by scanning (SEM) and transmission electron microscopy (TEM) and confirmed the square shape of the AgNP and their ~50 nm size. The antimicrobial properties of these AgNPs were tested with both solid and liquid media and demonstrated dose-dependent action against E. faecalis. Based on our results of the antimicrobial action of AgNPs, we developed a dental root canal model which close to in-vivo replica the application of AgNPs in endodontic treatment. Bacterial growth of E. faecalis was confirmed throughout the root canal in our dental models by immunocytochemical staining. These results showed that supplementation of AgNPs in the dental model slowed down the growth of E. faecalis compared to dental models without AgNPs.

Thus, our new results demonstrated the effective antimicrobial action against E.faecalis, by application of AgNPs to the dental models and the suggest that AgNPs provides promising translational potential as antimicrobial agent with quality of patient-care improvements and long-term cost-efficiency in the clinical endodontics.

Acknowledgements: The project was supported in part by the HORIZON-MSCA-SE-2021 project ARGO (#101086441).

Keywords: silver nanoparticles, endodontic treatment, root canal treatment, Enterococcus faecalis, antibiotic resistance.

Presenter: BUTSYK Anna (Dept. Medical Biochemistry and Biophysics, Umeå University)
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Abstract ID: **13**

Silver Nanoparticles Antibiofilm Activity Against ESKAPE Bacteria

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Over the last two decades, nanoparticles have been actively studied as an alternative to antibiotics due to the rise of antibiotic resistance. However, while nanoparticles have demonstrated proven antimicrobial effectiveness, their antibiofilm activity still requires further investigation. In particular, this is especially relevant for ESKAPE pathogens (E. faecium, S. aureus, K. pneumoniae, A. baumannii, P. aeruginosa, and Enterobacter spp.), which are the major causes of healthcare-associated infections and are capable of "escaping" the biocidal action of antimicrobial agents. The aim of this study was to investigate the antibiofilm activity of the silver nanoparticles against biofilms formed by ESKAPE bacteria.

Silver nanoparticles (NPs) provided by Nano Pure Co. (Warsaw, Poland) were used to treat biofilms formed by ESKAPE pathogens after 1, 2, and 5 days of incubation. Biofilm mass and viability were assessed using the resazurin assay and gentian violet staining.

The results indicate that silver NPs exhibited antibiofilm activity at low concentrations (ranging from 10 to 40 μg/mL). There was a varying degree of reduction in biofilm mass and the number of viable cells forming mature biofilms. The effectiveness of the silver antibiofilm activity varied depending on the species and the age of the biofilms. Biofilms formed by S. aureus and P. aeruginosa were the most sensitive to the action of silver nanoparticles, while five-day-old biofilms were the most resistant.

These findings highlight the potential of AgNPs as a promising alternative to conventional antibiotics in the treatment of biofilm-associated infections caused by ESKAPE pathogens.

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Keywords: bacteria, biofilms, silver nanoparticles, antimicrobials.

Presenter: HOLUBNYCHA Viktoriia (Sumy State University)

Status: ACCEPTED

Submitted by **BĒRZIŅA Dina** on **Monday, February 10, 2025**

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Latvijas Universitātes EZTF **Atomfizikas un spektroskopijas institūts** (LU EZTF ASI) dibināts 1994.gadā uz LU Spektroskopijas problēmu laboratorijas (dibināta 1967.g.) un LZA Fizikas institūta (dibināts 1957.g.) Teorētiskās fizikas laboratorijas bāzes. 2024.gadā institūts svinēja 30-gadu pastāvēšanu (https://www.asi.lu.lv/par-mums/zinas/zina/t/83903). Institūtā veic starptautiska līmeņa fundamentālus un lietišķus pētījumus atomfizikā, spektroskopijā, kvantu fizikā, fotonikā, optiskajās tehnoloģijās, medicīnas fizikā un ar tām saistītajās starpnozarēs. Institūtā tiek arī izstrādātas jaunas optiskās metodes un ierīces izmantošanai ražošanā, medicīnā un vides monitoringā.

Pētniecības projektu izstrādē piedalās gan akadēmiskais personāls: vadošie pētnieki, pētnieki, un zinātniskie asistenti, gan arī bakalaura, maģistra un doktora programmu studenti, kā arī grāda pretendenti. 2024.gada noslēgumā ASI bija 92 darbinieki, no tiem ap 70 pamatdarbā. Institūta personāls iesaistījies EZTF studiju darbā ar speciāli sagatavotiem mācību kursiem.

LU ASI kā fundamentālo un lietišķo pētījumu ekselences centru ir atbalstījusi Eiropas Komisija. Aktīvu starptautisku zinātnisko sadarbību veicina Starptautiskā lietišķās optikas biedrība (SLOB) un Starptautiskās optikas komisijas (ICO) Latvijas reģionālā komiteja, kuras darbojas institūta paspārnē.

The **Institute of Atomic Physics and Spectroscopy** of the FST, University of Latvia (IAPS FST UL) was founded in 1994 based on the Spectroscopy Problem Laboratory (founded in 1967) and the Laboratory of Theoretical Physics of the Institute of Physics of the Latvian Academy of Sciences (founded in 1957). The IAPS performs recognised fundamental and applied research in atomic physics, spectroscopy, photonics, quantum physics, medical physics and related areas. New optical methods and devices for applications in industry, medicine and environmental monitoring are being developed, as well. The Institute has been supported by the European Commission as the Centre of Excellence for Basic Research in Nanoscale Physics and Applications. By the end of 2024, IAPS employed 92 persons