KONDOKPAN 2024

VIII Conference of doctoral students of the PAS

BOOK OF ABSTRACTS

11-13 October 2024

PAN
Rada
Samorządu Doktorantów
Polskiej Akademii Nauk

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Organizers

The event is organized by the
Doctoral Council of the Polish Academy of Sciences
teams operating at the Council and the Institute of Physical Chemistry, PAS.

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WFD Warszawskie Forum Doktorantów

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Conference schedule

Friday, October 11th, 2024	
Time	What's going on
13.00	**Registration** Institute of Physical Chemistry of Polish Academy of Sciences (PAS) Kasprzaka 42/55, 01-224, Warszawa
15.00 – 15.10	**Conference opening**, Presentation of main partners
15.10 – 15.30	**Sirlara Alves** Sign Language in the Spotlight: Pointing Signs in Brazilian Sign Language (Libras) and Polish Sign Language (PJM)
15.30 – 15.50	**Shweta** Into deciphering the role of drug/metabolite transporters in Pseudomonas aeruginosa
15.50 – 16.10	**Rim Ibrahim** Uncovering the genetic causes of asthenozoospermia using whole genome sequencing in three consanguineous families
16.10 – 16.30	**Anna Fedenko** Repartitioning of dsDNA homo- and hetero- duplexes by DNA melting and annealing
16.30 – 18.00	**Trip to the Muzeum Gazowni Warszawskiej**
19.00	**Integration Meeting** Elektrownia Powiśle - Dobra 42, Warszawa, PL 00-312Warszawa

Saturday, October 12th, 2024	
Time	What's going on
9.20 – 9.40	**Uroosa** Effect of microplastics on microbial communities from the coastal Baltic Sea
9.40 – 10.00	**Julia Sepielak-Świderska** Making decisions: novel method for exploring spatial choices
10.00 – 10.20	**Muhammed Aktas** Polarization doped; the alternative of Mg doping for nitride semiconductors
10.20 – 10.40	**Magdalena Rowińska** Beyond Solar Cells - Unlocking the Versatile Applications of Hybrid Perovskite Materials
10.40 – 11.00	**Asha Ajithakumari Sobhanakumar** Studies On Drug/Metabolite Transporters Of Pseudomonas Aeruginosa, An Opportunistic Human Pathogen
11.00 – 11.20	**Coffee break**
11:20 – 11:40	**PWN**
11.40 – 12.00	**James Pogrebetsky** Novel correction scheme to reach CCSD(T)/CBS: racing towards accuracy
12.00 – 12.20	**Christian Ikechukwu Eze** Characterizing the variability of a sample of massive pulsators in eclipsing binaries
12.20 – 12.40	**Spoorthy Gowda** Into deciphering the role of drug/metabolite transporters in Pseudomonas aeruginosa

Saturday, October 12th, 2024	
Time	What's going on
12.40 – 13.00	**Martyna Anna Przewoźnik** Plant-derived chimeric Virus-Like Particles for injection-oral vaccine delivery
13.00 – 14.00	**Lunch break**
14.00 – 14.20	**Adam Kabański** Luminescent thermometery - a novel approach to remote temperature sensing
14.20 – 14.40	**Mohammad Azam** High-pressure growth effects on superconducting properties of iron-based superconductors
14.40 – 15.00	**Farzad Khanipour** mTORopathic Dysfunction in Hippocampal DG/CA3 Circuitry as a Common Etiology of Epilepsy-Associated Cognitive Comorbidities
15.00 – 15.20	**Elżbieta Jarosińska** The lights and shadows of the scaffold-based 3D cell culture models
15.20 – 15.40	**Naira Grigoryan** Effective Tomonaga-Luttinger liquid theory for multi-wall nanotubes
15.40 – 16.00	**Coffee break**
16.00 – 17.00	**Discussion Panel**: *AI in Science*
20.00	**Integration Meeting** Fabryka Norblina – bar & food court, Żelazna 51/53, 00-841 Warszawa

Sunday, October 13th, 2024	
Time	What's going on
09.40 – 10.00	**Estera Wojtkowiak** „Houston, we have problem" - about all the problems in orally-delivered vaccines production
10.00 – 10.20	**Małgorzata Drabko** Analysis of a novel human trimeric complex TTC33-associated network core (TANC) formed by TTC33:PHF5A:WDR61
10.20 – 10.40	**Patrycja Zdeb** How to disinfect surfaces with the sunlight? Phosphors converting visible light into the UVC
10.40 – 11.00	**Farwa Khalid** NMR Photodegradation Insights: Contrasting Low-Field and High- Field Approaches via In-Situ and Inflow Methods
11.00 – 11.30	**Coffee break**

Sunday, October 13th, 2024	
Time	What's going on
11.30 – 11.50	**Dhruv Maniktala** Studying glacier calving variability in the High-Arctic (Svalbard)
11.50 – 12.10	**Marek Adaszyński** The critical role of high-quality white light and techniques for developing LED composites with high CRI index
12.10 – 12.30	**Zofia Rudnicka** Exploring Spiking Neural Networks: Applications in Biomedical Signal Classification
12.30 – 12.50	**Ved Prakash Dubey** Yield surface identification of additively manufactured stainless steel 316L considering its printing orientation
13.00 – 14.00	**Workshop** – Voice emission
14.00	**Closing ceremony**

General Information

The conference Venue:
Institute of Physical Chemistry
Polish Academy of Sciences
Ul. Kasprzaka 44/52
01-221 Warszawa

The Institute is located in the Wola district, near Płocka metro station (M2) and Warszawa Wola train station (PKP). There are also many bus and train stops in the area allowing access from the center of Warsaw. Entry to the premises of the IOC / IPC PAS is possible from Kasprzaka Street through building 1 (8 am – 4 pm) or through the gate from Płocka Street. Access by car to the IOC / IPC PAS premises is possible through the gate from Płocka Street.

Integration meeting places:

Integration meeting (Friday):	DZIEŃ I NOC Hala Mirowska, plac Mirowski 1, 00-138 Warszawa
Integration meeting (Saturday):	Fabryka Norblina – bar & food court, Żelazna 51/53, 00-841 Warszawa

Abstracts

Friday, October 11th 2024

Sign Language in the Spotlight: Pointing Signs in Brazilian Sign Language (Libras) and Polish Sign Language (PJM)

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Sign languages are natural, visual-spatial communication systems used by Deaf communities worldwide. Each country, and sometimes even regions within a country, have their own sign language, which contributes to the great diversity among these linguistic systems. Despite their complexity and linguistic validity, research on sign languages is relatively new and continues to develop in various fields of linguistics. This study presents the results of my first-year doctoral research conducted at the Institute of Polish Language, Polish Academy of Sciences. Its aim is to compare the use of *pointing signs* in Brazilian Sign Language (Libras) and Polish Sign Language (PJM), with a focus on their linguistic functions. The analysis, based on video recordings from the RISE project, reveals differences in the frequency and types of pointing signs used in both languages. Libras is characterized by a higher number of classifiers, whereas PJM more frequently employs agreement verbs and additional localization signs. Preliminary analyses of two children's video stories about COVID-19, told in Libras and PJM, confirm these differences. Moreover, the findings indicate different communicative strategies, suggesting complex structural differences between Libras and PJM. These initial conclusions contribute to a better understanding of the role of pointing signs in these sign languages. They also highlight the need for further comparative research in this field, with significant implications for theoretical sign language linguistics.

References:

1. Bertone, C., & Cardinaletti, A. (2010). The syntax of pronominal pointing signs in Italian Sign Language (LIS). In *Proceedings of TISLR 10*, Purdue University, September 30 - October 2, 2010.
2. Cormier, K., Schembri, A., & Woll, B. (2012). Pronouns. In R. Pfau, M. Steinbach, & B. Woll (Eds.), *Sign Language: An International Handbook* (pp. 109-137). Mouton de Gruyter.
3. De Meulder, M., Murray, J. J., & McKee, R. L. (Eds.). (2019). *The legal recognition of sign languages: Advocacy and outcomes around the world*. Multilingual Matters.
4. Johnston, T., & Schembri, A. (2007). *Australian Sign Language (Auslan): An introduction to sign language linguistics*. Cambridge University Press.
5. Johnston, T. (2013). Formational and functional characteristics of pointing signs in a corpus of Auslan (Australian sign language): Are the data sufficient to posit a grammatical class of 'pronouns' in Auslan? *Corpus Linguistics and Linguistic Theory, 9*(1), 109-159.
6. Stokoe, W. C. (1960). *Sign language structure: An outline of the visual communication systems of the American deaf. Studies in Linguistics: Occasional Papers, 8*. Gallaudet College Press.
7. Świdziński, M., & Rutkowski, P. (2022). Korpus ogólny jako model danego języka naturalnego: Korpusy języków fonicznych a korpus polskiego języka migowego. *Poradnik Językowy, 2022*(792), 7-22. Towarzystwo Kultury Języka.

Into deciphering the role of drug/metabolite transporters in *Pseudomonas aeruginosa*

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Pseudomonas aeruginosa is a Gram-negative and common environmental bacterium. It is an opportunistic human pathogen infecting immunocompromised patients. It is recognized as one of the main causes of nosocomial infections infecting hospitalized patients. Being intrinsically resistant to a wide range of antibiotics it is the primary cause of morbidity and mortality in people with cystic fibrosis [1,2]. We study drug/metabolite transporters (DMTs), a poorly characterised class of proteins categorized as secondary transporters, using *P. aeruginosa* as a model organism. Around 33 proteins categorized as DMTs are encoded by the *P. aeruginosa* genome [3,4]. In the *in silico* studies it has been predicted that DMTs have 4-5 or 9-10 transmembrane segments [5]. We use *in silico*, genetic and microbiological techniques to decipher the role of DMTs in *P. aeruginosa.* We demonstrated that bacterial growth is significantly inhibited when certain DMTs are overexpressed. *P. aeruginosa* strains that overexpressed specific DMTs were also evaluated for their ability to grow in the presence of antimicrobial drugs, to move, and to form biofilms. These strains have shown some modulation of tested phenotypes for particular proteins. We also tested the effect of DMT overproduction on *E.coli* in the presence of quaternary ammonium compounds (QACs); which might lead us towards finding the substrate for the DMTs. As a part of *in silico* analyses, we also tried to identify the potential inhibitors of the DMTs by using molecular docking techniques. The findings point to the important roles that DMTs play in *P. aeruginosa* survival and pathogenicity. The obtained data provide light on the DMT family, their importance to bacteria, and role they play in the biology of *P. aeruginosa.*

This research was funded by the Polish National Science Centre-OPUS 23(grant 2022/45/B/NZ2/03716 (2023-2026).

References:

1. Alhazmi A. (2015) *Pseudomonas aeruginosa* – Pathogenesis and Pathogenic Mechanisms. *International Journal of Biology* 7.
2. Gales AC, Jones RN, Turnidge J, Rennie R, Ramphal R. (2001) Characterization of *Pseudomonas aeruginosa* isolates: occurrence rates, antimicrobial susceptibility patterns, and molecular typing in the global SENTRY Antimicrobial Surveillance Program, 1997-1999. *Clin Infect Dis.* 32 Suppl 2:S146-155.
3. Winsor GL, Griffiths EJ, Lo R, Dhillon BK, Shay JA, Brinkman FSL. (2016) Enhanced annotations and features for comparing thousands of *Pseudomonas* genomes in the *Pseudomonas* genome database. *Nucleic Acids Res.* 44:D646-653.
4. Elbourne LDH, Tetu SG, Hassan KA, Paulsen IT (2017) TransportDB 2.0: a database for exploring membrane transporters in sequenced genomes from all domains of life. *Nucleic Acids Res.* 45:D320–4.
5. Jumper, J. et al. (2021) Highly accurate protein structure prediction with AlphaFold. *Nature*, 596, pp 583–589.

Uncovering the genetic causes of asthenozoospermia using whole genome sequencing in three consanguineous families

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Infertility affects around 15% of reproductive couples, and male infertility accounts for approximately half of these cases. Asthenozoospermia (AZS), one of the most common causes of male infertility, is caused by sperm structural or functional deficiencies, the deleterious effect of the seminal plasma, life style and environmental factors; it can also be of idiopathic causes. Genetic diagnosis technologies such as whole genome sequencing (WGS) and whole exome sequencing (WES) are crucial to uncover novel genetic variants causative of AZS. Many studies employed consanguineous families to search for genes underlying diseases as they offer valuable genetic data with enhanced accuracy in genomic analysis. In this study, we performed WGS on three Pakistani consanguineous families affected by asthenozoospermia. We will present the results of one of these families, in which we compared the results of the two asthenozoospermic brothers and the brother with severe oligoasthenozoospermia, to the results of other family members, the mother and the fertile brother, to identify gene variants responsible for the conditions. We identified homologous mutations in key genes related to sperm flagella, including *DNAH12* (c.7558C>T; p.Arg2520Ter) and *DNAAF6* (g.107244441T>C) crucial for dynein arm function, and in two CCDC family genes *CCDC122* (g.43832019A>G), *CCDC27*(c.1513A>C; p.Asn505His), as well as *CYLC1*(c.1943A>G; p.His648Arg), all of which are essential for maintaining the structure and the integrity of the flagellum. We also uncovered a mutation in the *KATNAL1* gene, which is predicted to be related to severe male infertility phenotypes and regulates microtubule dynamics, in the patient with severe oligoasthenozoospermia. And finally, we uncovered variants in *MUC19*(c.16851G>A; p.Trp5617Ter, and two novel frameshift mutations g.40489363insCT, and g.40489365_40489367delAA) and *MOSMO* (c.*612A>C), which may have a possible role in male fertility. These findings reaffirm the importance of the dynein arm assembly genes in asthenozoospermia and highlight the potential role of the *KATNAL1* mutation in causing severe oligozoospermia.

This work was supported by the National Science Centre in Poland, Grant No. 2020/37/B/NZ5/00549.

Slow versus fast DNA annealing

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The melting and annealing of mixtures of related DNA alleles is part of many enzymatic and non-enzymatic methods for mutation detection. After DNA has been denatured to single strands by heating, the annealing step can generate both homo- and heteroduplexes. Qualitatively, it is clear that very slow, quasi-equilibrium annealing will generate the thermodynamic products, i.e. the ratios of homo- and heteroduplexes are determined by the Boltzmann distribution and their relative (free) energies. Fast annealing generates kinetic products, in the extreme case, equal amounts of homo- and heteroduplexes are expected. But what is fast and what is slow? Here, we develop and Arrhenius model for the annealing of DNA mixtures, analyze the model numerically, show that the meaning of "slow" and "fast" is strongly dependent on the salt concentration, and we test the predictions of the model experimentally.

Abstracts

Saturday, October 12th 2024

Effect of microplastics on microbial communities from the coastal Baltic Sea

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Increasing microplastic (MP) pollution is greatly affecting the aquatic environment. Thus, it is vital to know its effects on the ecosystem. The current studies focus mostly on its toxicity in marine organisms, mostly animals such as fish, but little information is available regarding microbial communities. This study was designed to find out the effects of Polystyrene (PS) and Polyethylene (PE), which are of smaller size and commonly found pollutants. The natural microbial community was collected from the coastal Baltic Sea and exposed to bacteria- sized PS, PE and glass microspheres. Two experiments were designed. In the first experiment, we studied the effect of PS concentrations on the abundance and activity of heterotrophic nanoflagellates (HNF) and prokaryotes over five days, while in the second experiment, we compared the effects of PS and PE. We observed a consistent negative effect of PS (that was more conspicuous at higher concentrations) and PE on HNF abundance, while for bacteria the effect was negligible or, in the case of PS, even positive. Moreover, the presence of glass and MPs particles lowered the respiration rate of the microbial community, indicating the importance of the physical effects of increased particle concentrations in the water. The changes in microbial abundance and activity were accompanied by shifts in bacterial and HNF community composition. These results indicate the complex nature the presence of MPs may have on microbial communities. The combined effect of toxicity and the physical presence of inedible particles may alter the primary microbial consumers and cause a disturbance in microbial aquatic food webs. Further experiments are planned to understand the observed patterns.

This research was funded NCN research project 'Effect of the microplastic pollution on structure and functioning of pelagic microbial food webs (2021/42/E/NZ8/00163).

Making decisions: novel method for exploring spatial choices

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Most aspects of animal behaviour are based on decisions. One of the most extensively researched type of decisions is spatial choice -that uses spatial information to suppress inappropriate behaviours [1]. The population activity of place cells in the dCA1 area underlies spatial choice and memory. Place cell activity can be recorded when an animal is freely moving throughout the space. However, in the majority of studies on spatial choices, behaviour is investigated with protocols that require direct involvement of the researcher. Additionally, traditional tools used for assessment of spatial choice do not have required dimensions to monitor changes within place cells' activity using genetically encoded, and relatively slow, calcium indicators.

Here, we present a new system for monitoring mice activity and navigation with our recent findings on behavioural protocol that can be employed within it. This apparatus is built of integrated modules including camera system, cue display system, liquid reward dispensers and door control system. Animals are tested within 3 connected corridors, parted with automatic doors, where they can roam undisturbed and consume reward (sweet milk) at the end of reward arms from automatic dispensers. The automation of our task enables evaluation of spatial choices without the researcher's direct involvement. Additionally, an open construction ofthe maze allows for recording of the brain cell activity of a freely moving mouse with the use of a miniature microscopy and optogenetic tools along with recording of the animal's behaviour within the entire space.

This research was funded by the Polish National Science Centre (project No. 2020/38/1/NZ4/00483 K. Radwanska).

Reference:

1. Bannerman, D., Bus, T., Taylor, A. et al. Dissecting spatial knowledge from spatial choice by hippocampal NMDA receptor deletion. Nat Neurosci 15, 1153–1159 (2012). https://doi.org/10.1038/nn.3166.

Polarization doped; the alternative of Mg doping for nitride semiconductors

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Nitride semiconductors are crucial for applications spanning the UV to visible spectrum owing to their wide direct bandgap, high thermal stability, and excellent electron mobility. A significant advancement in this field is successful p-type doping using Mg, which has revolutionized optoelectronics. Currently, Mg is irreplaceable in this role, although it has certain limitations. Due to the wide bandgap of nitride semiconductors, Mg has a relatively high ionization energy (ranging from 160-200 meV in GaN to 630 meV in AlN) compared to other optical materials (40 meV for GaAs, 35 meV for GaP). Additionally, the low free hole concentration resulting from this ionization energy poses challenges because the hole concentration is highly temperature-dependent, complicating applications at cryogenic temperatures.

Polarization doping offers a solution to these issues. The wurtzite structure of nitride semiconductors enables strong spontaneous and piezoelectric polarization. A composition gradient along the growth direction induces a fixed volume charge that attracts free carriers, resulting in n- or p-type conduction, which is known as polarization doping. Adjusting the thickness and gradient slope allows the carrier concentration to be controlled, making carrier generation almost independent of temperature. Unlike Mg-doping, this characteristic is particularly advantageous for applications at cryogenic temperatures.

In this paper, we present the concept of polarization doping and demonstrate recent results in its application. The laser structure exhibits stable performance across a broad temperature range (350–200 K). At room temperature, the slope efficiency varies between 0.8 and 1.2 W/A, while the threshold current ranges from 30 to 60 mA. Polarization-doped structures show promising results at both high and low temperatures.

Beyond Solar Cells - Unlocking the Versatile Applications of Hybrid Perovskite Materials

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Lead halide perovskites have attracted significant interest due to their unique photovoltaic properties. In recent years, advancements in lead halide perovskite-based solar cell technologies have resulted in impressive improvements in energy conversion efficiency, rising from 3.8% to 22.7% in laboratory conditions [1,2]. Theoretical studies indicate that the cubic phase of $MAPbI_3$ exhibits a bandgap of approximately 1.7 eV, closely aligned with the experimentally measured optical bandgap of ~1.6 eV [3]. Beyond photovoltaics, hybrid perovskites show potential applications in light-emitting diodes (LEDs), lasers, photodetectors, and memory transistors [4]. However, materials such as $CH_3NH_3PbI_3$ face challenges related to the toxicity of lead and instability when exposed to ambient humidity. Consequently, the search for novel organic-inorganic compounds with optimized optoelectronic properties remains crucial for enhancing the efficiency of perovskite solar cells and expanding their large-scale application. Examples include hybrid organic-inorganic perovskites (HOIPs) based on Sb^{3+} or Bi^{3+}, which have demonstrated potential in photocatalytic hydrogen synthesis [5]. Additionally, tin-based hybrids present a promising alternative to lead and hold potential for use in artificial synapse applications [4].

Organic-inorganic hybrids with perovskite structures continue to be a subject of extensive exploration. Antimony (Sb^{3+}) and bismuth (Bi^{3+}) cations, featuring lone pairs, have been proposed as suitable substitutes for lead cations. This is attributed to the electronic configuration of Pb ($6s^26p^0$), which plays a crucial role in the distinctive optoelectronic properties of perovskites, such as high symmetry of perovskite structure and broad absorption spectrum [6]. The general formula of lead halide perovskite is $\mathbf{ABX_3}$, involves **A** as a small organic cation, B as a divalent metal like Pb^{2+} and as **X** a halide. In contrast, double perovskites with the formula $\mathbf{A_2BB'X_6}$, where B is a monovalent metal (Na^+, K^+, Cs^+) and **B**' is a trivalent metal (Bi^{3+} o Sb^{3+}) offer remarkably stability and are environmentally more friendly than lead-based perovskites [7].

This research was funded by the Polish National Science Centre (project No. 2021/43/B/ST5/01172).

References:

1. Kojima, A., Teshima, K., Shirai, Y., and Miyasaka, T., *J. Am. Chem. Soc*. (2009),131, 6050–6051. Agrios GN (2005) *Plant Pathology*. 5th ed. Academic Press, San Diego, CA, USA.
2. Chen, W., Wu, Y., Yue, Y., Liu, J., Zhang, W., Yang, X., Chen, H., Bi, E., Ashraful, I., Gratzel, M., *Science* (2015), 350, 944–948.
3. R.Long, J.Liuand O.V.Prezhdo, , *J. Am. Chem. Soc*., (2016), 138, 3884–3890.
4. Y.Liu, Y.Liu, Y. Guo, Mater. Chem. Front., (2023), 7, 5215.
5. ACS Sustainable Chem. Eng. (2019), 7, 17, 15080–15085.
6. Yin, W.J., Shi, T., Yan, Y. *Adv. Mater*. (2014), 26, 4653–4658.
7. Zhou, J., Xie, P., Wang, C., Bian, T., Chen, J., Liu, Y., Guo, Z., Chen, C., Pan, X., Luo, M., Yin, J., Mao, L., *Angew. Chem., Int. Ed*. (2023),*64* e202307646.

Studies on Drug/Metabolite Transporters of *Pseudomonas aeruginosa*, an opportunistic human pathogen

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Pseudomonas aeruginosa is a bacterium commonly found in various niches and able to survive in very unfavourable conditions. Being a dangerous opportunistic human pathogen, it is often the cause of nosocomial infections [1-2]. We use *P. aeruginosa* as a model organism to characterize drug/metabolite transporters (DMTs) comprising a poorly characterized group of proteins, classified as secondary transporters. *P. aeruginosa* genome encodes at least 33 proteins classified as DMTs [3-4]. Predicted *in silico* model structures of DMTs suggest 4-5 or 9-10 transmembrane segments [5]. At the N-terminus of the DMTs, the signal peptide allowing targeting to the membrane was identified [6]. We apply microbiological and genetic techniques with *in silico* analyses to decipher the role of DMTs in bacteria. We cloned genes encoding DMTs from *P. aeruginosa* in expression vectors. The influence of the DMTs overproduction on the kinetics of growth was tested in *E. coli* and *P. aeruginosa*. We showed that the overproduction of some DMTs causes significant inhibition of bacterial growth. The ability to grow in the presence of antimicrobial agents, to move, or to form biofilm were also tested for *P. aeruginosa* strains overproducing chosen DMTs, showing some modulation of tested phenotypes for certain proteins. The results suggest the involvement of DMTs in important functions connected with *P. aeruginosa* survival and virulence. Obtained results provide insight into the DMT family, their essentiality for bacteria, and role in *P. aeruginosa* biology.

This research was funded by the Polish National Science Centre-OPUS 23(grant 2022/45/B/NZ2/03716 (2023-2026).

References:

1. Alhazmi A. (2015) *Pseudomonas aeruginosa* – Pathogenesis and Pathogenic Mechanisms. *International Journal of Biology* 7.
2. Gales AC, Jones RN, Turnidge J, Rennie R, Ramphal R. (2001) Characterization of *Pseudomonas aeruginosa* isolates: occurrence rates, antimicrobial susceptibility patterns, and molecular typing in the global SENTRY Antimicrobial Surveillance Program, 1997-1999. *Clin Infect Dis.* 32 Suppl 2:S146-155.
3. Winsor GL, Griffiths EJ, Lo R, Dhillon BK, Shay JA, Brinkman FSL. (2016) Enhanced annotations and features for comparing thousands of *Pseudomonas* genomes in the *Pseudomonas* genome database. *Nucleic Acids Res.* 44:D646-653.
4. Elbourne LDH, Tetu SG, Hassan KA, Paulsen IT (2017) TransportDB 2.0: a database for exploring membrane transporters in sequenced genomes from all domains of life. *Nucleic Acids Res.* 45:D320–4.
5. Jumper, J. et al. (2021) Highly accurate protein structure prediction with AlphaFold. *Nature*, 596, pp 583–589
6. Teufel, F., Almagro Armenteros, J.J., Johansen, A.R. (2022) SignalP 6.0 predicts all five types of signal peptides using protein language models. *Nat Biotechnol* 40, 1023–1025.

Novel correction scheme to reach CCSD(T)/CBS: racing towards accuracy

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In many cases system size limits the applicability of theoretical methods. The famous coupled cluster (CCSD(T)) method, known as the "gold standard" – a title given for it's remarkable accuracy – is such an example. An approximation, denoted DLPNO-CCSD(T) [1] is a much more cost-efficient option, but it loses in accuracy in case of molecules possessing unpaired electrons or high degree of delocalization. It truncates the orbital space and in such cases much tighter truncation parameters are required. Another way to increase accuracy of the method is to use a recently developed PNO-extrapolation technique [2] that significantly rises the computational cost of the calculation. We propose a simple and more efficient correction procedure that makes up for the missing part of the orbital space [3] with negligible increase in computation time as well as fixes another major source of error in calculations – the basis set size. This simple procedure is able to bring the accuracy of DLPNO-CCSD(T) calculations to the level of state of the art CCSD(T)/CBS.

This research was funded by the Polish National Science Centre (project No. 2018/30/E/ST4/0000).

References:

1. Guo, Y., Riplinger, C., Becker, U., Liakos, D. G., Minenkov, Y., Cavallo, L., & Neese, F. (2018). Communication: An improved linear scaling perturbative triples correction for the domain based local pair-natural orbital based singles and doubles coupled cluster method [DLPNO-CCSD(T)]. The Journal of Chemical Physics, 148(1), 011101.
2. Altun, A., Neese, F., & Bistoni, G. (2020). Extrapolation to the Limit of a Complete Pair Natural Orbital Space in Local Coupled-Cluster Calculations. Journal of Chemical Theory and Computation, 16(10), 6142–6149.
3. Pogrebetsky, J., Siklitskaya, A., & Kubas, A. (2023). MP2-Based Correction Scheme to Approach the Limit of a Complete Pair Natural Orbitals Space in DLPNO-CCSD(T) Calculations. Journal of Chemical Theory and Computation, 19(13), 4023–4032.

Characterizing the variability of a sample of massive stars in eclipsing binaries

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Massive stars exhibit a perplexing mismatch between their inferred masses from different observational techniques, posing a significant challenge to our understanding of stellar evolution and structure. This discrepancy is believed to be caused by the underestimation of the convective core masses. The efficiency of such measurement is usually impaired by a lot of processes at work in the interior of the stars such as convective core overshooting and interior rotation. By integrating the precision of Asteroseismology which provides insights into the internal structure and dynamics of stars, with the detailed observational constraints offered by eclipsing binary systems, this study aims to precisely characterize a sample of massive pulsators in eclipsing binaries to infer their properties and evolutionary state. In this paper, a sample of ten massive pulsators in eclipsing binary systems observed photometrically with TESS and spectroscopically with SALT and CHIRON between 2021 and 2023 are analyzed. The orbital elements as well as the basic stellar parameters of the targets in the sample are fitted to derive the geometry of their orbits as well as their absolute parameters. The asteroseismic properties of the targets are also obtained, which unravel their core dynamics and profiles. This is a precursor work that provides detailed characterization of the targets in the sample for future theoretical modeling.

This research was funded by the Polish National Science Centre (grant No. 2021/43/B/ST9/02972).

Healthspan modulation in aging worms

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Aging is a complex biological process characterized by progressive physiological changes that ultimately lead to a decline in health and functional capacity within living organisms [1]. Healthspan is the period during which an individual remains healthy and free from discomfort and disease. Health maintenance is essential for improving quality of life as one ages. This study investigates strategies to enhance the health quality (rejuvenation) of aging *Caenorhabditis elegans* (*C. elegans*) worms, which serve as an excellent model organism for aging due to its short lifespan and well-characterized anatomy [2]. Specifically, we focus on the post-reproductive phase, a critical period where health deterioration starts to become evident.

Our research employs a pharmaceutical approach aimed at rejuvenation, utilizing voluntary locomotion as a main parameter to assess healthspan in *C. elegans*. By testing a curated list of small molecule compounds, along with selected combinations of two compounds, we aim to identify interventions that can effectively enhance healthspan. In our methodology, we intentionally repurpose existing compounds known for their biological activity, applying them on the aging *C. elegans* population. This targeted strategy represents a significant departure from existing aging studies that predominantly focus on extending lifespan through interventions during the reproductive stage.

The implications of this research extend beyond the realm of *C. elegans*, offering a new perspective on human health and medicine [3]. This study highlights the importance of shifting the focus from merely prolonging lifespan to enhancing the quality of life during aging.

In conclusion, our findings could pave the way for innovative repurposing strategies aimed at promoting healthspan, thereby improving the well-being of aging populations. By leveraging the simplicity and short lifecycle of *C. elegans*, we hope to contribute valuable knowledge that may inform future research and therapeutic development in the field of aging.

References:

1. Keshavarz, M., Xie, K., Bano, D., & Ehninger, D. (2023). Aging–What it is and how to measure it. Mechanisms of ageing and development, 213, 111837.
2. Saul, N., Möller, S., Cirulli, F., Berry, A., Luyten, W., & Fuellen, G. (2021). Health and longevity studies in C. elegans: the "healthy worm database" reveals strengths, weaknesses and gaps of test compound-based studies. Biogerontology, 22(2), 215–236. https://doi.org/10.1007/s10522-021-09913-2.
3. Guarente, L., Sinclair, D. A., & Kroemer, G. (2024). Human trials exploring anti-aging medicines. Cell Metabolism, 36(2), 354-376.

Plant-derived chimeric Virus-Like Particles for injection-oral vaccine delivery

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Chimeric Virus-Like Particles (cVLPs) have emerged as a versatile and potent platform for vaccine development, capable of inducing robust immune responses through both injection and mucosal, including oral, delivery. These VLPs are engineered to display antigens from various pathogens, mimicking structural properties of viruses while being non-infectious. The production of chimeric VLPs in plant expression systems offers several advantages, including cost-effectiveness, scalability, and safety from human pathogen contamination. These plant-derived VLPs maintain their structural integrity and antigenic properties, ensuring effective immune system engagement. Their capability of dual delivery broadens their applicability and accessibility, particularly beneficial in regions with limited healthcare infrastructure. Recent studies have shown that plant-produced chimeric VLPs delivered after purification via injection and via oral route using lyophilized plant tissue, can induce strong both mucosal and systemic immune responses, demonstrating their potential to combat a wide range of infectious diseases. This innovative approach promises a new generation of vaccines that are both versatile and efficient, addressing global health challenges with a novel and sustainable solution, not only for humans but also for domestic animals such as cattle or sheep.

In this research focus is put on the production of veterinary vaccine against *F. hepatica*, major parasite of ruminants, in plant expression systems using the catalytic domain of a cysteine proteinase (CP), defined as the major *F. hepatica* antigen, as an epitope displayed on the surface of VLPs assembled by the HBcAg protein (Hepatitis B Virus core Antigen). Transgenic plants of lettuce expressing the variants of chimeric antigen: heterodimer HBcCP-HBcAg or monoepitopic HBcCP, were obtained via *Agrobacterium*-mediated transformation. Superior plant producers were lyophilized to prepare oral vaccine component. Experiments of transient expression of HBcAg-CP were also performed.

This research was funded by the Polish National Science Centre (project No. 2019/35/B/NZ6/04002).

Luminescent thermometry – a novel approach to remote temperature sensing

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The constant development of fields such as science, industry, or medicine requires the implementation of highly accurate methods of monitoring the temperature. This parameter is directly related to a wide range of physical and chemical properties as well as strongly affects the dynamics of many phenomena. Even though conventional sensing solutions provide sufficient characteristics for the majority of the typical applications, the specific scientific, industrial, and biomedical sectors require to use of remote thermometric systems. [1,2]

Luminescence thermometry is a novel approach offering a lot of significant advantages over traditional contact thermometers, e.g. high sensitivity, remote and fast measurement as well as independence from the strong electromagnetic fields and minimization of the external factors effects.

The basis of this technique is related to temperature-dependent luminescent properties of a variety of materials. There are several approaches to determining the thermometric model, where ratiometric method - based on comparing the intensity ratio between two temperature-sensitive bands, is the most commonly reported. However, the change in a luminescent lifetime, bandwidth, or the position of specific bands may be also used to determine the temperature.
The presentation will be focused on the fundamentals of luminescent thermometry – the influence of temperature on optical properties, the development of the thermometric models based on various spectroscopic features as well as the determination of the parameters describing the obtained thermometer. To present the variety of implementation possibilities, particular attention will be given to two types of luminescent materials: inorganic lanthanide-based compounds and metal-organic frameworks (MOFs) containing Cr^{3+} ions. Depending on the composition of the host materials, the type of dopant, and its concentration, it is possible to obtain a wide sensing range. [1,2]

This research was supported by the National Science Center (Narodowe Centrum Nauki) in Poland under the project SONATA 16 no. 2020/39/D/ST5/01289.

References:

1. Ljubica Dacain Far, Miroslav Dramicanin (2023) Luminescence Thermometry with Nanoparticles: A Review, Nanomaterials, 13: 2904.
2. Kabański A, Ptak M, Stefańska D (2023) Metal–Organic Framework Optical Thermometer Based on Cr^{3+} Ion Luminescence. ACS Appl. Mater. Interfaces 15: 7074-7082.

High-pressure growth effects on superconducting properties of iron-based superconductors

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Iron-based superconductors (FBS) such as the oxypnictide (1111) family *RE*FeAsO (*RE* = La, Pr, Sm, Gd) show excellent superconducting properties, including a critical transition temperature (T_c) of up to 58 K, a high upper critical field (H_{c2}) of 100 T, and a critical current density (J_c) from 10^7 to 10^8 A/cm² [1-2]. These properties make FBS strong contenders for practical applications, including superconducting wires and tapes. Among the FBS, the 1111 family stands out for its highest T_c, particularly in F-doped SmFeAsO systems [2]. Despite these promising characteristics, producing high-quality, large-volume samples through conventional synthesis processes (CSP) at ambient pressure remains challenging because of arsenic and fluorine evaporation [4-5]. This study explored high-pressure growth techniques to overcome these limitations, specifically the high gas pressure and high-temperature synthesis (HP-HTS) method.

Our HP-HTS setup can generate inert gas pressures of up to 1.8 GPa and temperatures of up to 1700 °C, enabling the synthesis of high-quality FBS samples [5].We systematically compared samples synthesized using CSP and HP-HTS, including polycrystalline (Sm/Gd)FeAsO, Fe(Se, Te), across various pressure ranges (0-1 GPa) [3,6]. We evaluated the effects of chemical doping and high-pressure growth on these materials critical transition temperature, grain connectivity, and critical current density through structural, microstructural, transport, and magnetic measurements. Interestingly, the results show that high-pressure synthesis significantly enhances sample quality, density, and grain connectivity compared to CSP. Notably, for the 11 system, the T_c improved by approximately ~2 K, with J_c exceeding 10^4 A/cm² which are twice that of samples produced via CSP [3].

In the 1111 system, while HP-HTS slightly increased J_c, the T_c remained relatively constant compared to CSP samples [6]. Additionally, chemical doping were explored, including substituting Pr at the Sm site, Cu at the Fe site, and Sb at the As site in $SmFeAsO_{0.8}F_{0.2}$, further enhancing the superconducting properties and understated the superconductivity mechanism in FBS [7-8]. Our findings highlight the advantages of high-pressure synthesis in optimizing the superconducting properties of iron-based superconductors, making this technique invaluable for fundamental research and practical applications such as fabricating superconducting wires and tapes.

References:

1. S. J. Singh and M. I. Sturza, “Bulk and single crystal growth progress of iron-based superconductors (FBS): 1111 and 1144. Crystals **12**, 20 (2022).

2. S. J. Singh, J. Shimoyama, A. Yamamoto, H. Ogino, and K. Kishio, “Transition temperature and upper critical field in $SmFeAsO_{1-x}F_x$ synthesized at low heating temperatures,” . *IEEE Trans. Appl. Supercond.* **23**, 7300605 *(2013).*
3. M. Azam, M. Manasa, T. Zajarniuk, R. Diduszko, T. Cetner, A. Morawski, J. Więckowski, A. Wiśniewski, S. J. Singh, “High-Pressure Synthesis and the Enhancement of the Superconducting Properties of $FeSe_{0.5}Te_{0.5}$,” *Materials* **16**, 5358 (2023).
4. M. Azam, M. Manasa, T. Cetner, A. Morawski, S. J. Singh, “High Gas Pressure and High-Temperature Synthesis (HP-HTS) Technique and Its Impact on Iron-Based Superconductors,” *Crystals* **13**, 1525 (2023).
5. M. Azam, M. Manasa, T. Zajarniuk, S. Stelmakh, T. Cetner, A. Morawski, A. Wiśniewski, S. J. Singh, “Optimization of Synthesis Parameters and Superconducting Properties of GdFeAs(O,F),” *IEEE Trans. Appl. Supercond.* **34**, 7300205 (2024).
6. M Azam, M. Manasa, T. Zajarniuk, R. Diduszko, T. Palasyuk, J. Mizeracki, T. Cetner, A. Morawski, C. Jastrzębski, M. Wierzbicki, A. Wiśniewski, S.j. Singh, “High-pressure growth effects on the superconducting properties of Sm-based oxypnictide superconductors” (Communicated).
7. M. Azam, M. Manasa, T. Zajarniuk, R. Diduszko, T. Cetner, A. Morawski, A. Wiśniewski, S. J. Singh, “Antimony Doping Effect on the Superconducting Properties of SmFeAs(O,F)” *IEEE Trans. Appl. Supercond.* **34**, 7300405 (2024).
8. M. Azam, M. Manasa, T. Zajarniuk, T. Palasyuk, R. Diduszko, T. Cetner, A. Morawski, C. Jastrzebski, M. Wierzbicki, A. Wiśniewski, S. J. Singh, “Copper doping effects on the superconducting properties of Sm-based oxypnictides, ”*J. Am. Ceram. Soc*. **107** (2024).

Acknowledgments:

The work was funded by SONATA-BIS 11 project (Registration number: 2021/42/E/ST5/00262) sponsored by National Science Centre (NCN), Poland. SJS acknowledges financial support from National Science Centre (NCN), Poland through research Project number: 2021/42/E/ST5/00262.

mTORopathic Dysfunction in Hippocampal DG/CA3 Circuitry as a Common Etiology of Epilepsy-Associated Cognitive Comorbidities

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Epilepsy and autistic spectrum disorders (ASD) are common comorbidities of the genetic mTORopathic conditions manifesting severe cognitive deficits, while the acquired mesial temporal lobe epilepsy (mTLE) is also associated with mTOR hyperactivity in the hippocampus and cognitive impairments. The hippocampal dentate gyrus (DG) is crucial for gating the flow of cortical inputs, transmitting them via the mossy fiber axons of DG granule cells (GCs) and their synaptic connections (giant boutons) to CA3, a DG/CA3 circuitry involved in key cognitive functions, such as pattern separation in episodic memory formation. The mTORopathy-associated disturbance of DG/CA3-dependent hippocampal functions may represent a common mechanism underlying cognitive deficits in both genetic and acquired mTLE. PTEN protein is an upstream negative regulator of mTOR signalling, and up to 20% of ASD patients with macrocephaly carry a germline Pten gene mutation. Additionally, it has been shown that mTOR hyperactivity induced by the conditional knockout of Pten gene in postnatally born DG GCs is sufficient to cause epileptic seizures.

To test the hypothesis that mTOR hyperactivity in DG GCs links seizures with cognitive deficits as a common etiology in mTLE, we employed a mouse model in which the Pten gene was conditionally knocked out (Pten-cKO) in adult GCs using cre/loxP gene editing system and region-specific intracranial adeno-associated virus (AAV) injection into mouse DG. Using behavioral experiments to assess hippocampal pattern separation, c-Fos imaging to explore hippocampal memory engram formation, EEG recordings to detect seizures, and patch-clamp recordings to study single-cell alterations, we not only demonstrated the hypothesized link but also uncovered observational clues for further mechanistic insight into this pathophysiological phenomenon. In this regard, I will also discuss the adoption of a phenomenological approach, which I found useful in navigating research on complex multi-faceted phenomena by hypothesizing informed guesses for scientific discoveries.

This research was funded by the Polish National Science Centre SONATA BIS grant No. 2021 42 /E/NZ 5 00185.

The lights and shadows of the scaffold-based 3D cell culture models

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Cell culture research are essential in pharmaceutical industry, especially in predictions of drug activity, metabolism and toxicity *in vivo* [1]. However, two-dimensional monolayer of cells, which are used all over the world, are not exactly reflect tissue-specific architecture, mechanical and biochemical cues and cell–cell communication [2]. They are lost under such simplified and highly biased conditions. *Animal models* commonly used in various stage in drug development do not meet expectation many scientist, therefore one of the solution is to create 3 dimensional cell cultures or even organoids, small human tissues on-chip. This technology would have allow better understanding of malfunctions of diseases in organs and tissues.

Electrochemical methods enable real-time in vitro analysis. Moreover they allow measurement at different places of the culture by placing electrodes throughout the cell culture scaffold. Oxygen and glucose consumption measurements provide us with a lot of information about cell viability and can be translated to toxicity during tests of new drugs [3]. The research was focus on the different approaches of electrode fabrication for the cell culture analysis –photolithography, 3D printed approach, Laser Induced Graphene electrodes (LIG) and ITO electrodes. However, only low-cost method fabrication of ITO microarrays were successfully fabricated and used to study cell culture dynamics by electrochemical impedance spectroscopy.

References:
1. Int. J. Mol. Sci. **2015**, 16.
2. S. C. Caliari, J. A. Burdick, Nature Methods, 2016, 13, 5.
3. N. Pereira Rodrigues, Y. Sakai, T. Fujii, 2008, Sensors and Actuators B 132, 608–61.

Effective Tomonaga-Luttinger liquid theory for multi-wall nanotubes

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This study develops a formalism based on Tomonaga-Luttinger liquid (TLL) theory, which effectively describes one-dimensional (1D) systems through collective modes that account for electron-electron interactions. One of the most promising 1D materials are carbon nanotubes, which come in two types single- and multi-wall. Specifically, we present here a TLL model for multi-wall nanotubes (MWNTs) which include the valley degree of freedom alongside spin and charge. We address the complexity introduced by inter-shell interactions and hybridization in MWNTs, considering that conducting paths are randomly distributed among coaxial shells.

Our findings indicate a universal value of compressibility for the holon mode, while neutral mode parameters vary with inter-shell coupling details.

References:

1. Mattsson, A. E., Eggert, S., & Johannesson, H. (1997). Properties of a Luttinger liquid with boundaries at finite temperature and size. *Physical Review B*, *56*(24), 15615.
2. Chudzinski, P. (2015). Spin-orbit coupling and proximity effects in metallic carbon nanotubes. *Physical Review B*, *92*(11), 115147.
3. Grigoryan, N. and Chudzinski, P., Role of electron-electron interactions in electron emission from nanotube materials. Physical Review Materials, 8(1), 016003, (2024).
4. Nakamura, N., & Suzumura, Y. (1997). Comment on Density of States of Tomonaga-Luttinger Model at Finite Temperatures. *Progress of theoretical physics*, *97*(1), 163-167.
5. Komnik, A., & Gogolin, A. O. (2002). Multiparticle effects in nonequilibrium electron tunneling and field emission. *Physical Review B*, *66*(3), 035407.

Abstracts

Sunday, October 13th 2024

“Houston, we have a problem” - about all the problems in orally-delivered vaccines production

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Virus-like particles (VLPs) produced using in vitro plant cultures represent significant advancements in biotechnology, offering promising applications in vaccine development, pharmaceutical production, and plant-based bioproducts. VLPs, which mimic the structure of viruses without containing viral genetic material, are particularly valuable as safe platforms for antigen presentation in vaccine development. Their production in in vitro plant cultures, using tissue culture techniques, presents a sustainable and scalable method for biosynthesis. Furthermore, in vitro plant cultures provide controlled environments for optimizing the growth conditions and genetic manipulation of plants, enhancing the yield and quality of VLPs and other valuable bioactive compounds. This integration of plant biotechnology and virology opens up new avenues for producing vaccines, therapeutic proteins, and plant-derived bioproducts with higher efficiency and sustainability.

This research was funded by the Polish National Science Centre (project No. OPUS 19 UMO-2020/37/B/NZ6/02334).

References:

1. Lomonossoff, G. P., & D'Aoust, M. A. (2016). Plant-produced biopharmaceuticals: A case of technical developments driving clinical implementation. Science, 353(6305), 1237-1240. https://doi.org/10.1126/science.aaf6638.
2. Rybicki, E. P. (2014). Plant-based vaccines against viruses. Virology Journal, 11(1), 205. https://doi.org/10.1186/s12985-014-0205-0.
3. Roy, P., & Noad, R. (2008). Virus-like particles as a vaccine delivery system: Myths and facts. Human Vaccines, 4(1), 5-12. https://doi.org/10.1007/978-1-4419-1132-2_11.
4. Shanmugaraj, B., Malla, A., & Phoolcharoen, W. (2020). Emergence of plant-derived recombinant vaccines and therapeutics against viral diseases. Viruses, 12(7), 764. https://doi.org/10.3390/v12070764.
5. Capell, T., Twyman, R. M., Armario-Najera, V., Ma, J. K. C., & Christou, P. (2020). Potential applications of plant biotechnology against SARS-CoV-2. Trends in Plant Science, 25(7), 635-643. https://doi.org/10.1016/j.tplants.2020.04.009.

Analysis of a novel human trimeric complex TTC33-associated network core (TANC) formed by TTC33:PHF5A:WDR61

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Among the vast array of over 20,000 protein-coding genes in humans, a substantial 10% remain enigmatic, with their functions yet to be fully characterized. In this study, we investigate the biochemical and functional attributes of TTC33, a 30 kDa protein that is conserved exclusively in bony vertebrates. Composed of three well-defined tetratricopeptide (TRP) motifs, and a fourth, degenerate TRP motif overlapping with a nuclear localization signal, TTC33 plays a crucial role in cellular processes. Through a series of biochemical assays, including co-immunoprecipitation, mass spectrometry, and size exclusion chromatography, we discovered that TTC33 forms a network of interactions with proteins such as WDR61, CCDC97, UNG DNA glycosylase, PHF5A, and SF3B, a core component of the U2 splicing factor [1]. This network, termed the TTC33-associated network (TAN), is anchored by a trimeric core (TANC) comprising TTC33, WDR61, and PHF5A. The TRP domains of TTC33 are critical for TAN assembly, with distinct TRP motifs binding to different partners.

Intriguingly, the unstructured C-terminal region of TTC33 facilitates self-association, suggesting a role in higher-order complex formation. Our findings propose that TANC is involved in transcriptional regulation, as evidenced by transcriptomic analysis showing altered expression of over 400 genes upon TTC33 knockdown. These genes are linked to diverse biological processes, including neurotransmitter release and cellular development. Additionally, we observed that both depletion and overexpression of TTC33 significantly impact cell proliferation, pointing to a potential interplay between TANC and the PAF complex, particularly in modulating the cell cycle. Future research will aim to unravel the detailed mechanisms by which TTC33 and TANC influence gene expression and cell proliferation.

This research was funded by the Polish National Science Centre (OPUS 2022/45/B/NZ1/02654).

References:

1. Cretu C, Schmitzová J, Ponce-Salvatierra A, et al. (2016). "Molecular Architecture of SF3b and Structural Consequences of Its Cancer-Related Mutations." Mol Cell, 64(2), 307-319.

How to disinfect surfaces with the sunlight? Phosphors converting visible light into the UVC

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Modern medicine is facing a serious problem: bacteria are becoming increasingly resistant to antibiotics. This phenomenon, known as antibiotic resistance, results from the excessive and improper use of antibiotics in healthcare and agriculture. To address this issue, we need to reduce the need for their use by preventing bacterial infections through effective disinfection.

One of the effective methods for combating microorganisms is the use of ultraviolet light. (UV). The strongest bactericidal effect is shown by UVC (100–280 nm) radiation, which changes the DNA structure of microorganisms, preventing them from further reproduction [1]. Currently, the most commonly used source of UVC radiation is a mercury lamp, which emits light at a wavelength of 254 nm. However, mercury is toxic, which creates the need to find safer alternatives.

The aim of this research is to develop innovative materials that emit UVC radiation, which can be used for the disinfection of air, water, and surfaces. The materials we propose are built of an inorganic matrix doped with praseodymium ions (Pr^{3+}). These compounds can convert visible light into UVC radiation through the phenomenon of upconversion [2-4]. Thanks to that, the disinfection of surfaces covered with such materials can be carried out using blue LEDs instead of mercury lamps. Moreover, if the energy conversion effect also occurs for sunlight, such surfaces will be able to disinfect themselves under the influence of sunlight.

We believe that our research will contribute to the development of new luminescent materials that will emit UVC in an efficient and environmentally friendly manner, bringing us closer to creating self-cleaning surfaces activated by sunlight.

This work was supported by The National Science Centre (NCN) under the OPUS 21 project, grant no. UMO-2021/41/B/ST5/03792, which is gratefully acknowledged.

References:

1. Cates EL, Cho M, Kim J (2011) Converting Visible Light into UVC: Microbial Inactivation by Pr^{3+}-Activated Upconversion Materials. Environ Sci Technol 45(8): 3680–3686.
2. Zdeb P, Rebrova N, Dereń PJ (2024) Discovering the Potential of High Phonon Energy Hosts in the Field of Visible-to-Ultraviolet C Upconversion. J Phys Chem Lett 15(XXX): 9356–9360.
3. Rebrova N, Zdeb P, Lemański K, Macalik B, Bezkrovnyi O, Dereń PJ (2024) Upconversion Luminescence Properties of Pr^{3+}-Doped $BaYF_5$ Nanoparticles Prepared by Microwave Hydrothermal Method. Inorg Chem 63(6): 3028– 3036.
4. Rebrova N, Zdeb P, Dereń PJ (2024) Synthesis and Upconversion Luminescence of $LiY_9(SiO_4)_6O_2$ Phosphor Doped with Pr^{3+}. J Phys Chem C 128(22): 9090–9098.

NMR Photodegradation Insights: Contrasting Low Field and High Field Approaches via In Situ and In Flow Method

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Nuclear Magnetic Resonance (NMR) spectroscopy is a powerful tool for investigating photodegradation, a process where materials break down when exposed to light. Recent studies have focused on using low-field and high-field NMR to gain insights into these reactions. Low-field NMR operates at a lower magnetic strength, making it more cost-effective and portable but offering lower resolution. High-field NMR, on the other hand, uses stronger magnetic fields, providing greater sensitivity and detailed molecular information. By comparing these approaches, we have discovered that low-field NMR can effectively track bulk chemical changes during photodegradation. At the same time, high-field NMR offers deeper insights into specific molecular structures and degradation pathways. This contrast highlights the complementary nature of the two approaches, where low-field methods are suitable for real-time monitoring, while high-field methods are valuable for detailed analysis.

Moreover, different experimental setups, such as in situ and in-flow NMR, have been used to monitor photodegradation processes under realistic conditions. In situ NMR allows for real-time analysis directly within the reaction vessel, giving insights into the dynamic changes in molecular structures during degradation [1],[2]. In-flow NMR, by contrast, continuously feeds the reacting material through an NMR cell, enabling prolonged degradation monitoring over time. Studies show that high-field in-flow NMR is particularly beneficial for observing fast, transient chemical species, while low-field in situ NMR provides practical, real-time data on long-term reactions. This comparison emphasizes how the combination of low-field and high-field approaches and in situ and in-flow methods offers a more comprehensive understanding of photodegradation mechanisms.

This research was funded by the Polish National Science Centre (project No. 2022/47/D/ST4/00846).

References:

1. M. Urbańczyk, A. Shchukina, D. Gołowicz, and K. Kazimierczuk, 'TReNDS—Software for reaction monitoring with time-resolved non-uniform sampling', *Magnetic Resonance in Chemistry*, vol. 57, no. 1, pp. 4–12, Jan. 2019, doi: 10.1002/mrc.4796.
2. K. Kristinaityte *et al.*, 'Deeper Insight into Photopolymerization: The Synergy of Time-Resolved Nonuniform Sampling and Diffusion NMR', *J Am Chem Soc*, vol. 144, no. 30, pp. 13938–13945, Aug. 2022, doi: 10.1021/jacs.2c05944.

Studying glacier calving variability in the High-Arctic (Svalbard)

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As a response to the rapidly warming climate, the glaciers and ice sheets of the world are disappearing faster than ever [1]. The retreat of the land based ice contributes to the global sea level rise(SLR) through the disintegration and melting. Due to increasing ocean temperatures, the glaciers that terminate in a water body (also known as the marine terminating glaciers), also lose mass at an accelerated rate. Two important processes through which marine terminating glaciers lose mass are submarine melting, and glacier calving [2]. Glacier calving is a mechanism of breaking-off of huge chunks of ice from the terminus of the glaciers [3] and plays in significant role in contribution to SLR.

Here, glacier calving has been observed using high-frequency time lapse imagery at terminus of Hansbreen (a tidewater glacier located in Hornsund fjord, Svalbard). The visual analysis of these images from May 2016 – October 2016 has revealed a temporal and spatial variability in the calving rates. These variabilities, when compared to meteorological and oceanographic parameters, may reveal the degree of sensitivity of the glacier to warming climate. Furthermore, this shows the benefits of using high-frequency time lapse imagery as an important and robust tool to conduct such studies in the Arctic environments.

This research was funded by the Polish National Science Centre (grant no. 2021/43/D/ST10/00616).

References:

1. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324. Agrios GN (2005) *Plant Pathology*. 5th ed. Academic Press, San Diego, CA, USA.
2. Cogley, J.G., Hock, R., Rasmussen, L.A., Arendt, A.A., Bauder, A. and Braithwaite, R.J., 2011. Glossary of Glacier Mass Balance and Related Terms, IHPVII Tech. Doc.
3. Benn, D.I., Warren, C.R. and Mottram, R.H., 2007. Calving processes and the dynamics of calving glaciers. Earth-Science Reviews, 82(3-4), pp.143-179.

The critical role of high-quality white light and techniques for developing LED composites with high CRI index

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The need for advanced white light emitters and phosphors has significantly increased over the last few years. Currently, white emitting LEDs are the leading and most popular technology. They provide high brightness of the light source, together with low energy consumption in contrast to incandescent lamps. However, LEDs still face certain limitations such as the poor quality of emitted light [1]. This parameter can be described by the Color Rendering Index (CRI), which indicates how accurately colors are rendered compared to the same colors observed under natural sunlight [1]. A common and still popular LED design, which uses a blue LED chip and yellow-emitting YAG: Ce^{3+} phosphor, has a CRI of around 60 [2]. In contrast, natural daylight has a CRI of 100, meaning that traditional LED designs can distort the true colors of illuminated objects. Better CRI values can be achieved by using UV-emitting LED chips combined witha composition of phosphors that convert the UV excitation to the visible range. In this setup, CRI values higher than 90 can be achieved [3]. Consequently, new phosphors for UV chips are currently being extensively investigated and developed.

In this work, we present a comprehensive approach to the development of new composite materials. First, we provide an easy step-by-step guide for simulating the spectra of composites. Based on the simulation results, a selection of phosphor mixtures is made for composite preparation. Subsequently, the spectroscopic properties of these composites are investigated, and colorimetric parameters such as CRI, CCT, and CIE x, y, z are calculated. Various silicone-based resins have been examined as the base for the composites.

One of the selected pairs of compounds is the mixture of borate LSBO and aluminosilicate doped with Eu^{2+}, whose broad emission covers the entire visible range. The highest CRI value is 92, with a CCT of 2702 K, which is obtained for these compounds in QSil silicone resin. Moreover, there is no blue light dominance as seen in YAG: Ce^{3+} - based LED setups, due to the use of the UV excitation diodes. In summary, the simulations effectively help in identifying the optimal phosphor mixtures for use in composites designed for high CRI white light sources.

This research was funded by the National Centre for Research and Development in Poland (LIDER/19/0103/L-12/NCBR/2021).

References:

6. Sato M, Kim SW, Shimomura Y, Hasegawa T, Toda K, Adachi G (2016) Rare Earth-Doped Phosphors for White Light-Emitting Diodes. Handb. Phys. Chem. Rare Earths, 49: 1–128.
7. Hu S, Lu C, Zhou G, Liu X, Qin X, Liu G, Wang S, Xu Z (2016) Transparent YAG:Ce ceramics for WLEDs with high CRI: Ce^{3+} concentration and sample thickness effects. Ceramics International 42 (6): 6935–6941.
8. Liu Z, Li Z, Seto T, Wang Y (2023) An Ultra-Broadband Yellow-Emitting Phosphor $KRbCa_{0.8}Mg_{0.2}PO_4F:Eu^{2+}$ for White Light-Emitting Diodes with High Color Rendering Index. Adv. Optical Mater. 11 (2300845): 1–9.

Exploring Spiking Neural Networks: Applications in Biomedical Signal Classification

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Artificial Intelligence (AI) has become increasingly important over the past few decades due to its wide-ranging applications across various domains of life, science, and technology. It helps analyze huge amounts of data quickly and is a powerful tool for solving complex problems, like recognizing patterns and sorting information [1]. However, traditional AI approaches, particularly those based on perceptrons and Artificial Neural Networks (ANNs), face limitations that drive the exploration of new neural network models to enhance computational speed and capability.
One promising advancement is Spiking Neural Networks (SNNs) [2]. These kind of neural networks differ from conventional ANNs by mimicking the way real neurons in the brain communicate. Instead of simply processing information, SNNs send out spikes of electrical activity, similar to how our brains process time-sensitive and dynamic data. This gives them a unique advantage in handling complex tasks, making them behave more like a human brain in action.

Learning is one of the most essential functions of the human brain, allowing us to gain new skills and knowledge. Despite extensive research, the exact way neurons learn by transmitting timed spikes remains a mystery. This is also one of the challenges when training SNNs, as their intricate dynamics make them difficult to manage, especially when applied to biomedical signal classification. [3, 4].

My research focuses on developing and implementing biologically inspired Artificial Intelligence for processing and classifying biomedical data [5]. Specifically, it aims to enhance the efficient identification of signal disturbances, even at subtle levels, to improve treatment outcomes.

References:

1. Francescangeli, F.; Balzani, D.; Brunetti, S.; Castellano, S.; Dattola, G.; De Stefano, A.; Fonda, S.; Gallo, L.; Mencaroni, A.; Modica, G.; et al. (2023) Image dataset for benchmarking automated fish detection and classification algorithms. *Sci. Data*, **10**, 5.
2. Gerstner, W.; Kistler, W.M.; Naud, R.; Paninski, L. (2014) *Neuronal dynamics: From single neurons to networks and models of cognition*; Cambridge University Press: UK.
3. Shaik, M.A.; Rao, U.S.; Sharma, R.; Kaushik, R.; Radhakrishna, S. (2023) Remote patient monitoring using artificial intelligence: Current state, applications, and challenges. *WIREs Data Min. Knowl. Discov.*, **13**(2).
4. Sun, T.; He, X.; Li, Z. (2023) Digital twin in healthcare: Recent updates and challenges. *Digit. Health*, **9**, 20552076221149651.
5. Rudnicka, Z.; Szczepański, J.; Pręgowska, A. (2024) Artificial Intelligence-Based Algorithms in Medical Image Scan Segmentation and Intelligent Visual Content Generation—A Concise Overview. *Electronics*, **13**(4), 746.

Yield surface identification of additively manufactured stainless steel 316L considering its printing orientation

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Stainless steel 316L (SS316L) is highly valued across industries for its excellent mechanical properties, corrosion resistance, and formability, making it ideal for additive manufacturing. Its biocompatibility and strength at high temperatures further enhance its use in medical, aerospace, and energy sectors. With low thermal conductivity, a high melting point, and non-magnetic properties, SS316L also supports complex geometries in industrial applications, ensuring versatility and broad utility. In this work, the yield surface behaviour of additively manufactured (AM) stainless steel 316L are investigated under complex loading conditions, focusing on the effect of printing orientation. Using the Laser Powder Bed Fusion Melting (LPBF-M) method, stainless steel tubes were fabricated in three orientations: horizontal (XY), vertical (Z), and 45° (ZX), as shown in Figure 1a.

Yield surfaces were determined based on a 0.005% plastic offset strain criterion [1], revealing significant variations in mechanical properties due to the orientation. It can be observed from Figure 1b, that the XY-printed specimens demonstrate the largest yield surface, while Z-printed specimens exhibit lower tensile yield properties. This anisotropic behaviour is attributed to the texture developed during the additive manufacturing process. The yield surface analysis, coupled with the probing technique employed during biaxial stress testing, offers valuable insights into the material's anisotropic hardening and texture effects, contributing to a deeper understanding of the mechanical behaviour of AM stainless steel 316L. These findings will be instrumental in improving constitutive models and optimizing AM processes for structural applications in engineering.

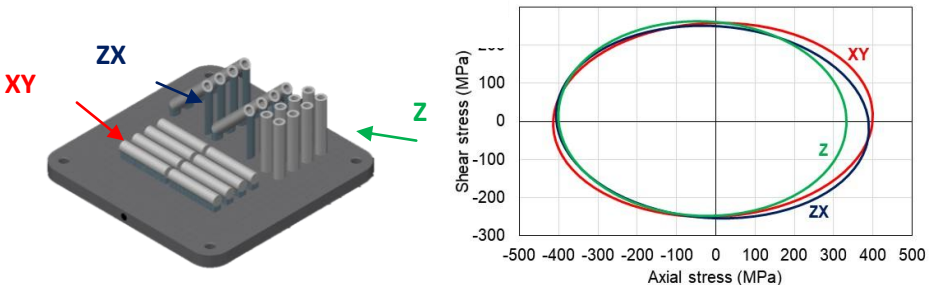

Figure 1. *Printing orientation of specimens on the build plate (a); comparison of the yield surfaces for three build orientations (b).*

This research has been supported by the Polish National Science Centre (Grant No. 2019/35/B/ST8/03151).

Reference:

1. Dubey, V. P., Kopec, M., Łazińska, M., & Kowalewski, Z. L. (2023). Yield surface identification of CP-Ti and its evolution reflecting pre-deformation under complex loading. *International Journal of Plasticity*, 103677.

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