Institute of Solid State Physics
University of Latvia

ANNUAL REPORT
2024

Riga 2025

Annual Report 2024, Institute of Solid State Physics, University of Latvia.
Editor: Dr. Habil. phys. A.Šternbergs
Set up at the Institute of Solid State Physics, University of Latvia,
Kengaraga Str. 8, LV-1063 Riga, Latvia.

Riga, Institute of Solid State Physics, University of Latvia, 2025, 64 pages

Director: **Dr. phys. A.Anspoks**
Institute of Solid State Physics, University of Latvia
Kengaraga Str. 8, LV-1063 Riga, Latvia
Tel.: *+371 67187816*
Fax: *+371 67132778*
ISSP@cfi.lu.lv
http://www.cfi.lu.lv

Contents

Introduction

The Institute of Solid State Physics, University of Latvia (ISSP UL) is the leading research centre in the field of materials science in Latvia. Awarded the Horizon 2020 Teaming project "The Excellence Centre of Advanced Material Research and Technology Transfer – CAMART^2" in 2015, ISSP UL collaborated with the Royal Institute of Technology (KTH) and the Research Institute of Sweden (RISE). The project concluded successfully in January 2025, significantly enhancing ISSP UL's research and innovation capabilities, and establishing it as one of the most advanced regional centres for material research and technology transfer in Europe.

ISSP UL has developed a strong research and innovation ecosystem that includes the following centres:

- Computing centre,
- Spectroscopy centre,
- X-Ray absorption centre,
- Microscopy and structure analysis centre,
- Thin films centre,
- Electrochemistry centre,
- Nanotechnology centre.

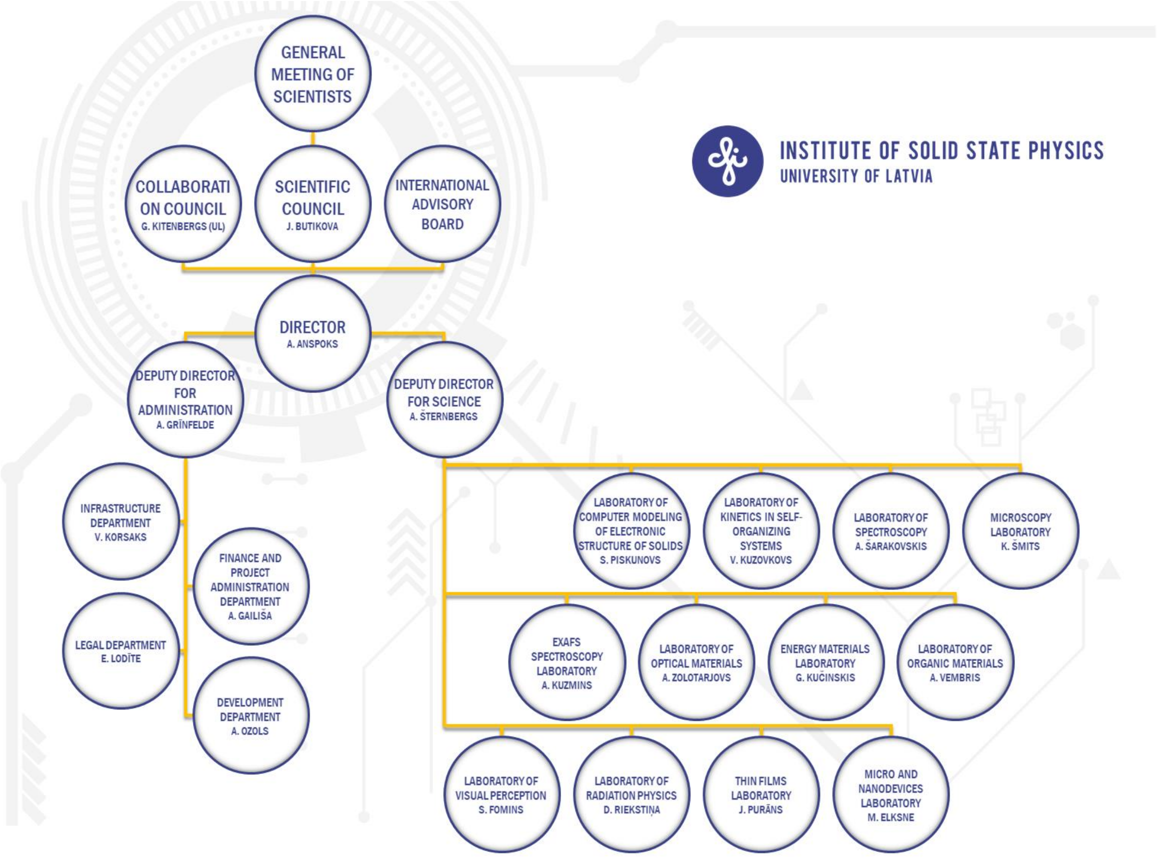
ISSP UL operates a 10,000 m² facility with state-of-the-art infrastructure, including a 650 m² ISO-class cleanroom space, and cooperates with more than 100 scientific institutions around the world. About one third of the projects are carried out jointly with companies.

ISSP UL is continuously using possibilities offered by Large European Infrastructure centers such as synchrotron radiation facilities, including DESY PETRA-III and MaxIV Laboratory, XFEL, and neutron spallation source - ESS.

ISSP UL has created a platform **Materize** to provide access to the ISSP UL's expertise and resources facilitating cooperation with industry in Latvia and abroad including joint projects.
Our **Research Programme 2030** serves as a road map and an entry-point for advanced materials-related R&D&I challenges, inquiries, and proposals. It helps to launch projects with a scope wider than that of a specific single research domain.

The structure of ISSP UL promotes research and innovation by creating a service-oriented environment, fostering openness and product-oriented research (Figure 1).

Figure 1: **The organizational structure of ISSP UL in 2024**



The highest decision-making body of ISSP UL is the **Scientific Council,** consisting of 15 members elected by the employees of the Institute. The Council appoints the director and his/her deputies.

The Scientific Council of the Institute

1. Jeļena Butikova, Dr.phys., Chairperson of the Scientific Council
2. Anatolijs Šarakovskis, Dr.phys. , Vice- chairman of the Scientific Council
3. Andris Anspoks, Dr.phys.
4. Līga Grīnberga, Dr.phys.
5. Edgars Butanovs, Ph.D.
6. Sergejs Piskunovs Dr.rer.nat.
7. Dmitry Bocharov, Dr.phys.
8. Boriss Poļakovs Dr.phys.

9. Kaspars Pudžs Dr.phys.
10. Mārtiņš Rutkis, Dr.phys.
11. Andris Šternbergs, Dr.habil.phys.
12. Aivars Vembris, Dr.phys.
13. Virgīnija Vītola, Dr.phys.
14. Aleksejs Kataševs, Dr.phys., Riga Technical University, Institute of Biomedical Engineering and Nanotechnologies
15. Guntars Kitenbergs Dr.phys., University of Latvia.

To ensure an optimal alignment with global tendencies in material science, the ISSP UL performs consultations with the International Advisory Board when making strategic decisions. Additionally, the International Advisory Board issues recommendations for the commercialization of scientific results and for improving management.

The International Advisory Board

1. IAB chairperson Dr. Jiri Kulda, Institut Laue-Langevi, France
2. Prof. Juras Banys, Vilnius University, Lithuania
3. Prof. Antonio Bianconi, Rome International Center for Materials Science Superstripes, Italy
4. Prof. Annette Bussmann-Holder, Max-Planck-Institute for Solid State Research, Germany
5. Prof. Ming-Chi Chou, Department of Materials and Optoelectronic Science, National Sun Yat-sen University, Taiwan, R.O.C.
6. Prof. Tony Donné, Programme Manager (CEO) for the consortium EUROfusion, DIFFER, the Netherlands
7. Prof. Dag Høvik, Former member, The Research Council of Norway, Norway
8. Prof. Marco Kirm, University of Tartu, Estonia
9. Prof. Maija Kuklja, Program director at National Science Foundation, USA
10. Dr. Nils Nordell, Emeritus Director, Electrum Laboratory, KTH, Sweden
11. Prof. Toshio Ogawa, Shizuoka Institute of Science and Technology, Japan
12. Prof. Lars Österlund, The Ångström Laboratory, Uppsala University, Sweden
13. Dr. Mārtiņš Rutkis, Institute of Solid State Physics, University of Latvia, Latvia
14. Prof. Andrejs Silins, Latvian Academy of Sciences, Latvia
15. Dr.habil.phys. Andris Šternbergs, Institute of Solid State Physics, University of Latvia, Latvia

16. Prof. Pauls Stradins, Colorado School of Mines, USA

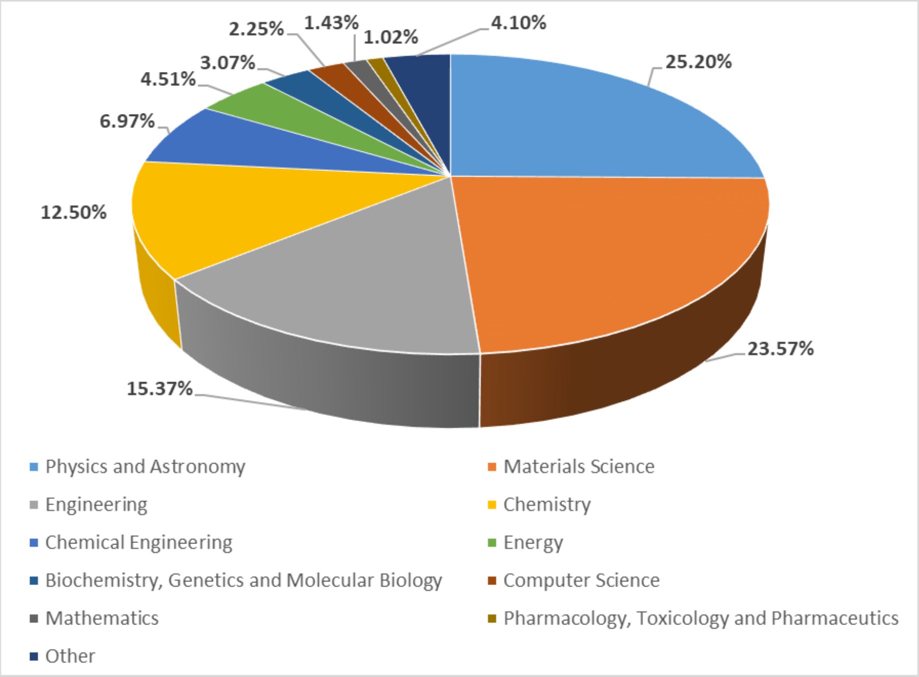
17. Honorary member Prof. Juris Upatnieks, Applied Optics, USA

The multidisciplinary research (Figure 2) at the ISSP UL is performed by its highly qualified staff where the data are provided in Table 1 and Figure 2.

Table 1: Employees at ISSP UL in 2024

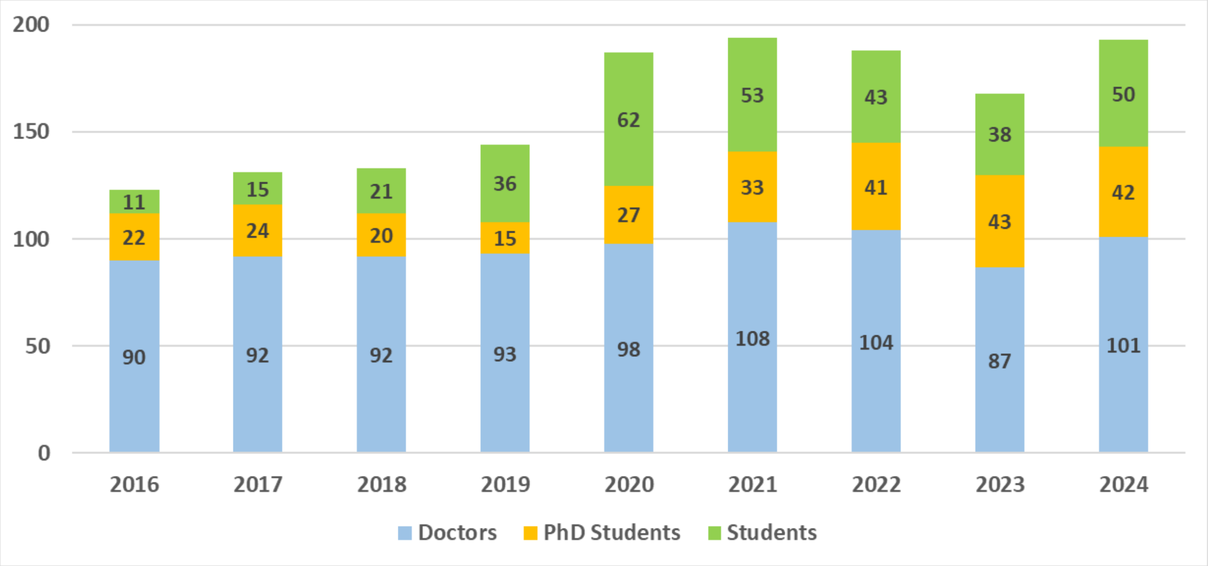
	FTE	No of employees	Women	Men	PhD- s	PhD students	Mg students	Bc students	Students total (Mg+Bc)
Administrative staff	45	67	43	24	7	3	0	0	0
Research technical support staff (RTSS)	36	90	31	59	11	10	18	30	48
Scientists	87	136	44	92	90	32	2	0	2
Total	168	293	118	175	108	45	20	30	50
Scientists + RTSS	123	226	75	151	101	42	20	30	50

Figure 2: Multidisciplinary research at ISSP UL: Publications by Subject Area



The dynamics of the ISSP UL research staff from 2016 to 2024 is shown in Figure 3. It indicates a stable situation with an increasing number of students as our employees involved in our projects during the last three years. Note an increase in the number of Doctors in 2024.

Figure 3: ISSP UL research staff dynamics 2016-2024



This Annual Report summarizes the research activities of the ISSP UL in 2024 in the KPIs as reported in Table 2.

Table 2: Key performance indicators

Key performance indicators for Research	**2015 - 2017 (3 years average)**	**2021**	**2022**	**2023**	**2024**	**2026**
Number of scientific publications according to "Scopus"	119	122	195	167	**180**	250
A fraction of scientific publications in International Collaboration (%)	51	73	65	72	**71**	65
Number of citations/year according to "Scopus"	2043	3105	4014	4110	**4392**	5000
Average SNIP per publication	0.79	1.04	0.96	1.03	**0.96**	1.25
Number of scientific and technical personnel (FTE)	105	141	153	126	**123**	175
Publications/FTE	1.13	0.84	1.27	1.33	**1.46**	1.45
Gender balance of scientific and technical personnel (% female)	26	31	31	34	**33**	40

In 2024, ISSP UL researchers published a total of 180 papers in peer-reviewed journals. Of these, 51 papers (28%) were featured in journals with a SNIP factor greater than 1. Additionally, 88% of the publications appeared in journals classified within the Q1 and Q2 quartiles.

We should especially note several studies published in the highest-impact journals (IF > 20) in collaboration with international partners.

A stable polymer blend with high electronic mobility for use in high-performance organic electrochemical transistors was proposed (*Advanced Materials,* IF=27.4, DOI: 10.1002/adma.202302624).

A new method for the synthesis of metal polyhydrides for modifying existing hydrogen storage materials was suggested (*Advanced Energy Materials*, IF=24.4, DOI: 10.1002/aenm.202400077).

The robust photo-electrocatalytic performance of In-doped $BiVO_4$ impregnated on 2D S-doped g-C_3N_4 was confirmed using systematic computational and experimental study (*Advanced Composites and Hybrid Materials*, IF=23.2, DOI: 10.1007/s42114-024-00843-4).

Several metrics from the SCOPUS database were used to evaluate the research output, calculated using the SciVal research performance assessment tool. This tool enables analysis of data from Scopus.

The first two metrics highlight the number of ISSP UL publications among the most-cited within the entire Scopus database or published in the most-cited journals indexed by Scopus. In 2024, 13% of our publications were among the top 10% of most-cited publications worldwide (Figure 4). Additionally, 17% of our publications were in the top 10% of the most-cited journals indexed by Scopus (Figure 5).

Figure 4: Percentage of publications that are within the top 10% of the most cited worldwide publications (from Scopus database)

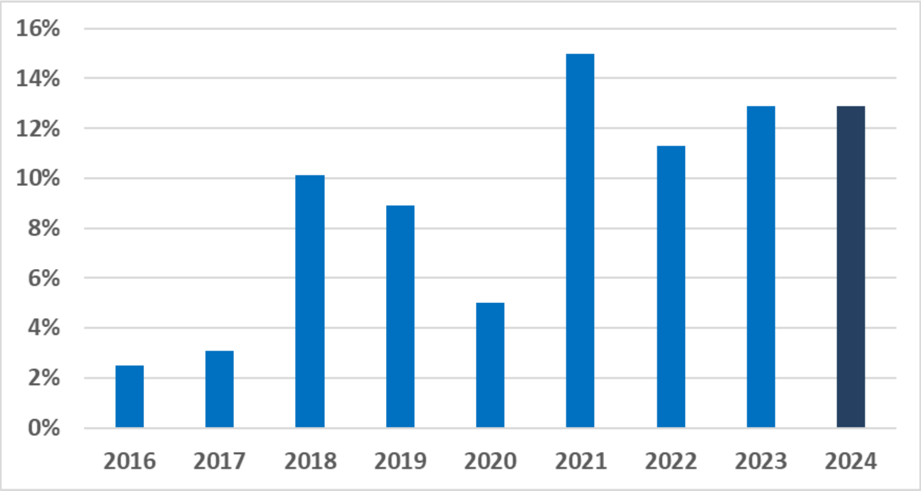
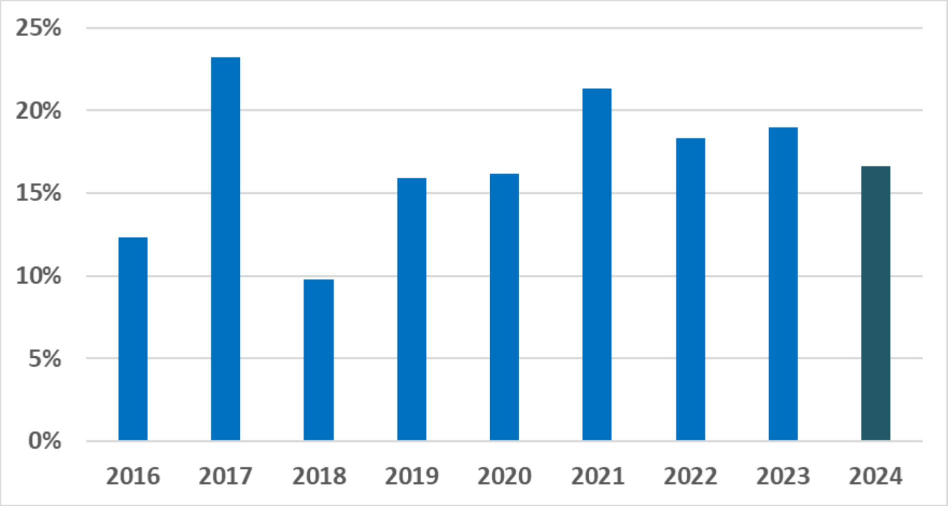
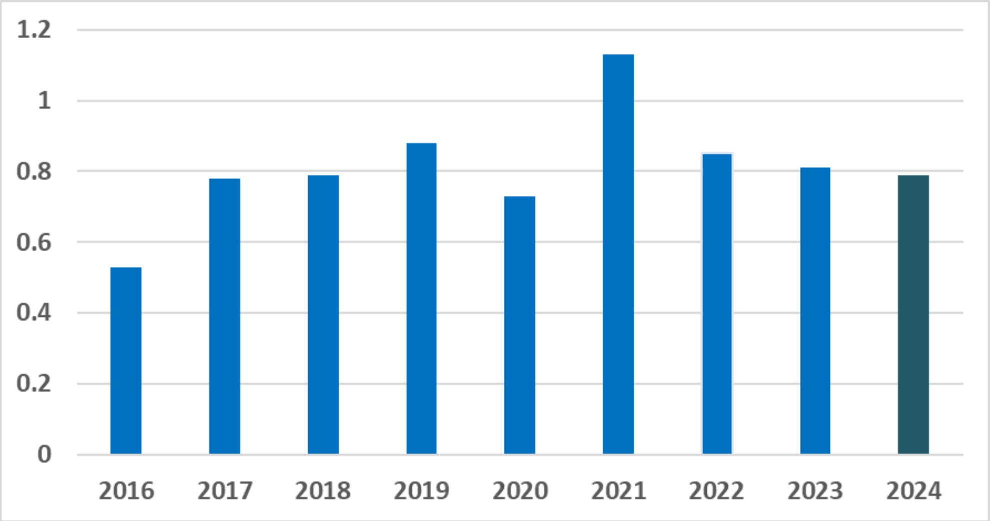


Figure 5: Share of the publications belonging to the top 10% of the most-cited journals indexed by Scopus (from Scopus database)



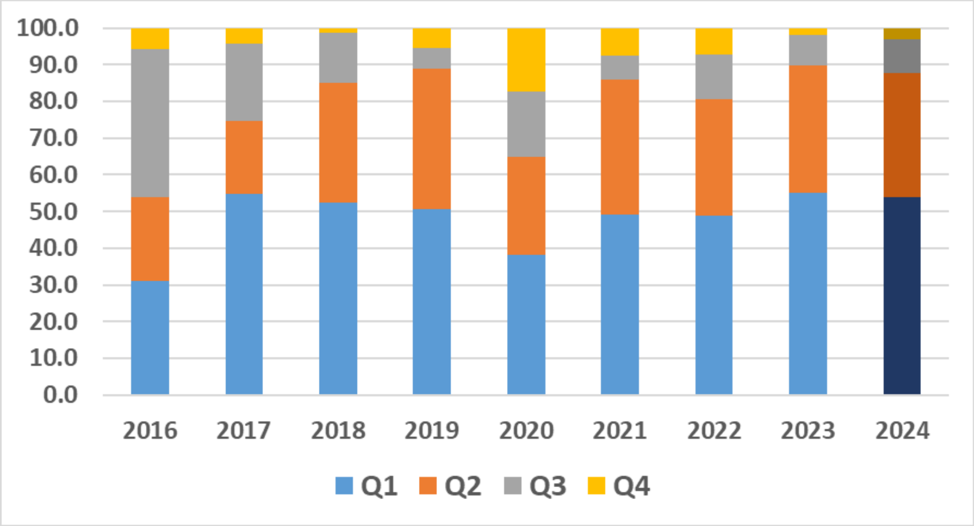
The third metric, Field-Weighted Citation Impact (FWCI), measures how citations received by ISSP UL publications compare to the world average. An FWCI value of 1.00 indicates that the entity's publications were cited exactly as one would expect based on the global average of similar publications. The FWCI of our publications was 0.81 in 2023 and 0.79 in 2024, indicating high publication quality and stability (Figure 6).

Figure 6: Field-Weighted Citation Impact (FWCI) of publications compared with the world average (1.0). (from Scopus database)



The fourth metric shows the distribution of ISSP UL publications across journals, divided into four quartiles according to their Impact Factor. It is important to stress that about 88% of all publications in 2024 were published in peer-reviewed journals belonging to the first (Q1) and second (Q2) quartiles (Figure 7).

Figure 7: ISSP UL publications by Journal quartile (from Scopus database)



Building the research capacity and development of human capital are among the priorities at our institute. These are addressed in collaboration with the University of Latvia and other universities through the preparation of the next generation of researchers. The ISSP UL is a traditional place where many students start and accelerate their research careers to Bachelor, Master and PhD levels. In 2024, 3 PhD, 7 MSc, and 6 Bc theses were prepared and successfully defended in ISSP UL.

ISSP UL traditionally actively participates in enhancing the university's master's and doctoral programs in physics and materials science.

The high quality of research at ISSP UL was recognized at both international and national levels by various **awards**.

A study on “Tomorrow's energy: unlocking the potential of graphene, batteries, superconductivity and photocatalysis” (Dr. phys. Roberts Eglītis, Dr. hab. phys. Juris Purāns, Dr. phys. Anatolijs Popovs, and Dr. Ran Jia) conducted by the ISSP UL team in collaboration with the Institute of Theoretical Chemistry, Jilin University (China) was among the winners of the Science Achievements Competition 2024 by the Latvian Academy of Sciences (LAS).

Dr. habil. phys. Jevgenijs Kotomins, a full member of the Latvian Academy of Sciences and a leading researcher at the Laboratory of Computer Modeling of Electronic Structure of Solids at ISSP UL, received the Edgars Siliņš Award for his lifetime contribution to the establishment of the quantum chemistry school and the computational modeling of nanomaterials.

By the decision of the National Council of Emeritus Scientists in November 2024, the status of national emeritus scientist was granted to two scientists from the ISSP UL: leading researcher of the Optical Materials Laboratory Ēriks Birks and leading researcher Vera Skvorcova.

Dr. phys. Boriss Poļakovs, a leading researcher at the Thin Films Laboratory of ISSP UL, was elected as a corresponding member of the Latvian Academy of Sciences.

Mg. Līga Ignatāne was announced as the winner of the Women in Science Baltic Fellowship contest, launched in 2024 by the Latvian Academy of Sciences and the Latvian National Commission for UNESCO.

One of the winners of the Annual Award for Achievements in Energy by "Latvenergo" and the Latvian Academy of Sciences for young scientists in 2024 was Maksims Sokolovs, a scientific assistant at the Laboratory of Computer Modeling of Electronic Structure of Solids at ISSP UL. He received the award for his series of works titled "Computational Modeling of Complex Materials for Electrocatalysis".

Mg.phys. Anete Bērziņa was awarded with the Ludvigs and Māris Jansons Prize in Physics for her work “Third and Higher-Order Nonlinear Optical Effects of Organic Materials”.

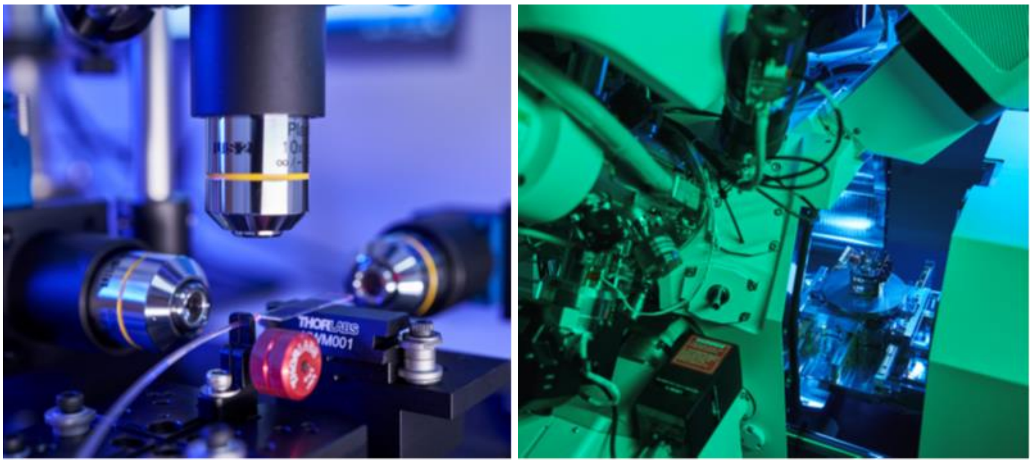
Mg.phys. Vitalijs Dimitrijevs received the Young Scientist Award for his work “Studies of Lattice Dynamics Anisotropy in Metals Using X-ray Absorption Spectroscopy”.

In the summer, Lindau (Germany) hosted the 73rd meeting of Nobel laureates, dedicated to physics. For the first time in history, Latvia was represented at this event, with Mg. Rihards Ruska, a scientific assistant at the Spectroscopy Laboratory of ISSP UL, among the 650 invited young researchers.

It is worth mentioning that, honoring the contribution of Latvian scientists to nuclear energy research, the Bank of Latvia issued the "Energy Coin" in October 2024. The coin symbolizes the nuclear fusion process, highlighting its potential as an inexhaustible and environmentally friendly energy source. The unveiling of the coin was followed by a discussion led by Andris Šternbergs, Deputy Director for Science at the ISSP UL.

Scientific Highlights

I. Research in the field of physical sciences

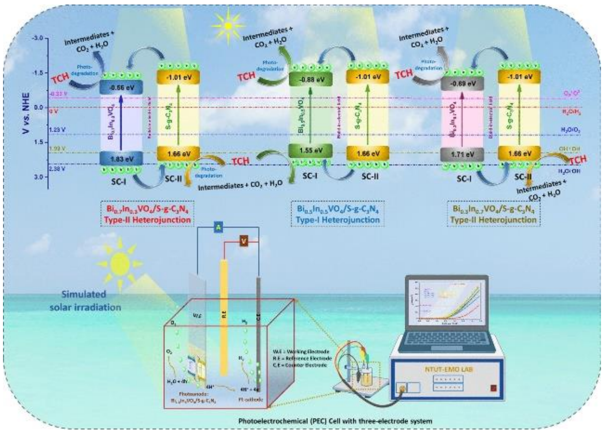


In-co-doped $Bi_{1-x}VO_4$ drenched Sulfur–doped g-C_3N_4 Nanocomposite: A Type-II Photo(electro)catalytic System for Visible-light–driven Water-splitting and Toxic removal Applications

S. Balu[1,2], S.-W. Chen[3], S. Piskunov[4], H. Venkatesvaran[2], L. W.-C. Lee[5], Th. C.-K. Yang[1,2]

[1] Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, Taipei 10608, Taiwan (Republic of China)
[2] Precision Analysis and Materials Research Center, National Taipei University of Technology, Taipei 10608, Taiwan (Republic of China)
[3] Graduate Institute of Automation Technology, National Taipei University of Technology, Taipei 10608, Taiwan (Republic of China)
[4] Institute of Solid State Physics, University of Latvia, Riga LV-1063, Latvia
[5] Asia Electronic Material Co., Ltd., Taihe Village, Zhubei City, Hsinchu 30267, Taiwan (Republic of China)

A promising alternative technology for the direct utilization and conversion of renewable energy sources is essential in order to overcome energy crises owing to the limited source of fossil fuels. Herein, we report the partial substitution of different amounts (x = 0.3, 0.5, 0.7) of indium (In^{3+}) in the Bi^{3+} sites of $BiVO_4$ through a one-pot hydrothermal route without additives. The as-prepared $Bi_{1–x}In_xVO_4$ was impregnated on 2D S-doped g-C_3N_4 via the total solvent evaporation method. The optical, electronic, and catalytic properties of the synthesized $Bi_{1–x}In_xVO_4$/S-g-C_3N_4 materials were systematically investigated through computational and experimental methods. Under simulated solar irradiation, the $Bi_{0.7}In_{0.3}VO_4$/S-g-C_3N_4 exhibits PEC-OER lower overpotentials of 118 mV and 126 mV at 10 and 20 mA/cm^2, respectively, and in contrast, the $Bi_{0.3}In_{0.7}VO_4$/S-g-C_3N_4 shows maximum photocurrent density of 15.3 mA/cm^2 at 1.23 V (vs RHE). Furthermore, the $Bi_{0.7}In_{0.3}VO_4$/S-g-C_3N_4 exhibits 91.7% photodegradation of tetracycline hydrochloride (TCH) with a high rate constant (k') of 0.0147 min^{-1}. The plausible charge transfer mechanism for the enhanced photo(electro)catalytic performance of $Bi_{1–x}In_xVO_4$/S-g-C_3N_4 was expressed as consistent with the experimental and computational results. The In^{3+} substitution can lead to increased water oxidation potential and charge carrier mobility, and the S-doped g-C_3N_4 helps to passivate the photoanode for enhanced PEC stability and efficiency. Therefore, the above results confirm the robust photoelectrocatalytic performance of $Bi_{1–x}In_xVO_4$/S-g-C_3N_4 systems in energy production and environmental remediation applications.



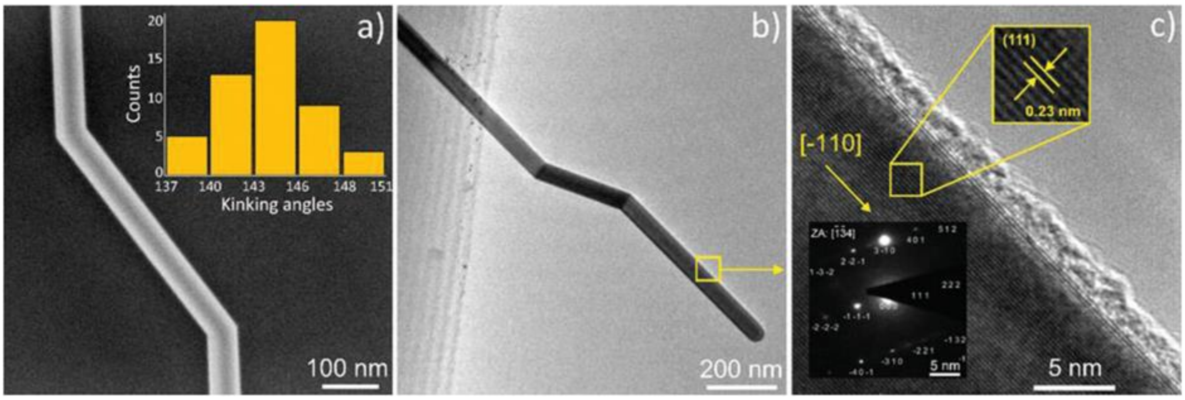
Published in:
S. Balu, S.-W. Chen, S. Piskunov, H. Venkatesvaran, L. W.-C. Lee, Th. C.-K. Yang, Adv. Compos. Hybrid Mater. 7 (2024) 32. Doi: 10.1007/s42114-024-00843-4.

Reshaping Covalent Nanowires by Exploiting an Unexpected Plasticity Mediated by Deformation Twinning

S. Vlassov[1], S. Oras[2], A. Trausa[3], T. Tiirats[2], E. Butanovs[3], B. Polyakov[3],
V. Zadin[2], A. Kyritsakis[2]

[1] Institute of Physics, University of Tartu, Tartu 50411, Estonia
[2] Institute of Technology, University of Tartu, Tartu 50411, Estonia
[3] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia

In recent years, mechanical tests on small volume covalent materials (nanospheres, nanowires, and nanopillars) reveal many unique and intriguing mechanical properties which were never observed in their bulk counterparts. Nanowires are among the most studied nanostructures as they have numerous promising applications thanks to their various unique properties. Furthermore, the properties of nanowires can be tailored during synthesis by introducing structural defects such as nano-twins, periodic polytypes, and kinks, i.e., abrupt changes in their axial direction. Here, this work reports for the first time the postsynthesis formation of such defects, achieved by exploiting peculiar plasticity that may occur in nanosized covalent materials. Specifically, in this work the authors found that single-crystal CuO nanowires can form double kinks when subjected to external mechanical loading. Both the microscopy and atomistic modeling suggest that deformation-induced twinning along the (-110) plane is the mechanism behind this effect. In a single case the authors are able to unkink a nanowire back to its initial straight profile, indicating the possibility of reversible plasticity in CuO nanowires, which is supported by the atomistic simulations. The phenomenon reported here provides novel insights into the mechanisms of plastic deformation in covalent nanowires and offers potential avenues for developing techniques to customize the shape of nanowire postsynthesis and introduce new functionalities.



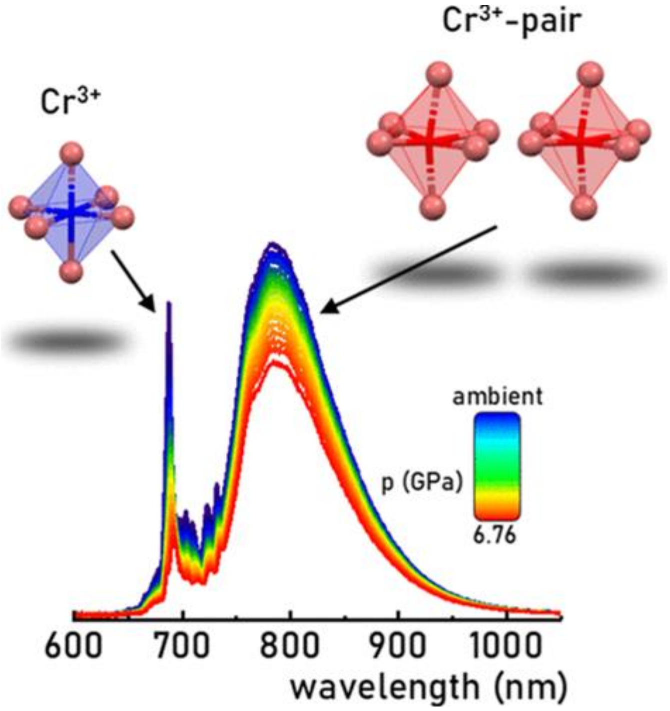
Published in:
S. Vlassov, S. Oras, A. Trausa, T. Tiirats, E. Butanovs, B. Polyakov, V. Zadin, A. Kyritsakis, Small 20 (2024) 2304614. Doi: 10.1002/smll.202304614.

Bifunctional Luminescent Thermometer-Manometer Based on Cr^{3+}–Cr^{3+} Pair Emission

M. Szymczak[1], A. Antuzevics[2], P. Rodionovs[2], M. Runowski[3], U.R. Rodríguez-Mendoza[4],
D. Szymanski[1], V. Kinzhybalo[1], L. Marciniak[1]

[1] Institute of Low Temperature and Structure Research, Polish Academy of Sciences, Wrocław, Poland
[2] Institute of Solid State Physics, University of Latvia, Riga, LV-1063, Latvia
[3] Faculty of Chemistry, Adam Mickiewicz University, Poznan, 61-614, Poland
[4] Departamento de Física, Instituto de Materiales y Nanotecnología, IUdEA & MALTA Consolider Team, Universidad de La Laguna, San Cristóbal de La Laguna, Santa Cruz de Tenerife, E-38200, Spain

Pressure dependence of spectral positions of the $^2E \rightarrow {}^4A_2$ and $^4T_2 \rightarrow {}^4A_2$ bands of Cr^{3+} ions, resulting from changes in Cr^{3+}–O^{2-} covalency and variations in crystal field strength, respectively, is commonly utilized in luminescence manometry. However, as demonstrated in this paper, the luminescence of Cr^{3+}–Cr^{3+} pairs shows insensitivity to pressure changes, making this signal suitable as a luminescence reference. The significant difference in the thermal and pressure dependences of luminescence with Cr^{3+} occupying different crystallographic positions in $CaAl_{12}O_{19}$:Cr^{3+} enables the development of a dual-function luminescence thermometer that operates in both ratiometric and lifetime-based readout modes. The presented first demonstration on utilization of Cr^{3+}–Cr^{3+} pairs luminescence for sensing applications may rekindle interest in Cr^{3+}–Cr^{3+} pairs for the development of optical sensors for physical quantities.



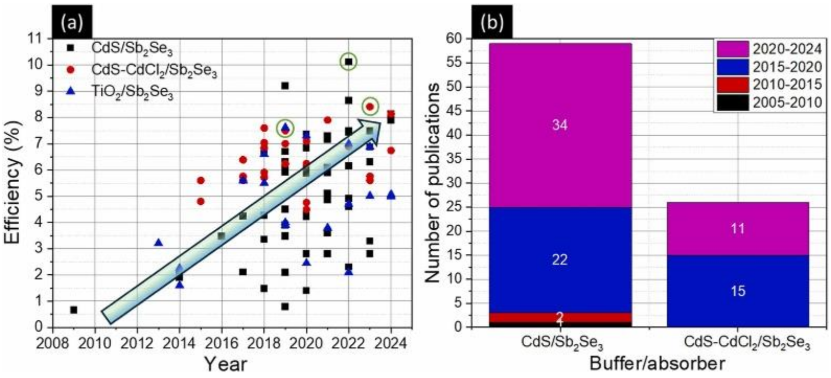
Published in:
M. Szymczak, A. Antuzevics, P. Rodionovs, M. Runowski, U.R. Rodríguez-Mendoza, D. Szymanski, V. Kinzhybalo, L. Marciniak, ACS Appl. Mater. Interfaces 16 (2024) 64976–64987. Doi: 10.1021/acsami.4c11806.

An Alternative Chlorine-Assisted Optimization of CdS/Sb_2Se_3 Solar Cells: Towards Understanding of Chlorine Incorporation Mechanism

S. V. Gopi[1], N. Spalatu[1], A. Katerski[1], J. Kuliček[2], B. Rezek[2], E. Ukraintsev[2], M. Š. Bařinková[2], G. Zoppi[3], L. Ignatane[4], R. Grzibovskis[4], M. Krunks[1], I. O. Acik[1]

[1] Department of Materials and Environmental Technology, Tallinn University of Technology,
Tallinn, Estonia
[2] Faculty of Electrical Engineering, Czech Technical University in Prague,
Prague 166 27, Czech Republic
[3] Department of Mathematics, Physics, and Electrical Engineering, Northumbria University,
Newcastle-upon-Tyne NE1 8ST, United Kingdom
[4] Institute of Solid State Physics, University of Latvia, Riga, Latvia

The current strategies in the development of Sb_2Se_3 thin film solar cells involve fabrication and optimization of superstrate and substrate device architectures, with the preferable choice for TiO_2 and CdS heterojunction layers. For CdS-based superstrate cells, several studies reported the necessity to apply $CdCl_2$ or other metal halide-based post-deposition treatment (PDT), highlighting improvement of CdS/Sb_2Se_3 device efficiency. However, the need, effect, and mechanism of such PDT are very often not described. Additionally, the fact that many groups have not succeeded in demonstrating its benefits suggests that this strategy is not straightforward, requiring a deeper understanding towards a more unified concept. The present study proposes an alternative approach to the challenging $CdCl_2$ PDT of CdS in CdS/Sb_2Se_3 device, involving controllable Cl incorporation in CdS films by systematically varying the concentration of NH_4Cl in the CBD precursor solution from 1 to 8 mM. Structural and electrical characterizations are correlated with advanced measurements of Scanning Kelvin Probe, surface photovoltage, and atomic force microscopy to understand the impact of Cl incorporation on the properties of CdS films and CdS/Sb_2Se_3 devices. The validity of Cl incorporation in the CdS lattice and interdiffusion processes at the CdS-Sb_2Se_3 interface is confirmed by secondary ion mass spectrometry analysis. It is demonstrated that incorporation of 1 mM of NH_4Cl, as a Cl source in CBD CdS, can boost the PCE of CdS/Sb_2Se_3 by ~20 %. With this approach, we offer new perspectives on the optimization methodology for Cl-based CdS/Sb_2Se_3 device processing and complementary understanding of the physiochemistry behind these processes.



Published in:
S. V. Gopi, N. Spalatu, A. Katerski, J. Kuliček, B. Rezek, E. Ukraintsev, M. Š. Bařinková, G. Zoppi, L. Ignatane, R. Grzibovskis, M. Krunks, I. O. Acik, J. Alloys Compd. 1005 (2024) 176175. Doi: 10.1016/j.jallcom.2024.176175.

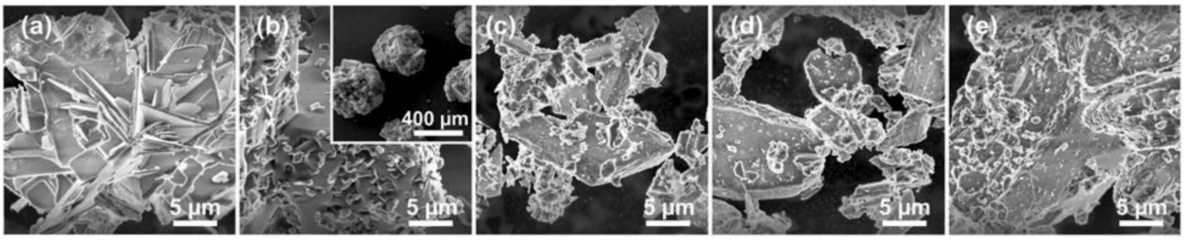
Electron Paramagnetic Resonance and Luminescence Spectroscopy of Transition Metal Ion Impurities and X-Ray-Induced Radicals in Brushite

A. Antuzevics[1,2], G. Krieke[1,2], G. Doke[1,2], A. Zarins[3,4], L. Avotina[3], E. Sprugis[2], J. Stadulis[1], A. Beganskiene[1], A. Kareiva[1], A. Zarkov[1]

[1] *Institute of Chemistry, Vilnius University, Vilnius LT-03225, Lithuania*
[2] *Institute of Solid State Physics, University of Latvia, Riga, Latvia*
[3] *University of Latvia, Institute of Chemical Physics, Riga LV-1004, Latvia*
[4] *Daugavpils University, Faculty of Natural Sciences and Healthcare, Daugavpils LV-5401, Latvia*

Calcium phosphates (CPs) represent a family of inorganic compounds, which contain calcium and phosphate ions. These materials hold paramount importance as the constituents of hard tissue of living organisms. Consequently, significant scientific attention has been devoted in the fields of biology, medicine, materials science and engineering to the research and development of these materials. Due to similarities with their natural counterparts, synthetic CPs exhibit superior integration with living tissue, which enables the use of these materials in biomedical applications such as bone grafts, dental implants and drug delivery systems. However, while some CPs such as hydroxyapatite (HA; $Ca_{10}(PO_4)_6(OH)_2$) and tricalcium phosphate (TCP; $Ca_3(PO_4)_2$) have been comprehensively characterised, other compounds within the family remain relatively unexplored.

Brushite ($CaHPO_4 \cdot 2H_2O$), also known as dicalcium phosphate dihydrate (DCPD), is a common precursor in phosphate synthesis and is becoming increasingly appealing as a biomaterial for bone regeneration applications. This study presents a comparative analysis of structural, morphological, thermal, and spectroscopic properties of synthetic brushite prepared by the wet precipitation method with several brushite products available from commercial vendors. Electron paramagnetic resonance (EPR) spectroscopy revealed that Mn^{2+} and Fe^{3+} ions are common trace impurities in commercial products. Following exposure to X-rays, EPR signals of several phosphorous-related radicals emerge. The annealing of the irradiated samples gives rise to broad thermally stimulated luminescence (TSL) signals in the 40–120 °C range, which correlates with the annealing kinetics of the radicals. The stability of radiation-induced EPR and TSL signals is limited by the phase transformation temperature from brushite to monetite ($CaHPO_4$). The results of this study provide novel insights into the formation and stability of phosphorous-related radicals and demonstrate how minuscule amounts of impurity ions can strongly influence the spectroscopic properties of brushite.



Published in:
A. Antuzevics, G. Krieke, G. Doke, A. Zarins, L. Avotina, E. Sprugis, J. Stadulis, A. Beganskiene, A. Kareiva, A. Zarkov, J. Alloys Compd. 996 (2024) 174779. Doi: 10.1016/j.jallcom.2024.174779.

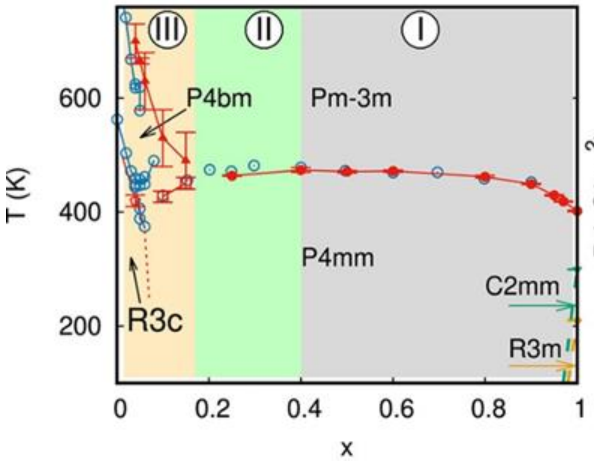
Thermal Expansion, T−x Phase Diagram and Polarization of $(1\text{-}x)Na_{1/2}Bi_{1/2}TiO_3\text{-}xBaTiO_3$ Solid Solutions

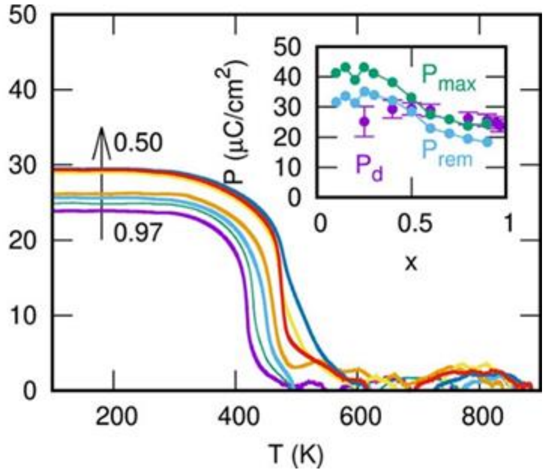
M.V. Gorev[1,2], I.N. Flerov[1], M.S. Molokeev[1,2], K. Bormanis[3], E. Birks[3],
S.V. Sapozhnikov[2], E.A. Mikhaleva[1]

[1] Kirensky Institute of Physics, Federal Research Center KSC SB RAS, 660036, Krasnoyarsk, Russia
[2] Institute of Engineering Physics and Radioelectronics, Siberian Federal University,
660074 Krasnoyarsk, Russia
[3] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia

In recent years, considerable attention has been paid to the study of multi-component oxide perovskites, which demonstrate large dielectric permittivity and high piezoelectric efficiency, making them promising for various applications in microelectronics. Among these materials, lead-containing compounds such as PZT and multi-component ceramics based on PZT, have found widespread application due to their excellent electromechanical properties. However, the high volatility of toxic PbO does not only cause environmental pollution, but also leads to heterogeneity of the composition and formation of an undesirable pyrochlore phase. For this reason, significant efforts have been made to actively search for ways to develop lead-free materials with properties comparable to those of lead-based ceramics.

This study presents the results of detailed studies of thermal expansion of solid solutions $(1\text{-}x)Na_{1/2}Bi_{1/2}TiO_3\text{-}xBaTiO_3$ with x=0.04-0.97 in the temperature range from 100 to 900 K. A change in chemical pressure associated with the complex cationic substitution, $(Na_{1/2}Bi_{1/2})^{2+} \rightarrow Ba^{2+}$, result in a very rapid decrease in the temperatures of the transformation P4mm→C2mm→R3m below 100 K which are characteristic of BaTiO3. Significant features in the behavior of thermal expansion were observed near two triple points in the T−x phase diagram where the phases Pm-3m, P4mm, P4bm (x≈0.15-0.20) and P4bm, P4mm, R3c (x≈0,06) coexist, allow the studied solid solutions to be divided into three groups. The relationship between the effects of internal chemical pressure and external hydrostatic one is discussed. By analyzing the thermodynamic potential, the root-mean-square polarization Pd is determined, which increases by about 16% with a decrease in the BT content from 0.97 to 0.4.





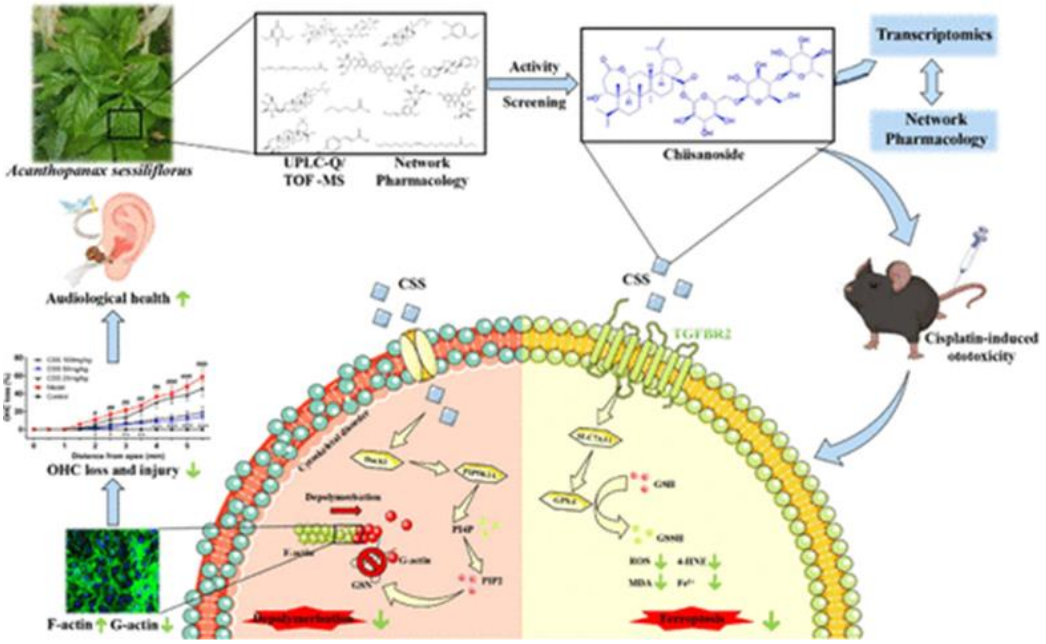
Published in:
M.V. Gorev, I.N. Flerov, M.S. Molokee, K. Bormanis, E. Birks, S.V. Sapozhnikov, E.A. Mikhaleva, J. Eur. Ceram. Soc. 44 (2024) 116769. Doi: 10.1016/j.jeurceramsoc.2024.116769.

Chiisanoside from the Leaves of Acanthopanax Sessiliflorus can resist Cisplatin-Induced Ototoxicity by maintaining Cytoskeletal Homeostasis and Inhibiting Ferroptosis

H. Teng[1,2], X. Sun[2,3], R. Eglitis[4], X. Wang[1,2], W. Zhang[1,2], H. Wang[1,2], S. Qu[1,2], Z. Yu[1],
S. Liu[1,2], Y. Zhao[1,2]

[1] College of Chinese Medicinal Materials, Jilin Agricultural University, Changchun,
Jilin Province 130118, China
[2] International Joint Laboratory for Development of Animal and Plant Resources
for Food and Medicine, Changchun, Jilin Province 130118, China
[3] College of Pharmacy, Jilin Medical University, Jilin, Jilin Province 132013, China
[4] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia

Ototoxicity is a common side effect of cisplatin cancer treatment, potentially leading to hearing loss. This study demonstrated the significant protective activity of *Acanthopanax sessiliflorus* (*A. sessiliflorus*) leaves against cisplatin-induced ototoxicity (CIO), investigated the active compounds, and elucidated their mechanisms in countering CIO. UPLC-Q/TOF-MS analysis identified 79 compounds. Network pharmacology and activity screening determined that chiisanoside (CSS) plays a crucial role in combating CIO. Transcriptomics combined with network pharmacology analysis and experiments revealed that CSS activates the Dock1/PIP5K1A pathway to suppress the actin-severing protein gelsolin, protecting hair cells from cisplatin-induced cytoskeleton damage. CSS also activates the SLC7A11/GPX4 pathway via TGFBR2, reducing lipid peroxidation and intracellular iron accumulation to suppress cisplatin-induced ferroptosis. This study discovers that the major component CSS in *A. sessiliflorus* leaves reverses CIO by regulating actin homeostasis via Dock1 and inhibiting ferroptosis through TGFBR2, providing a theoretical basis for expanding CIO treatment targets and related drug development.



Published in:
H. Teng, X. Sun, R. Eglitis, X. Wang, W. Zhang, H. Wang, S. Qu, Z. Yu, S. Liu, Y. Zhao, J. Agric. Food Chem. 72 (2024) 25720-25742. Doi: 10.1021/acs.jafc.4c07994.

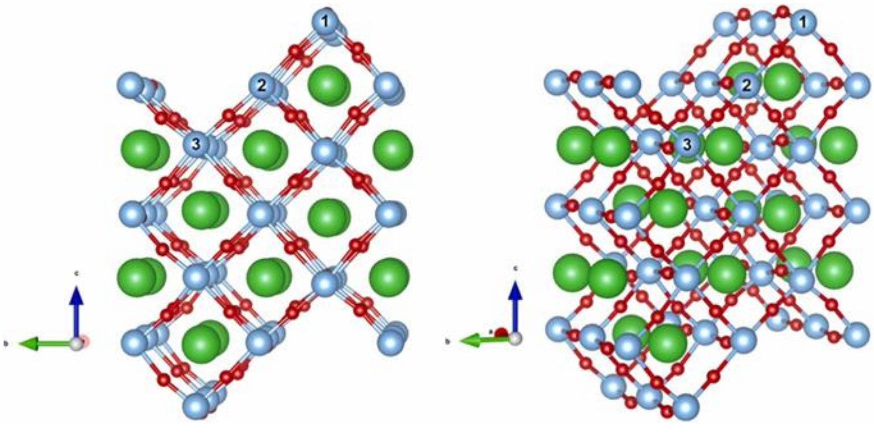
Computational Study of Oxygen Evolution Reaction on Flat and Stepped Surfaces of Strontium Titanate

M. Sokolov[1,2,3], Y. A. Mastrikov[1], D. Bocharov[1], V. Krasnenko[4], G. Zvejnieks[1],
K. S. Exner[2,3,5], E. A. Kotomin[1,6]

[1] *Institute of Solid State Physics, Riga LV-*1063*, Latvia*
[2] *University of Duisburg-Essen, Essen 545141, Germany*
[3] *Cluster of Excellence RESOLV, Bochum 44801, Germany*
[4] *Institute of Physics, University of Tartu, Tartu 50411, Estonia*
[5] *Center for Nanointegration (CENIDE) Duisburg-Essen, Duisburg 47057, Germany*
[6] *Max Planck Institute for Solid State Research, Stuttgart 70569, Germany*

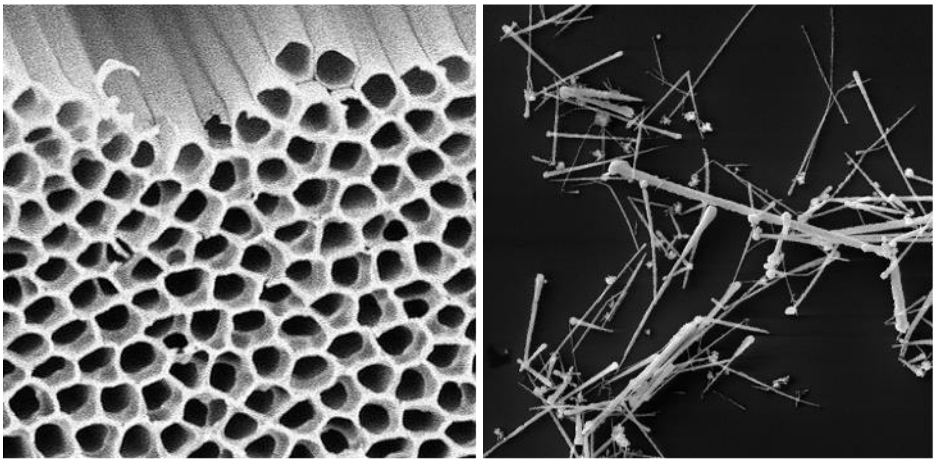
In view of the energy crisis caused by the depletion of fossil fuel resources, the performance of energy conversion and storage devices of alternative energy sources are extremely important. Gaseous hydrogen (H_2) is frequently discussed as a promising energy carrier for intermittent energy supply from renewables, however, hydrogen production by (photo-) electrochemical water splitting is hampered by the kinetically sluggish oxygen evolution reaction (OER). The overall performance of electrolyzers and fuel cells is dominated by two reactions, the oxygen evolution reaction and the oxygen reduction reaction (ORR).

Oxygen evolution reaction (OER) is reconciled with the bottleneck in hydrogen production via photo- or electrocatalytic water splitting. One of the remedies to overcome this shortcoming is to develop catalytically efficient anode materials. Strontium titanate (STO) is a potential candidate for the OER by referring to recent experimental reports on enhanced photocatalytic activity of faceted nanoparticles. In this paper, we perform electronic structure calculations in the density functional theory approximation to study the OER on flat and stepped surfaces, such as encountered in nano-sized STO. We demonstrate that stepped surfaces reveal higher OER activity than flat surfaces, which is consistent with experimental data. We also observe partial breaking of OER scaling relation on stepped surfaces, albeit this does not necessarily cause higher catalytic activity. Finally, we propose recommendations for thorough implementation of zero-point energy calculations as the calculation method may impact the free-energy landscape of the OER.



Published in:
M. Sokolov, Y. A. Mastrikov, D. Bocharov, V. Krasnenko, G. Zvejnieks, K. S. Exner, E. A. Kotomin, Catal. Today 432 (2024) 114609. Doi: 10.1016/j.cattod.2024.114609.

II. Development of novel functional materials

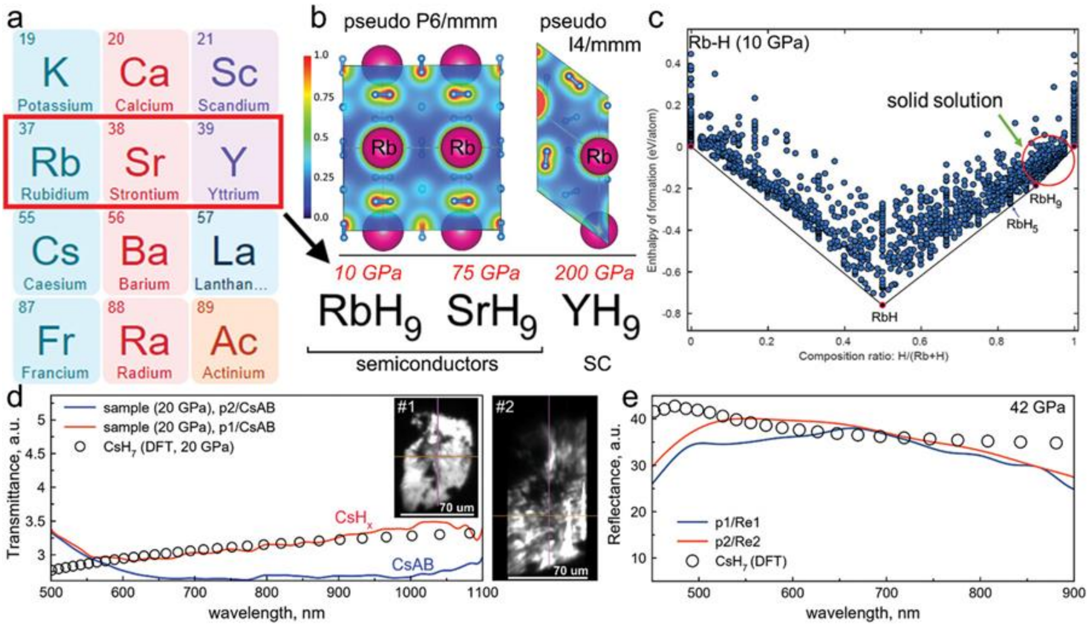


Raisins in a Hydrogen Pie: Ultrastable Cesium and Rubidium Polyhydrides

D. Zhou[1], D. Semenok[1], M. Galasso[2], F. G. Alabarse[3], D. Sannikov[4], I. A. Troyan[5],
Y. Nakamoto[6], K. Shimizu[6], A. R. Oganov[4]

[1] *Center for High Pressure Science & Technology Advanced Research, Beijing 100193, China*
[2] *Institute of Solid State Physics, University of Latvia, Riga LV-1063, Latvia*
[3] *Elettra Sincrotrone Trieste, Basovizza, Trieste 34149, Italy*
[4] *Skolkovo Institute of Science and Technology, Moscow 121205, Russia*
[5] *A.V. Shubnikov Institute of Crystallography» of the Kurchatov Complex of Crystallography and Photonics (KKKiF), Moscow 119333, Russia*
[6] *KYOKUGEN, Graduate School of Engineering Science, Osaka University, Osaka 560–8531, Japan*

Stabilizing polyhydrides is crucial for developing hydrogen batteries and environmentally-friendly vehicles based on them. A new method for synthesis of metal polyhydrides via high-pressure thermal decomposition of corresponding amidoboranes in diamond anvil cells is proposed. Within this approach, molecular semiconducting cesium ($P4/nmm$-CsH_7, $P1$-CsH_{15+x}) and rubidium (RbH_{9-x}) polyhydrides with a very high hydrogen content reaching 93 at.% are synthesized. Preservation of CsH_7 at near ambient conditions, confirmed both experimentally and theoretically, represents a significant advance in the stabilization of hydrogen-rich compounds. In addition, two crystalline modifications of RbH_{9-x} with pseudohexagonal and pseudotetragonal structures identified by synchrotron X-ray diffraction, and Raman measurements are synthesized. Both phases are stable at 8–10 GPa. This is an unprecedentedly low stabilization pressure for polyhydrides. These discoveries open up possibilities for modifying existing hydrogen storage materials to increase their efficiency.



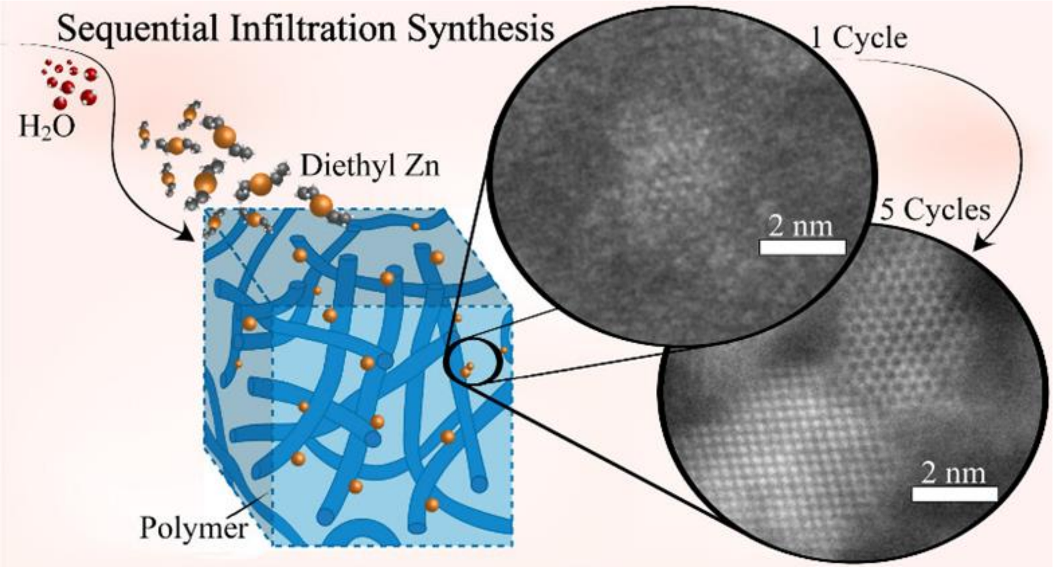
Published in:
D. Zhou, D. Semenok, M. Galasso, F. G. Alabarse, D. Sannikov, I. A. Troyan, Y. Nakamoto, K. Shimizu, A. R. Oganov, Adv. Energy Mater. 14 (2024) 2400077. Doi: 10.1002/aenm.202400077.

The Development and Atomic Structure of Zinc Oxide Crystals Grown within Polymers from Vapor Phase Precursors

I. Weisbord[1], M. Barzilay[1], R. Cai[1], E. Welter[2], A. Kuzmin[3], A. Anspoks[3], T. Segal-Peretz[1]

[1] Department of Chemical Engineering, Technion − Israel Institute of Technology, 3200003 Haifa, Israel
[2] Deutsches Elektronen-Synchrotron − A Research Centre of the Helmholtz Association, D-22607 Hamburg, Germany
[3] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia

Sequential infiltration synthesis (SIS), also known as vapor phase infiltration (VPI), is a quickly expanding technique that allows growth of inorganic materials within polymers from vapor phase precursors. With an increasing materials library, which encompasses numerous organometallic precursors and polymer chemistries, and an expanding application space, the importance of understanding the mechanisms that govern SIS growth is ever increasing. In this work, we studied the growth of polycrystalline ZnO clusters and particles in three representative polymers: poly(methyl methacrylate), SU-8, and polymethacrolein using vapor phase diethyl zinc and water. Utilizing two atomic resolution methods, high-resolution scanning transmission electron microscopy and synchrotron X-ray absorption spectroscopy, we probed the evolution of ZnO nanocrystals size and crystallinity level inside the polymers with advancing cycles – from early nucleation and growth after a single cycle, through the formation of nanometric particles within the films, and to the coalescence of the particles upon polymer removal and thermal treatment. Through in situ Fourier transform infrared spectroscopy and microgravimetry, we highlight the important role of water molecules throughout the process and the polymers' hygroscopic level that leads to the observed differences in growth patterns between the polymers, in terms of particle size, dispersity, and the evolution of crystalline order. These insights expand our understanding of crystalline materials growth within polymers and enable rational design of hybrid materials and polymer-templated inorganic nanostructures.



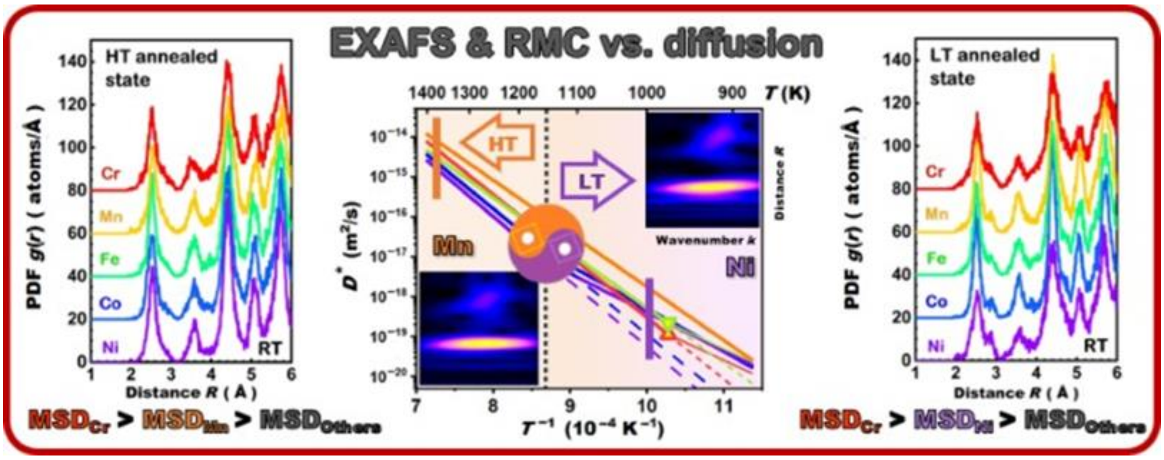
Published in:
I. Weisbord, M. Barzilay, R. Cai, E. Welter, A. Kuzmin, A. Anspoks, T. Segal-Peretz, ACS Nano 18 (2024) 18393-18404. Doi: 10.1021/acsnano.4c02846.

Anomalies in the Short-Range Local Environment and Atomic Diffusion in Single Crystalline Equiatomic CrMnFeCoNi High-Entropy Alloy

A. Smekhova[1], D. Gaertner[2], A. Kuzmin[3], A. Guilherme Buzanich[4], G. Schuck[1], I. Zizak[1],
G. Wilde[2], K. V. Yusenko[4], S. Divinski[2]

[1] Helmholtz-Zentrum Berlin für Materialien und Energie (HZB), D-12489 Berlin, Germany
[2] Institute of Materials Physics, University of Münster, D-48149 Münster, Germany
[3] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia
[4] Bundesanstalt für Materialforschung und - prüfung (BAM), D-12489, Berlin, Germany

Multi-component systems continuously attract the close attention of researchers from a wide range of disciplines due to a variety of phenomena observed through either non-ordinary macroscopic behaviour or exquisite local atomic interactions. High-entropy alloys (HEAs) composed of at least five principal components with nearly equiatomic concentrations represent a class of materials with unique macroscopic properties attractive for technological applications, and at the same time, they stimulate new approaches in disentangling their intricate local structure responsible for such behaviour. Multi-edge extended X-ray absorption fine structure (EXAFS) spectroscopy combined with reverse Monte Carlo (RMC) simulations was used to probe the details of element-specific local coordinations and component-dependent structure relaxations in single crystalline equiatomic CrMnFeCoNi high-entropy alloy as a function of the annealing temperature. Two representative states, namely a high-temperature state, created by annealing at 1373 K, and a low-temperature state, produced by long-term annealing at 993 K, were compared in detail. Specific features identified in atomic configurations of particular principal components indicate variations in the local environment distortions connected to different degrees of compositional disorder at the chosen representative temperatures. The detected changes provide new atomistic insights and correlate with the existence of kinks previously observed in the Arrhenius dependencies of component diffusion rates in the CrMnFeCoNi high-entropy alloy.



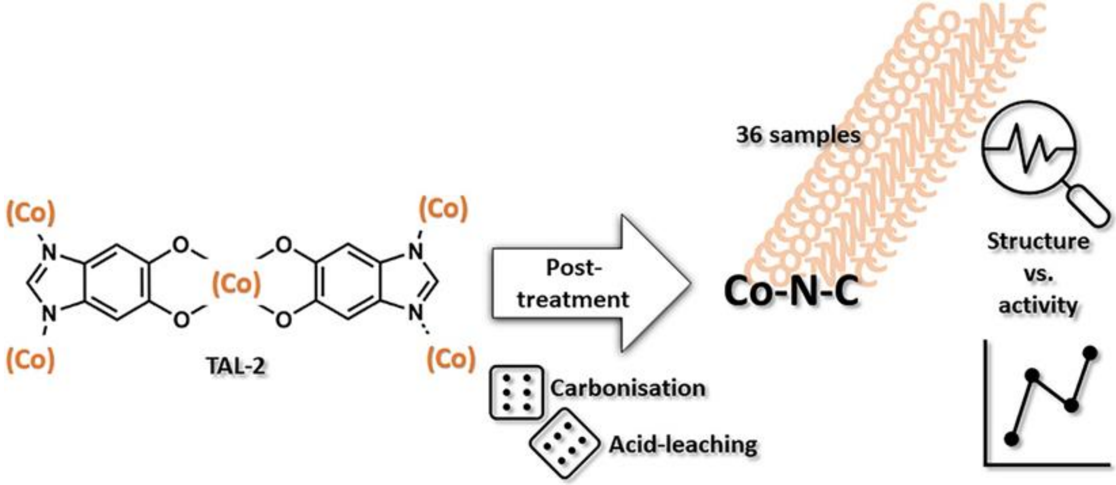
Published in:
A. Smekhova, D. Gaertner, A. Kuzmin, A. Guilherme Buzanich, G. Schuck, I. Zizak, G. Wilde, K. V. Yusenko, S. Divinski, Nano Res. 17 (2024) 5336-5348. Doi: 10.1007/s12274-024-6443-6.

Optimizing Post-treatment Strategies for Enhanced Oxygen Reduction/Evolution Activity in Co–N–C Electrocatalyst

G. Yusibova[1], K. Ping[2], M. Käärik[1], J. Leis[1], J. Aruväli[3], K. Šmits[5], T. Käämbre[4], V. Kisand[4],
Y. Karpichev[6], K. Tammeveski[1], N. Kongi[1]

[1] Institute of Chemistry, University of Tartu, Tartu, 50411, Estonia
[2] Yichang Humanwell Pharmaceutical Co., Ltd, Xiling District, Yichang, 443005, Hubei, China
[3] Institute of Ecology and Earth Sciences, University of Tartu, Tartu, 50411, Estonia
[4] Institute of Physics, University of Tartu, Tartu, 50411, Estonia
[5] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia
[6] Department of Chemistry and Biotechnology, Tallinn University of Technology, Tallinn, 12618, Estonia

Uncovering the origin of bifunctional oxygen reduction/evolution reaction (ORR/OER) activity of M-N-C type electrocatalysts is essential for their extensive usage in fuel cells and metal-air batteries. The electrochemical properties of heterogeneous M-N-C catalysts depend on the surface structure, which can be modified via different synthetic methods. Herein, we investigate the effect of structure on the activity of Co–N–C electrocatalyst material derived from an amorphous metal-organic framework TAL-2. Specifically, TAL-2 served as the sole precursor for the synthesis of a range of Co–N–C catalysts via various carbonization and acid-leaching modes. Co–N–C catalysts were prepared by carbonizing TAL-2 at different temperatures (700, 800, 900, and 1000 °C) and subsequent acid-leaching using different acids, namely HCl, H_2SO_4, and HNO_3, either individually or in various combinations. This resulted in the generation of 36 distinct catalyst samples, each exhibiting unique morphological characteristics. By systematically varying these parameters, we aimed to unravel the intricate relationship between post-synthetic treatment and the resulting electrocatalytic properties, shedding light on the rational design of Co–N–C catalysts for enhanced ORR/OER.



Published in:
G. Yusibova, K. Ping, M. Käärik, J. Leis, J. Aruväli, K. Šmits, T. Käämbre, V. Kisand, Y. Karpichev, K. Tammeveski, N. Kongi, Int. J. Hydrog. Energy 82 (2024) 398-406. Doi: 10.1016/j.ijhydene.2024.07.388.

A Step to Microplastic Formation: Microcracking and Associated Surface Transformations of Recycled LDPE, LLDPE, HDPE, and PP Plastics Exposed to UV Radiation

E. Kuka[1], D. Cirule[1], I. Andersone[1], L. O. Vasiljevs[1,2], J. Merna[3], A. Sarakovskis[4],
N. Kurnosova[1], E. Sansonetti[1], L. Vevere[1], B. Andersons[1]

[1] *Latvian State Institute of Wood Chemistry, Laboratory of Wood Biodegradation and Protection,*
LV-1006 Riga, Latvia
[2] *Faculty of Chemistry, University of Latvia, LV-1586 Riga, Latvia*
[3] *Department of Polymers, University of Chemistry and Technology Prague,*
Prague 6, 166 28, Czech Republic
[4] *Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia*

Plastics when exposed to UV radiation start to degrade via photooxidative aging including free radical formation, oxidation, chain scission and/or crosslinking reactions. These chemical changes can cause loss in mechanical strength, surface embrittlement, and eventually surface erosion. The eroded particles are microplastics (MPs), which have been identified as a potentially serious threat to the environment and its inhabitants. In general, photodegradation of virgin plastics has been studied extensively, but there is not much literature on the degradation of recycled plastics. The goal of the study was to investigate the changes caused by photodegradation in recycled plastics and assess the potential risks of MPs formation. And eventually, knowing the chemical and physical transformations occurring on the surface understand the mechanism behind surface microcracking, which is the first step of MPs formation. Pellets of five industrially recycled plastics (low-density polyethylene (rLDPE), linear low-density polyethylene (rLLDPE), high-density polyethylene (rHDPE), and two polypropylenes (rPP)) from different waste sources were analysed. UV irradiation was performed in an accelerated weathering chamber for milled (< 400 µm) plastic powder to ensure homogeneous changes throughout the sample. The properties were investigated by ATR-FTIR, HT-SEC, XPS and DSC. The formation of microcracks was studied on plastic pellets by SEM. The results showed that the degradation significantly differed between the recycled plastics, and the waste source was more important than the plastic type. rLDPE and one of the rPP samples showed a significant increase in carbonyl index as well as decrease in molar mass during the first 500 h of UV exposure. The other rPP and rHDPE samples showed the first considerable signs of degradation only after 1000 h of UV exposure. Minor changes were observed for the rLLDPE sample during the whole test. The SEM revealed microcracking on the surface of all samples, which also had noticeable degradation identified by other methods. These recycled plastics can be considered the ones with the highest potential of MPs formation. From the chemical and physical transformations identified on the surface, the mechanism leading to microcracking, which is the first step in the formation of MPs, is proposed.

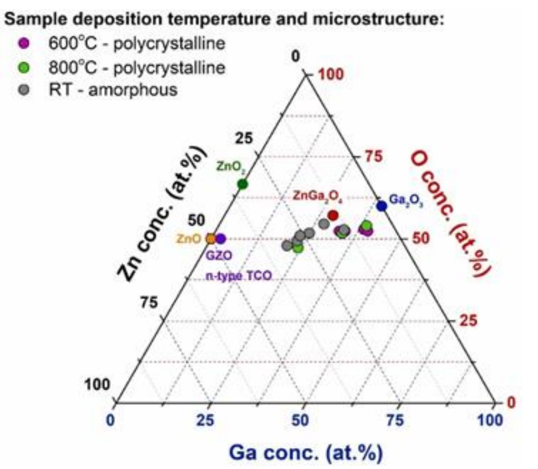
Published in:
E. Kuka, D. Cirule, I. Andersone, L. O. Vasiljevs, J. Merna, A. Sarakovskis, N. Kurnosova, E. Sansonetti, L. Vevere, B. Andersons, Polym. Degrad. Stab. 229 (2024) 110967. Doi: 10.1016/j.polymdegradstab.2024.110967.

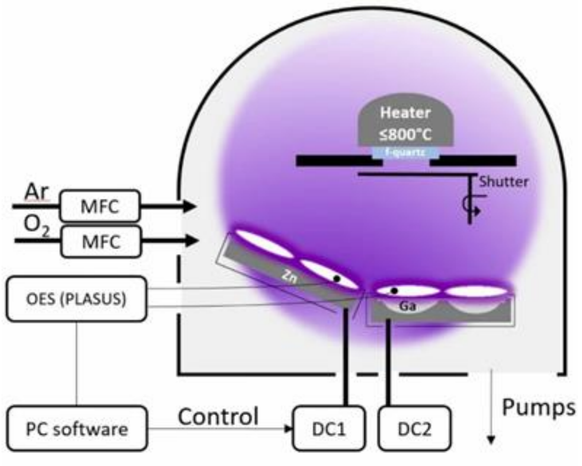
Deposition and Photoluminescence of Zinc Gallium Oxide Thin Films with Varied Stoichiometry Made by Reactive Magnetron Co-Sputtering

M. Zubkins[1], E. Strods[1], V. Vibornijs[1], A. Sarakovskis[1], R. Nedzinskas[1], R. Ignatans[1],
E. Butanovs[1], J. Purans[1], A. Azens[2]

[1] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia
[2] AGL Technologies SIA, LV-1006 Riga, Latvia

This paper reports on the deposition and photoluminescence of amorphous and crystalline thin films of zinc gallium oxide with Ga:Zn atomic ratio varied between 0.3 and 5.7. The films are prepared by reactive direct current magnetron co-sputtering from liquid/solid gallium/zinc targets onto fused quartz substrates; the temperature of the substrate is varied from room temperature (RT) to 800 °C. The sputtering process is effectively controlled by fixing the sputtering power of one of the targets and controlling the power of the other target by plasma optical emission spectroscopy. The method, in conjunction with oxygen flow adjustment, enables the production of near-stoichiometric films at any temperature used. The composition analysis suggests a few at% oxygen deficiency in the films. The resulting deposition rate is at least an order of magnitude higher compared to the commonly used radio-frequency sputtering from a ceramic ZnO:Ga_2O_3 target. Deposited onto unheated substrates, the films with Ga:Zn ≈ 2 are X-ray amorphous. Well-defined X-ray diffraction peaks of spinel $ZnGa_2O_4$ start to appear at a substrate temperature of 300 °C. The surface of the as-deposited films is dense and exhibits a fine-featured structure observed in electron microscopy images. Increasing the deposition temperature from RT to 800 °C eliminates defects and improves crystallinity, which for the films with Ga:Zn ratio close to 2 results in an increase in the optical band gap from 4.6 eV to 5.1 eV. Room temperature photoluminescence established the main peak at 3.1 eV (400 nm); a similar peak in Ga_2O_3 is ascribed to oxygen-vacancy related transitions. A prominent feature around 2.9 eV (428 nm) is attributed to self-activation center of the octahedral Ga-O groups in the spinel lattice of $ZnGa_2O_4$. It was found that photoluminescence from $ZnGa_2O_4$ depends significantly on the stoichiometric ratio between Ga and Zn and the deposition/annealing temperature.





Published in:
M. Zubkins, E. Strods, V. Vibornijs, A. Sarakovskis, R. Nedzinskas, R. Ignatans, E. Butanovs, J. Purans, A. Azens, J. Alloys Compd. 976 (2024) 173218. Doi: 10.1016/j.jallcom.2023.173218.

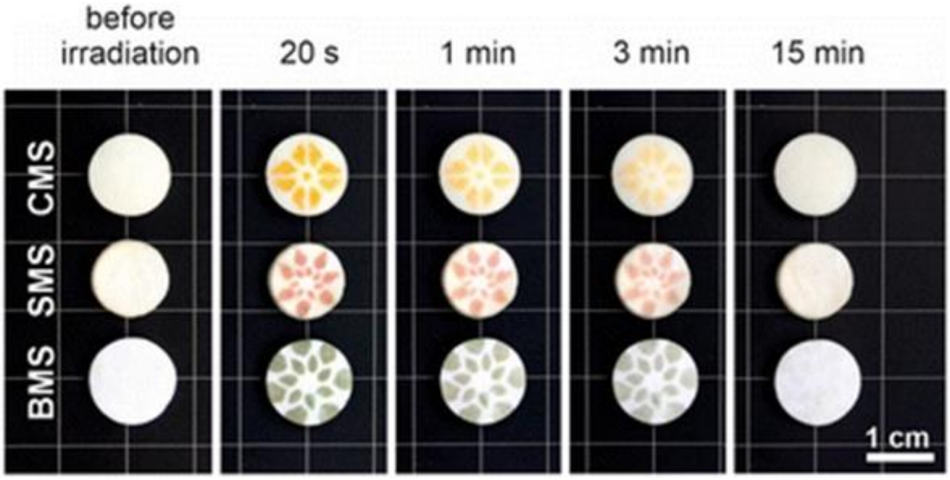
Matrix-dependent high-contrast photochromism in Eu-doped $M_3MgSi_2O_8$ (M = Ca, Sr, Ba)

G. Krieke[1,2], A. Antuzevics[1,2], A. Kalinko[2], A. Kuzmin[2], T. Murauskas[1], A. Kareiva[1], A. Zarkov[1]

[1] *Institute of Chemistry, Vilnius University, Vilnius LT-03225, Lithuania*
[2] *Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia*

Photochromism, or the photochromic effect, is a reversible color change in a material induced by exposure to electromagnetic radiation. It was first reported in mineral sodalite, from which some variants exhibited distinctive discoloration of bright pink color to green under sunlight. This phenomenon, also known as tenebrescence in minerals, was subsequently identified in organic compounds; Fritzsche documented this effect in an orange polycyclic hydrocarbon solution containing tetracene that discolored upon exposure to sunlight and could be restored by heating. The study of photochromic materials has garnered significant attention due to their diverse applications, including sensors, displays, data storage and optical switches, photochromic lenses, smart windows, textiles, anti-counterfeiting, dosimetry, and others. Inorganic oxide-based photochromic materials show excellent thermal and chemical stability and long cycling life. Examples of such materials include sodalites, barium silicates, alkaline earth stannates, niobates and transition metal oxides.

The photochromic properties and charge transfer processes were studied in novel Eu-doped $M_3MgSi_2O_8$ (M = Ca, Sr, Ba) compounds. These materials exhibit vivid color changes upon irradiation with UV light, resulting in orange, reddish-pink, and green colors. The introduction of europium ions enhances photochromic efficiency and shifts excitation peaks to lower energy ranges. Analysis of diffuse reflectance and electron paramagnetic resonance spectra reveals the formation of both paramagnetic and non-paramagnetic defects, with the dominant signals attributed to electron centers, likely F^+-type centers. The $Eu^{2+} \rightarrow Eu^{3+}$ charge transfer during irradiation indicates that Eu^{2+} acts as a hole center. These findings contribute to a better understanding of the mechanisms underlying photochromism in these materials and highlight their potential for practical applications.



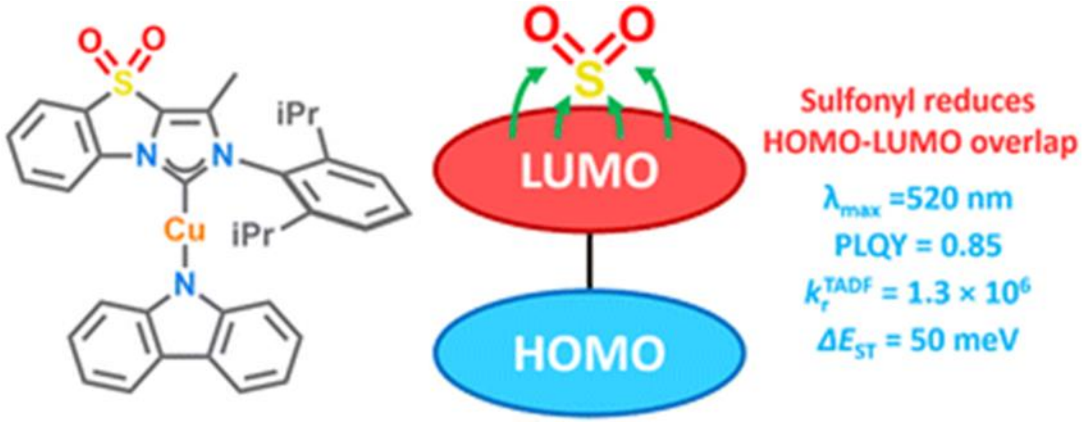
Published in:
G. Krieke, A. Antuzevics, A. Kalinko, A. Kuzmin, T. Murauskas, A. Kareiva, A. Zarkov, J. Mater. Chem. C 12 (2024) 16989-16998. Doi: 10.1039/D4TC03091E.

Sulfonyl-Functionalized Benzo[D]Imidazo[5,1-B]Thiazole-Based Carbenes as Building Blocks for Two-Coordinate Cu(I) Complexes Exhibiting Fast and Efficient Thermally Activated Delayed Fluorescence

A. Ruduss[1], A. Jece[1], K.A. Stucere[2], K.-W. Chen[3], B. Turovska[4], S. Belyakov[4],
A. Vembris[2], C.-H. Chang[3], K. Traskovskis[1]

[1] *Riga Technical University, Institute of Chemistry and Chemical Technology, Faculty of Natural Sciences and Technology, Riga LV-1048, Latvia*
[2] *Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia*
[3] *Department of Electrical Engineering, Yuan Ze University, Chungli 32003, Taiwan*
[4] *Latvian Institute of Organic Synthesis, Riga LV-1006, Latvia*

Linear two-coordinate carbene–metal–amide (CMA) complexes are an emerging class of luminescent materials that can provide efficient emission from triplet excited states through the thermally activated delayed fluorescence (TADF) mechanism, characterized by sub-microsecond lifetimes (τ) and unity photoluminescence quantum yields (Φ_{PL}). Structural diversity of these compounds is largely limited by the small number of suitable carbene fragments possessing sufficient stability and π-accepting property. By applying rational design principles, we have modified the tricyclic benzo[*d*]imidazo[5,1-*b*]thiazolium carbene precursor by the introduction of a strongly accepting sulfonyl group through the oxidation of the heterocyclic sulphur atom. Thus, an efficient TADF process is enabled in the corresponding Cu(I)-based CMA emitters in comparison to long-lived (^{3}LE) phosphoresce seen in sulfone-free structural analogues. Compounds are characterized using the Φ_{PL} of up to 0.85 and outstandingly high radiative rates (k_r) of up to 1.3×10^6 s^{-1}. The rapid emissive process is attributed to the unusually small overlap integral of 0.118 between the highest occupied and lowest unoccupied molecular orbitals (HOMO, LUMO), leading to a small singlet–triplet energy gap (ΔE_{ST}) of 0.05 eV. A vacuum-deposited green OLED incorporating the synthesized emitter was prepared showing an external quantum efficiency (EQE) of 8.6% and a maximum luminance of 26 000 cd m^{-2}.



Published in:
A. Ruduss, A. Jece, K.A. Stucere, K.-W. Chen, B. Turovska, S. Belyakov, A. Vembris, C.-H. Chang, K. Traskovskis, J. Mater. Chem. C 12 (2024) 2968-2980. Doi: 10.1039/D3TC04417C.

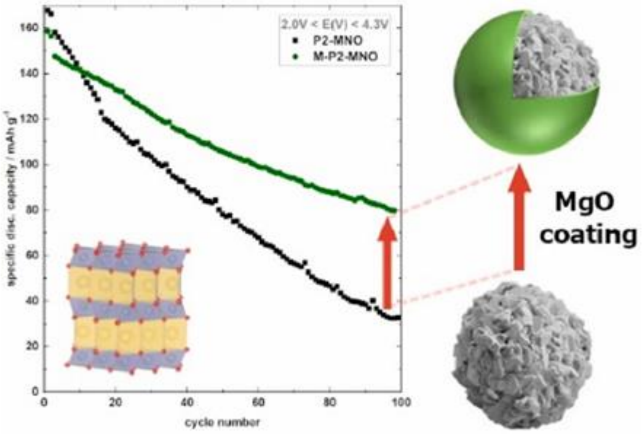
MgO coated P2-$Na_{0.67}Mn_{0.75}Ni_{0.25}O_2$ Layered Oxide Cathode for Na-Ion Batteries

C. Gauckler[1], G. Kucinskis[1,2], L. F. Pfeiffer[1], A. A. Abd-El-Latif[1], Y. Tang[4,5], C. Kübel[3,4,5],
F. Maroni[1], R. Gong[1], M. Wohlfahrt-Mehrens[1,3], P. Axmann[1], M. Marinaro[1]

[1] *Zentrum Für Sonnenenergie Und Wasserstoff Forschung Baden-Württemberg (ZSW),*
D-89081 Ulm, Germany
[2] *Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia*
[3] *Helmholtz Institute Ulm (HIU) Electrochemical Energy Storage, D-89081 Ulm, Germany*
[4] *Institute of Nanotechnology (INT), Karlsruhe Institute of Technology (KIT),*
D-76344 Eggenstein-Leopoldshafen, Germany
[5] *Karlsruhe Nano Micro Facility (KNMFi), Karlsruhe Institute of Technology (KIT),*
D-76344 Eggenstein-Leopoldshafen, Germany

Rechargeable batteries are the go-to energy storage technology not only for portable electronics, but also electric vehicles and stationary energy storage applications. Although Lithium-ion batteries (LIBs) currently dominate the market, sodium-ion batteries (NIBs) are increasingly gaining attention as a more sustainable and potentially cheaper alternative. Among various promising cathode materials for NIBs, P2-type Na-layered transition metal oxides with the stoichiometry $Na_{2/3}MO_2$ (M = transition metals), offer one of the highest discharge capacities and energy densities.

In this study, we propose an effective strategy to improve the electrochemical performance of a P2-$Na_{0.67}Mn_{0.75}Ni_{0.25}O_2$ (P2-MNO) cathode material for Na-ion batteries based on MgO surface coating. The MgO coating, with a thickness of ∼20–50 nm, is obtained by means of a facile wet-chemistry approach followed by heat treatment carried out at comparatively low temperatures (400–500 °C) in order to avoid possible Mg doping in the bulk of the P2-MNO. Detailed electrochemical investigations demonstrate improved electrochemical performance of the MgO-coated material (M-P2-MNO) in comparison to pristine bare one at both room and elevated (40 °C) temperatures. *Operando* differential electrochemical mass spectroscopy (DEMS) demonstrate that the MgO coating is effective in suppressing unwanted gas evolution due to side reactions thus stabilizing the cathode/electrolyte interface.



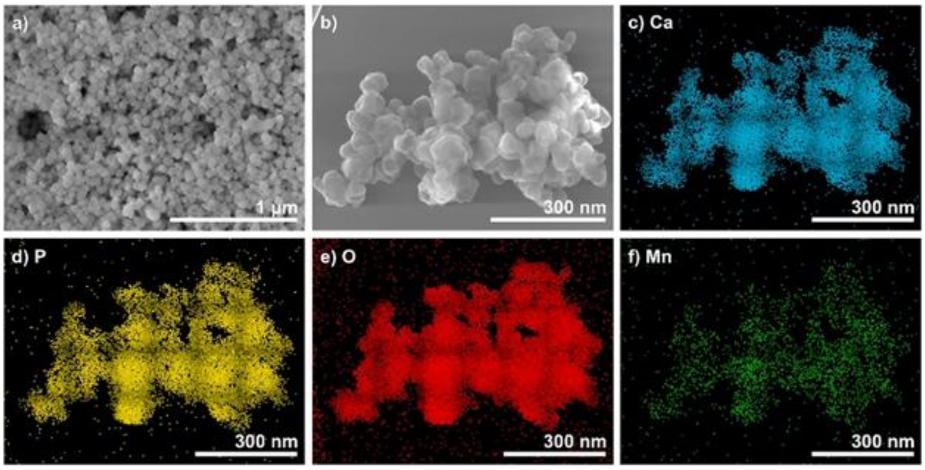
Published in:
C. Gauckler, G. Kucinskis, L. F. Pfeiffer, A. A. Abd-El-Latif, Y. Tang, C. Kübel, F. Maroni, R. Gong, M. Wohlfahrt-Mehrens, P. Axmann, M. Marinaro, J. Power Sources Adv. 25 (2024) 100135. Doi: 10.1016/j.powera.2024.100135.

Low-temperature aqueous synthesis and biocompatibility of manganese whitlockite

A. Kizalaite[1], A. Dubnika[2,3], A. Antuzevics[1,4], T. Murauskas[1], O. Stewart[5], S. L. Stoll[5],
T. Goto[6,7], T. Sekino[6], A. Zarkov[1]

[1] Institute of Chemistry, Vilnius University, LT-03225, Vilnius, Lithuania
[2] Institute of Biomaterials and Bioengineering, Faculty of Natural Sciences and Technology, Riga Technical University, Riga, LV-1007, Latvia
[3] Baltic Biomaterials Centre of Excellence, Headquarters at Riga Technical University, LV-1658, Riga, Latvia
[4]Institute of Solid State Physics, University of Latvia, LV-1063, Riga, Latvia
[5] Department of Chemistry, Georgetown University, Washington D.C, 20057, United States
[6]SANKEN (The Institute of Scientific and Industrial Research), Osaka University, Osaka, 567–0047, Japan
[7] Institute for Advanced Co-Creation Studies, Osaka University, Osaka, 565-0871, Japan

In recent years magnesium whitlockite (Mg-WH; $Ca_{18}Mg_2(HPO_4)_2(PO_4)_{12}$) has attracted the attention of the scientific community due to its potential to be used in bone regeneration and reconstruction. In this work, manganese whitlockite (Mn-WH, $Ca_{18}Mn_2(HPO_4)_2(PO_4)_{12}$) was successfully synthesized and comprehensively characterized. This material is a manganese-containing analog of the biomineral magnesium whitlockite (Mg-WH, $Ca_{18}Mg_2(HPO_4)_2(PO_4)_{12}$). The synthesis was performed *via* a low-temperature dissolution-precipitation process in aqueous medium under ambient pressure at 75 °C using dicalcium phosphate dehydrate and manganese acetate tetrahydrate as starting materials. The crystal structure of the synthesized powder was determined by powder X-ray diffraction, FTIR and Raman spectroscopies, demonstrating the presence of characteristic structural units. Morphological features and elemental distribution within the synthesized powder were studied by SEM/EDX analysis. XPS, EPR and magnetic studies confirmed the presence of Mn ions in a divalent state. Temperature-dependent magnetic measurements revealed a paramagnetic behavior of Mn-WH down to 5 K. *In vitro* cytotoxicity experiments were performed with MC3T3-E1 preosteoblastic cell line.



SEM micrographs (a, b) and EDX mapping (c–f) of the as-prepared Mn-WH powder.

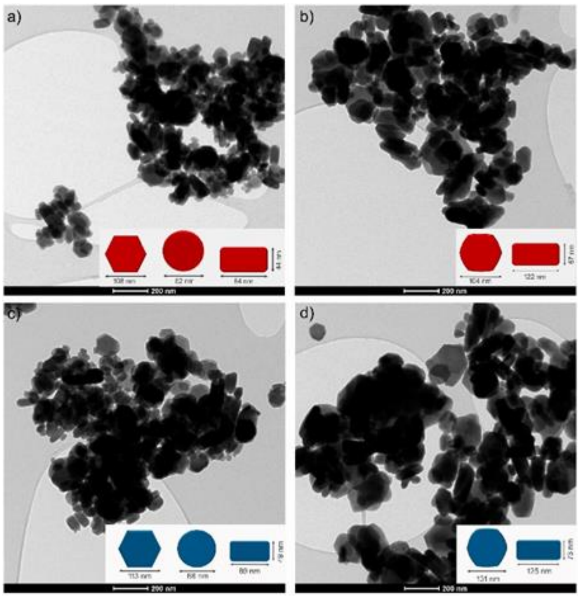
Published in:
A. Kizalaite, A. Dubnika, A. Antuzevics, T. Murauskas, O. Stewart, S. L. Stoll, T. Goto, T. Sekino, A. Zarkov, Ceramics International 50 (2024) 28490–28497. Doi: 10.1016/j.ceramint.2024.05.157.

Microwave-assisted solvothermal synthesis of Eu^{3+}-doped CsY_2F_7 and RbY_2F_7 phosphorescent nanoparticles

K. Milenković[1], I. Zeković[1], B. Milicević[1], Z. Ristić[1], K. Smits[2], A. I. Popov[2],
M. D. Dramicanin[1], V. Dordević[1]

[1] *Center of Excellence for Photoconversion, Vinča Institute of Nuclear Sciences-National Institute of the Republic of Serbia, University of Belgrade, PO Box 522, 11001, Belgrade, Serbia*
[2] *Institute of Solid State Physics, University of Latvia, Kengaraga Street 8, LV-1063, Riga, Latvia*

We synthesized Eu^{3+}-doped CsY_2F_7 and RbY_2F_7 nanoparticles (orthorhombic crystal structure, *Pnna* space group, No. 52) by the microwave-assisted solvothermal technique and investigated the influence of reaction temperature and fluoride ion concentration on the particles' phase and crystal structure. Fluoride ions were added in excess of the stoichiometric amount to achieve the orthorhombic phase for $C_sY_2F_7$ and to convert the cubic RbY_3F_{10} to the orthorhombic RbY_2F_7. Mild synthesis conditions yielded nanoparticles with crystallites ranging in size from 19 to 37 nm and a combination of spherical, rod-like, and hexagonal shapes. Nanoparticles emit a strong orange and red light when excited into the Eu^{3+} $^5L_6$ level, which is centered around 390 nm. The strongest emission peak is around 612 nm, which comes from the $^5D_0 \rightarrow {}^7F_2$ electronic transitions. Emission intensity dependence on Eu^{3+} concentration revealed that nanoparticles can be heavily doped with Eu^{3+}, up to 25 % with respect to Y^{3+}. Emission decay measurements provided values of excited state lifetimes of 6.2 ms for the $Cs(Y_{0.75}Eu_{0.25})_2F_7$ and 6.0 ms for the $Rb(Y_{0.75}Eu_{0.25})_2F_7$.



Representative TEM images of a) CYF sample with three different shapes recognized-hexagonal, spherical and rod; b) CYF:25Eu with two shapes recognized-irregular and rod, c) RYF sample with three different shapes recognized-hexagonal, spherical and rod; d) RYF:25Eu with two shapes recognized-irregular and rod.

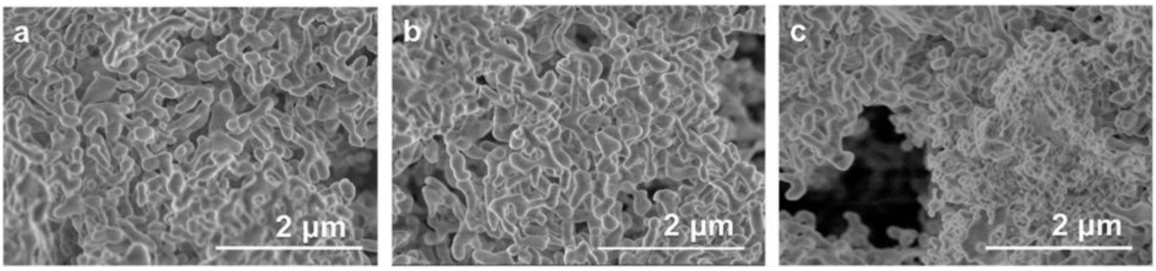
Published in:
K. Milenković, I. Zeković, B. Milicević, Z. Ristić, K. Smits, A. I. Popov, M. D. Dramicanin, V. Dordevic, Ceramics International 50 (2024) 26663–26669. Doi: 10.1016/j.ceramint.2024.04.394.

Hydrothermal synthesis of Mn^{2+}- and Cu $^{2+}$-doped calcium hydroxyapatite: morphological features and importance of EPR insights

E. Raudonyte-Svirbutaviciene[1], G. Klydziute[1], L. Lukaviciute[1], A. Antuzevics[1,2],
A. Balciunaite[3], E. Norkus[3], A. Beganskiene[1], A. Zarkov[1], A. Kareiva[1]

[1] *Institute of Chemistry, Vilnius University, Naugarduko 24, LT-03225, Vilnius, Lithuania*
[2]*Institute of Solid State Physics, University of Latvia, Kengaraga 8, LV-1063, Riga, Latvia*
[3] *Department of Catalysis, Center for Physical Sciences and Technology, Saulėtekio ave. 3, Vilnius, LT-10257, Lithuania*

This study aims to explore the effects of various hydroxyapatite (HA) doping techniques in depth. For this purpose, two ions with comparable sizes, namely Mn^{2+} and Cu^{2+}, were selected based on their suitability as dopants for HA in biomedical applications. Moreover, their paramagnetic properties enable sample characterization through electron paramagnetic resonance (EPR) spectroscopy. Two different approaches were employed: (I) ion-substituted α-TCP was used as starting material; (II) foreign ions presented in the solution during the transformation of undoped α-TCP to HA. The foreign ions influenced the hydrolysis process of α-TCP, altering the phase purity and morphology of the products. Doped α-TCP showed a weaker effect, while adding ions to the synthesis solution had substantial impact. Mn-doped α-TCP transformed into plate-like HA particles while Mn^{2+} ions present in the solution led to the formation of both plate- and rod-shaped particles. In contrast, Cu^{2+} ions induced the formation of rod-like particles independently of the doping process. Plate-like particles demonstrated higher Brunauer–Emmet–Teller surface area (S_{BET}) than rod-like HA. Each sample exhibited a combination of mesopores and macropores, with mesopores in the range of 15–17 Å being dominant. EPR investigations revealed that Mn^{2+} and Cu^{2+} are excellent paramagnetic probes to monitor synthesis reactions of HA and determine the localisation of foreign ions in the material.



SEM images of pristine and doped α-TCP powders:
pristine sample (a); Mn-doped sample (b); Cu-doped sample (c).

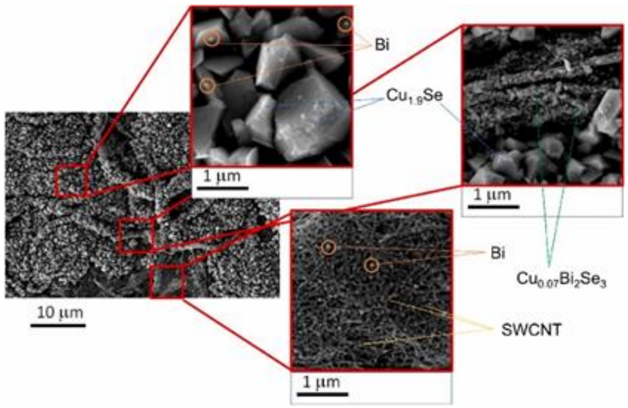
Published in:
E. Raudonyte-Svirbutaviciene, G. Klydziute, L. Lukaviciute, A. Antuzevics, A. Balciunaite, E. Norkus, A. Beganskiene, A. Zarkov, A. Kareiva, Ceramics International 50 (2024) 4005–4013. Doi: 10.1016/j.ceramint.2023.11.169.

Binder-free $Cu_{1.9}Bi_{0.1}Se$@SWCNT hybrid anodes for lithium-ion and sodium-ion batteries

Y. Rublova[1], R. Meija[1], X. Kong[2], V. Lazarenko[1,3], J. Andzane[1], A. Sarakovskis[5],
A. Viksna[4], T. Kallio[2], D. Erts[1,4]

[1] *Institute of Chemical Physics, University of Latvia, Raina Blv. 19, LV-1586, Riga, Latvia*
[2] *Department of Chemistry and Materials Science, School of Chemical Engineering, Aalto University, P.O. Box 16100, Aalto, FI-00076, Finland*
[3] *Nano RAY-T, Instituta str. 1, Ulbroka, LV-2130, Stopinu Parish, Latvia*
[4] *Faculty of Chemistry, University of Latvia, Raina Blv. 19, LV-1586, Riga, Latvia*
[5] *Institute of Solid State Physics, University of Latvia, Kengaraga Street 8, LV-1063, Riga, Latvia*

The rapid growth of portable electronic devices, electric vehicles, and grid-scale energy storage systems has accelerated the demand for enhancing existing materials and innovating new materials in rechargeable battery technologies. Li-ion batteries have dominated the energy storage field among the various battery systems. Na-ion batteries have emerged as promising candidates due to their similarities to Li-ion battery chemistry, low cost, and environmental sustainability. This study explores the potential advantages of synthesizing the binder-free $Cu_{1.9}Bi_{0.1}Se$@SWCNT heterostructure directly on the copper collector surface. A crucial aspect of this research is the intentional use of nanostructuring during synthesis. This technique capitalizes on the benefits of greater surface area, enhanced electron transport, and superior ionic conductivity. The synthesis method not only ensures excellent electrical and mechanical contact with the collector but also omits the need for a binder, offering a potential for improved overall performance in Li-ion and Na-ion batteries. The electrodes were synthesized using a simple and cost-effective physical vapor deposition method. The structural, morphological, and electrochemical properties of the electrodes were characterized. The binder-free $Cu_{1.9}Bi_{0.1}Se$@SWCNT electrode with 25 % SWCNT content exhibits excellent performance in Li-ion half cells, maintaining a high energy capacity of 556 mAh g^{-1} at 0.1 A g^{-1} over 100 cycles and 244 mAh g^{-1} at 0.5 A g^{-1} over 750 cycles. However, in the Na-ion battery system, the performance is notably poorer, revealing challenges and limitations. Most likely, the larger size of sodium ions posed difficulties in intercalation within the anode material structure.



The SEM images of the surface of synthesized $Cu_{1.9}Bi_{0.1}Se$@SWCNT electrode.

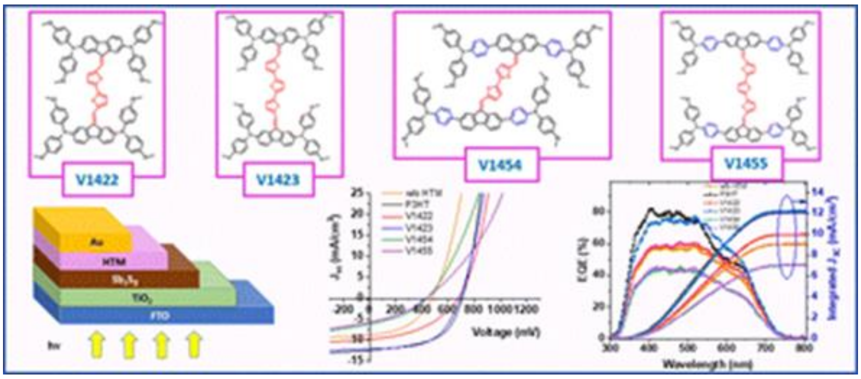
Published in:
Y. Rublova, R. Meija, X. Kong, V. Lazarenko, J. Andzane, A. Sarakovskis, A. Viksna, T. Kallio, D. Erts, Ceramics International 50 (2024) 14808–14822. Doi: 10.1016/j.ceramint.2024.01.395.

Dopant-free fluorene based dimers linked with thiophene units as prospective hole transport materials for Sb_2S_3 solar cells

N. Juneja[1], A. Jegorove[2], R. Grzibovskis[3], A. Katerski[1], M. Daskeviciene[2], T. Malinauskas[2], A. Vembris[3], S. Karazhanov[4], N. Spalatu[1], V. Getautis[2], M. Krunks[1], I. Oja Acik[1]

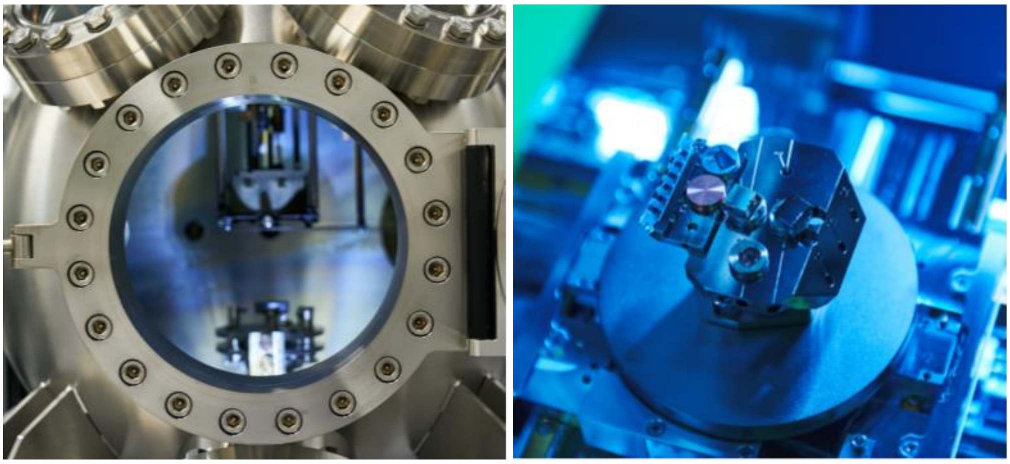
[1] *Department of Materials and Environmental Technology, Tallinn University of Technology, Tallinn, Estonia*
[2] *Department of Organic Chemistry, Kaunas University of Technology, Kaunas, Lithuania*
[3] *Institute of Solid State Physics, University of Latvia, Kengaraga Str. 8, Riga, Latvia*
[4] *Institute for Energy Technology (IFE), P.O. Box 40, Kjeller, Norway*

Novel dopant-free dimers comprising methoxydiphenylamine substituted fluorene derivatives and connected by central cores consisting of different numbers of thiophene moieties were synthesized and explored as hole transport materials (HTMs) in Sb_2S_3 absorber solar cells. Energy level diagrams show agreeable band offsets validating the compatibility of novel HTMs for the FTO/TiO_2/Sb_2S_3/HTM/Au solar cell with TiO_2 and Sb_2S_3 layers deposited by ultrasonic spray. X-ray photoelectron spectroscopy (XPS) study reveals the Sb 3d core level peak shift upon applying any of the HTMs on Sb_2S_3 indicating an increased electron density surrounding Sb atoms which refers to the interaction of S from electron-rich thiophene units with Sb in the absorber at the Sb_2S_3/HTM interface. It is demonstrated that application of HTMs containing diphenylamine units in their side fragments increases the cell open circuit voltage from 478 mV to 673 mV, fill factor from 46% to 56% and conversion efficiency from 1.9% to 4.5% as compared to the device without any HTM and the observed improvement can be explained by the passivation of the interfacial states. In contrast, no enhancement in device performance has been observed when applying HTMs containing triphenylamine units although strong Sb–S interaction has been detected at the Sb_2S_3/HTM interface. Quantum chemical simulation results suggest that to achieve enhanced charge selectivity by the organic HTM layer, the HOMO of the HTMs should be formed by the thiophene groups. Possible phenomena occurring at the Sb_2S_3/HTM interface are discussed providing new insights towards understanding the charge transfer at the Sb_2S_3/HTM interface.



Published in:
N. Juneja, A. Jegorove, R. Grzibovskis, A. Katerski, M. Daskeviciene, T. Malinauskas, A. Vembris, S. Karazhanov, N. Spalatu, V. Getautis, M. Krunks, I. Oja Acik, Sustainable Energy and Fuels 8 (2024) 4324–4334. Doi: 10.1039/D4SE00472H.

III. Technology, devices and applications



Mixing Insulating Commodity Polymers with Semiconducting n-type Polymers Enables High-Performance Electrochemical Transistors

E. Zeglio[1,2,3], Y. Wang[4], S. Jain[2], Y. Lin[2], A. E. Avila Ramirez[2], K. Feng[5,6], X. Guo[6], H. Ose[7], G. Mozolevskis[7], D. Mawad[8], W. Yue[3], M. M. Hamedi[9], A. Herland[1,2]

[1] AIMES-Center for the Advancement of Integrated Medical and Engineering Sciences, Department of Neuroscience, Karolinska Institute, Solna 171 77, Sweden
[2]Division of Nanobiotechnology Department of Protein Science, Science for Life Laboratory, KTH Royal Institute of Technology, Solna 171 65, Sweden
[3] Wallenberg Initiative Materials Science for Sustainability, Stockholm University, Stockholm 114 18, Sweden
[4] State Key Laboratory of Optoelectronic Materials and Technologies, School of Materials Science and Engineering, Sun Yat-sen University, Guangzhou 510275, P. R. China
[5]Academy for Advanced Interdisciplinary Studies, Southern University of Science and Technology (SUSTech), Shenzhen, Guangdong 518055, China
[6] Department of Materials Science and Engineering, Southern University of Science and Technology (SUSTech), Shenzhen, Guangdong 518055, China
[7] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia
[8] School of Materials Science and Engineering, UNSW Sydney, Sydney, New South Wales 2052, Australia
[9] Department of Fiber and Polymer Technology, School of Engineering Sciences in Chemistry, Biotechnology and Health, KTH Royal Institute of Technology, Stockholm 100 44, Sweden

Diluting organic semiconductors with a host insulating polymer is used to increase the electronic mobility in organic electronic devices, such as thin film transistors, while considerably reducing material costs. In contrast to organic electronics, bioelectronic devices such as the organic electrochemical transistor (OECT) rely on both electronic and ionic mobility for efficient operation, making it challenging to integrate hydrophobic polymers as the predominant blend component. This work shows that diluting the n-type conjugated polymer p(N-T) with high molecular weight polystyrene (10 KDa) leads to OECTs with over three times better mobility-volumetric capacitance product (μC^*) with respect to the pristine p(N-T) (from 4.3 to 13.4 F V^{-1} cm^{-1} s^{-1}) while drastically decreasing the amount of conjugated polymer (six times less). This improvement in μC^* is due to a dramatic increase in electronic mobility by two orders of magnitude, from 0.059 to 1.3 cm^2 V^{-1} s^{-1} for p(N-T):Polystyrene 10 KDa 1:6. Moreover, devices made with this polymer blend show better stability, retaining 77% of the initial drain current after 60 minutes operation in contrast to 12% for pristine p(N-T). These results open a new generation of low-cost organic mixed ionic-electronic conductors where the bulk of the film is made by a commodity polymer.

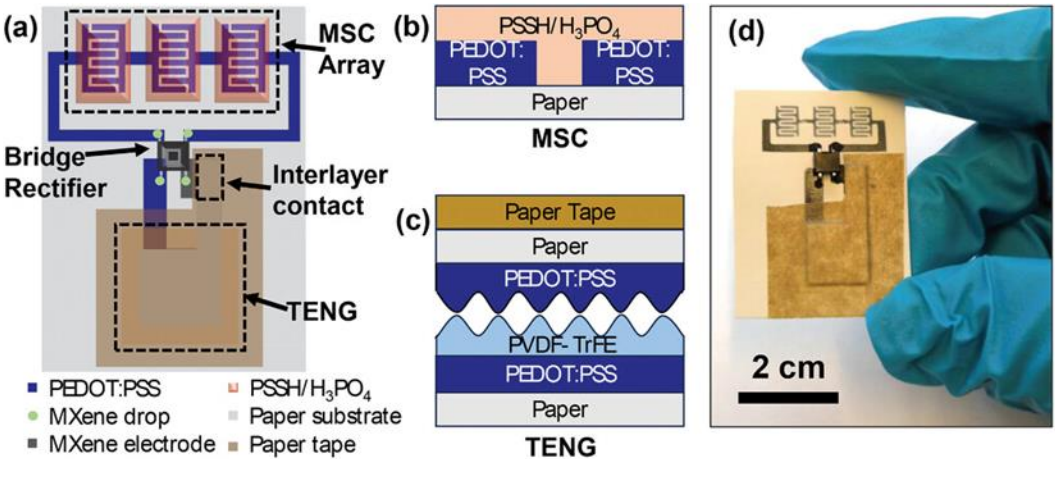
Published in:
E. Zeglio, Y. Wang, S. Jain, Y. Lin, A. E. Avila Ramirez, K. Feng, X. Guo, H. Ose, G. Mozolevskis, D. Mawad, W. Yue, M. M. Hamedi, A. Herland, Adv. Mater. 2024, 36, 2302624. Doi: 10.1002/adma.202302624.

Monolithic Fabrication of Metal-Free On-Paper Self-Charging Power Systems

Y. Su[1], H. Xue[1], Y. Fu[1], S. Chen[1], Z. Li[1], L. Li[2], A. Knoks, O. Bogdanova[3], P. Lesničenoks[3],
R. Palmbahs[3], M.-M. Laurila[4], M. Mäntysalo[4], M. Hammar[1], A. Hallén[1], N. Nordell[1], J. Li[1]

[1] School of Electrical Engineering and Computer Science, KTH Royal Institute of Technology,
Kista 16440, Sweden
[2] Department of Fibre and Polymer Technology, Wallenberg Wood Science Center,
KTH Royal Institute of Technology, Stockholm 10044, Sweden
[3] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia
[4] Faculty of Information Technology and Communication Sciences,
Tampere University, Tampere 33720, Finland

Self-charging power systems (SCPSs) are envisioned as promising solutions for emerging electronics to mitigate the increasing global concern about battery waste. However, present SCPSs suffer from large form factors, unscalable fabrication, and material complexity. Herein, a type of highly stable, eco-friendly conductive inks based on poly(3,4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) are developed for direct ink writing of multiple components in the SCPSs, including electrodes for miniaturized spacer-free triboelectric nanogenerators (TENGs) and microsupercapacitors (MSCs), and interconnects. The principle of "one ink, multiple functions" enables to almost fully print the entire SCPSs on the same paper substrate in a monolithic manner without post-integration. The monolithic fabrication significantly improves the upscaling capability for manufacturing and reduces the form factor of the entire SCPSs (a small footprint area of ≈2 cm × 3 cm and thickness of ≈1 mm). After pressing/releasing the TENGs for ≈79000 cycles, the 3-cell series-connected MSC array can be charged to 1.6 V while the 6-cell array to 3.0 V. On-paper SCPSs are promising to serve as lightweight, thin, sustainable, and low-cost power supplies.



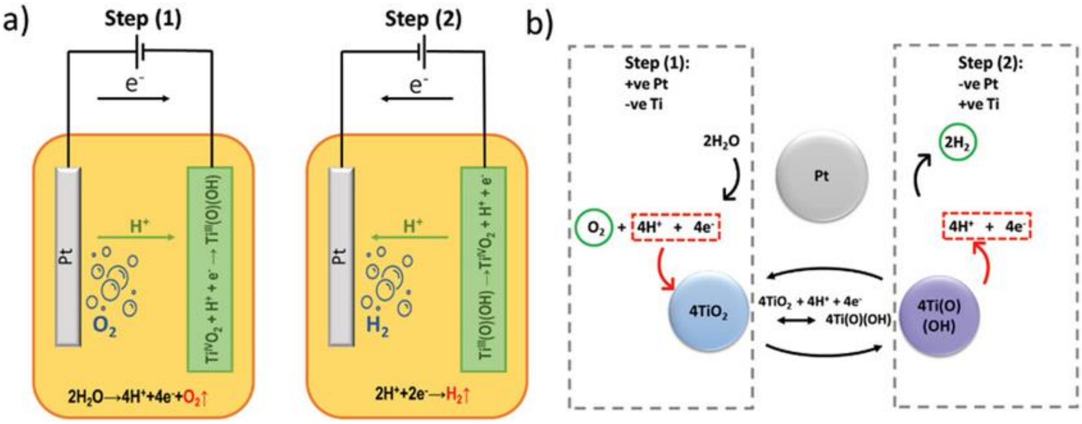
Published in:
Y. Su, H. Xue, Y. Fu, S. Chen, Z. Li, L. Li, A. Knoks, O. Bogdanova, P. Lesničenoks, R. Palmbahs, M.-M. Laurila, M. Mäntysalo, M. Hammar, A. Hallén, N. Nordell, J. Li, Adv. Funct. Mater. 34 (2024) 2313506. Doi: 10.1002/adfm.202313506.

Efficient Decoupled Electrolytic Water Splitting in Acid through Pseudocapacitive TiO_2

M. Iesalnieks[1], M. Vanags[1], L. L. Alsiņa[1], R. Eglītis[1], L. Grīnberga[2], P. C. Sherrell[3], A. Šutka[1]

[1] Institute of Materials and Surface Engineering, Faculty of Natural Sciences and Technology,
Riga Technical University, Riga LV-1048, Latvia
[2] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia
[3] Applied Chemistry & Environmental Science, School of Science, RMIT University,
Melbourne 3000, Australia

Hydrogen is considered a versatile and clean energy carrier as it can be produced by water electrolysis, electrochemically splitting water molecules into hydrogen and oxygen. Water electrolysis remains a key component in the societal transition to green energy. Membrane electrolyzers are the state-of-the-art technology for water electrolysis, relying on 80 °C operation in highly alkaline electrolytes, which is undesirable for many of the myriad end-use cases for electrolytic water splitting. Herein, an alternative water electrolysis process, decoupled electrolysis, is described, which performed in mild acidic conditions with excellent efficiencies. Decoupled electrolysis sequentially performs the oxygen evolution reaction (OER) and the hydrogen evolution reaction (HER), at the same catalyst. Here, H^+ ions generated from the OER are stored through pseudocapacitive (redox) charge storage and released to drive the HER. Here, decoupled electrolysis is demonstrated using cheap, abundant, TiO_2 for the first time. To achieve decoupled acid electrolysis, ultra-small anatase TiO_2 particles (4.5 nm diameter) are prepared. These ultra-small TiO_2 particles supported on a carbon felt electrode show a highly electrochemical surface area with a capacitance of 375 F g^{-1}. When these electrodes are tested for decoupled water splitting an overall energy efficiency of 52.4% is observed, with excellent stability over 3000 cycles of testing. This technology can provide a viable alternative to membrane electrolyzers—eliminating the need for highly alkaline electrolytes and elevated temperatures.



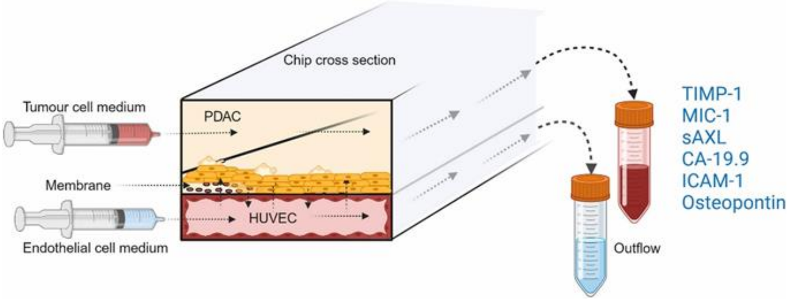
Published in:
M. Iesalnieks, M. Vanags, L. L. Alsiņa, R. Eglītis, L. Grīnberga, P. C. Sherrell, A. Šutka, Adv. Sci. 11 (2024) 2401261. Doi: 10.1002/advs.202401261.

Personalized PDAC Chip with Functional Endothelial Barrier for Tumour Biomarker Detection: A Platform for Precision Medicine Applications

K. Goluba[1], V. Parfejevs[1], E. Rostoka[1], K. Jekabsons[1], I. Blake[1], A. Neimane[1], A.A. Ule[2],
R. Rimsa[2], R. Vangravs[3], A. Pcolkins[4], U. Riekstina[1]

[1] Pharmaceutical Sciences Center, Faculty of Medicine and Life Sciences,
University of Latvia, Riga, Latvia
[2] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia
[3] Latvian Centre of Infectious Diseases, Laboratory Service, Riga East University Hospital,
LV-1006 Riga, Latvia
[4] Department of Abdominal and Soft Tissue Surgery, Riga East Clinical University Hospital,
Riga, Latvia

Pancreatic ductal adenocarcinoma (PDAC) is a highly aggressive cancer characterised by poor survival rates and an increasing global incidence. Advances in the staging and categorization of pancreatic tumours, along with the discovery of functional mutations, have made precision treatments possible, which may lead to better clinical results. To further improve customized treatment approaches, in vitro models that can be used for functional drug sensitivity testing and precisely mimic the disease at the organ level are required. In this study, we present a workflow for creating a personalized PDAC chip utilising primary tumour-derived human pancreatic organoids (hPOs) and Human Umbilical Vein Endothelial Cells (HUVECs) to simulate the vascular barrier and tumour interactions within a PDMS-free organ-on-a-chip system. The patient PDAC tissue, expanded as tumour hPOs, could be cultured as adherent cells on the chip for more than 50 days, allowing continuous monitoring of cell viability through outflows from tumour and endothelial channels. Our findings demonstrate a gradual increase in cell density and cell turnover in the pancreatic tumor channel. Tumour-specific biomarkers, including CA-19.9, TIMP-1, Osteopontin, MIC-1, ICAM-1 and sAXL were consistently detected in the PDAC chip outflows. Comparative analyses between tissue culture plates and microfluidic conditions revealed significant differences in biomarker secretion patterns, highlighting the advantages of the microfluidics approach. This PDAC chip provides a stable, reproducible tumour model system with a functional endothelial cell barrier, suitable for drug sensitivity and secretory biomarker studies, thus serving as a platform for functional precision medicine application and multi-organ chip development.



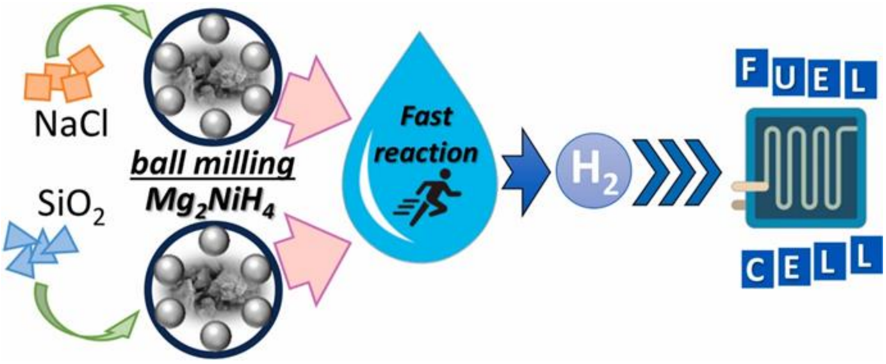
Published in:
K. Goluba, V. Parfejevs, E. Rostoka, K. Jekabsons, I. Blake, A. Neimane, A. A. Ule, R. Rimsa, R. Vangravs, A. Pcolkins, U. Riekstina, Mater. Today Bio 29 (2024) 101262. Doi: 10.1016/j.mtbio.2024.101262.

Enhanced Hydrogen Generation in Low-range Acidic Solutions using Mg_2NiH_4 Powders and their Mixtures Ball-milled with NaCl and Fused Silica

S. Varnagiris[1], M. Urbonavicius[1], A. Knoks[2], D. Milcius[1]

[1] Center for Hydrogen Energy Technologies, Lithuanian Energy Institute, 44403 Kaunas, Lithuania
[2] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia

Looking into the current trends in the energy sector, the worldwide energy industry is shifting towards the green energy sector, endeavouring to adopt the technologies that mitigate the release of CO_2 emissions and other harmful greenhouse gases. Hydrogen is emerging to play an essential role as an energy vector capable of contributing to, or, in some case, even solving issues related to greenhouse gas emissions and environmental pollution. Hydrogen stands out as a clean energy source having a remarkable energy content of 142 MJ/kg, which is approximately three times greater than that of crude oil. It exhibits renewability, abundant reserves and burns cleanly without producing toxic emissions. It demonstrates an energy yield of 122 kJ/g, which is 2.75 times greater than the value of hydrocarbon fuels. Moreover, when hydrogen reacts with oxygen, its only byproduct is H_2O. Therefore, hydrogen can easily be utilized in fuel cells for electricity generation, providing an energy efficiency of about 50–60%. These qualities make hydrogen highly suitable for autonomous and mobile energy storage and generation systems that are environmentally friendly and pollution-free.



Hydrogen production through hydrolysis shows a promise as a green and sustainable energy source that can be used for urgent need of energy on-board. This study presents a novel approach to boost the speed of hydrolysis reactions by utilizing Mg_2NiH_4 powder. The approach involves ball milling with NaCl and fused silica additives, that open additional active areas and accelerate the hydrolysis process. A comprehensive analysis encompasses morphology, elemental mapping, chemical bonding, structural changes, and surface area determination of the prepared powders. The hydrolysis reactions is performed using acetic acid solutions with different molarities (0.25 M, 0.12 M, and 0.06 M), as well as tap water. The impact on kinetics is profound, with reaction rates varying between 600 and 3000 ml/min during the initial seconds for different powders. Moreover, the study examines the application of such hydrolysis system for electricity generation through a proton-exchange membrane fuel cell.

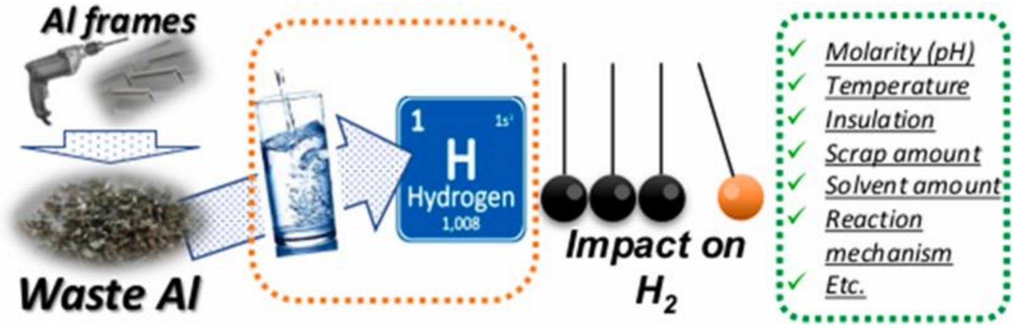
Published in:
S. Varnagiris, M. Urbonavicius, A. Knoks, D. Milcius, Int. J. Hydrog. Energy 50B (2024) 614-626. Doi: 10.1016/j.ijhydene.2023.10.083.

Hydrogen from Industrial Aluminium Scraps: Hydrolysis under Various Conditions, Modelling of pH Behaviour and Analysis of Reaction By-product

M. Urbonavicius[1], S. Varnagiris[1], A. Mezulis[2], P. Lesnicenoks[2], A. Knoks[2], C. Richter[3],
D. Milcius[1], R. Meirbekova[4], G. Gunnarsson[4], J. Kleperis[2]

[1] Center for Hydrogen Energy Technologies, Lithuanian Energy Institute, 44403 Kaunas, Lithuania
[2] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia
[3] Faculty of Industrial Engineering, Mechanical Engineering and Computer Science,
University of Iceland, Reykjavik, Iceland
[4] IceTec, Reykjavik, Iceland

The study explores the feasibility of utilizing aluminium scrap waste from the construction industry for hydrogen production via hydrolysis. Specifically, the study involves a primary analysis of aluminium scrap waste and the impact of various reaction parameters, such as NaOH molarity, reaction temperature, amount of Al scrap, solvent quantity, and the reaction vessel insulation, and their effects on the reaction rate, H_2 yield, and by-product formation. The pH of the reaction solution was continuously monitored to determine the reaction mechanism, while the structure of the by-product was analysed at two stages: after removal and drying, and after removal and washing. Our findings indicate that increasing the reaction temperature has the most significant influence on the reaction kinetics. Insulating the reaction vessel ensured self-promoted hydrogen production due to the heat generated from the exothermic reaction inside the vessel, resulting in an approximate temperature increase of 5 °C for all tested reaction solution molarities compared to non-insulated conditions. The pH measurements were conducted in two different ways. The first one involved immersing a pH probe directly into an open reaction container. The second approach utilized a closed reaction container under isothermal conditions, where both the pH and H_2 yield were measured simultaneously. In addition, the data obtained was compared between the measured pH values and the predictions generated by models utilizing the measured H_2 evolution in order to forecast the pH behaviour. The modelling results recognize and suggest the existence of separate reaction phases or zones, each characterized by distinct influences on the pH level.



Published in:
M. Urbonavicius, S. Varnagiris, A. Mezulis, P. Lesnicenoks, A. Knoks, C. Richter, D. Milcius, R. Meirbekova, G. Gunnarsson, J. Kleperis, Int. J. Hydrog. Energy 50B (2024) 431-446. Doi: 10.1016/j.ijhydene.2023.09.065.

Bi_2Se_3@SWCNT Heterostructures with Beyond Theoretical Capacity as Perspective Binder-Free Anodes for Lithium-Ion Batteries

V. Lazarenko[1,2], R. Meija[1], Y. Rublova[1], A. Kons[1], V. Voikiva[1], J. Andzane[1], R. Lohmus[3], A. Sarakovskis[4], X. Kong[5], T. Kallio[5], A. Viksna[6], D. Erts[1,6]

[1] Institute of Chemical Physics, University of Latvia, LV-1586 Riga, Latvia
[2]Nano RAY-T, LV-2130 Stopinu Parish, Latvia
[3] Institute of Physics, University of Tartu, 50411 Tartu, Estonia
[4] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia
[5] Department of Chemistry and Materials Science, School of Chemical Engineering, Aalto University, FI-00076 Aalto, Finland
[6] Faculty of Chemistry, University of Latvia, LV-1586 Riga, Latvia

Lithium-ion batteries (LIBs) have emerged as the preferred choice for efficient energy storage in portable devices (such as phones, tablets, and smartwatches), medium to large-scale stationary battery packs, and electric vehicles. This preference is attributed to their outstanding properties, including high energy density (>270 Wh kg^{-1}), extended cycling life, rapid charge/discharge capabilities, and a high nominal voltage of around 3.7 V. This voltage level surpasses that of nickel-cadmium batteries (approximately 1.2 V) and zinc-ion batteries (approximately 1.3 V). These exceptional features underscore the compelling need for further advancements in LIBs systems. To achieve a better LIBs performance, one of the main goals is the replacement of commercially used graphite anode with a higher capacity material.

Bi_2Se_3 has shown potential for implementation as an anode material for lithium-ion batteries (LIBs), however, the significant volume expansion and dissolution of selenium pose major challenges. In this work, Bi_2Se_3 nanostructures are synthesized by physical vapor deposition directly on top of a single-wall carbon nanotube (SWCNT) network to fabricate a binder-free Bi_2Se_3@SWCNT anode materials with different Bi_2Se_3/SWCNT ratios. Nanostructuring the Bi_2Se_3 directly on the top of the SWCNT network provides a large accessible contact area and improves mechanical and electrical contact. The heterostructures exhibit capacity, that is beyond the theoretical of pristine Bi_2Se_3, which can be attributed to the binding of the Se to C, resulting in the resilience against the dissolution of Se, while providing additional electron transport pathways and increased capacitive contribution. A Bi_2Se_3@SWCNT anode with a mass ratio of (1:1) has the highest capacity in a half-cell after 100 cycles (523 mAh g^{-1} at 0.1 A g^{-1}) and shows excellent capacity retention after 500 cycles at large current densities (2 A g^{-1} and 5 A g^{-1}): 1080 mAh g^{-1} and 809 mAh g^{-1} respectively. In addition, in a full-cell system Bi_2Se_3@SWCNT (1:1) delivers high reversible capacity after 150 cycles (484 mAh g^{-1}) at 0.4 A g^{-1}.

Published in:
V. Lazarenko, R. Meija, Y. Rublova, A. Kons, V. Voikiva, J. Andzane, R. Lohmus, A. Sarakovskis, X. Kong, T. Kallio, A. Viksna, D. Erts, J. Power Sources 593 (2024) 233964. Doi: 10.1016/j.jpowsour.2023.233964.

Antiviral and Antibacterial Efficacy of Nanocomposite Amorphous Carbon Films with Copper Nanoparticles

S. Bakhet[1], A. Tamulevičienė[1,2], A. Vasiliauskas[1], M. Andrulevičius[1], Š. Meškinis[1],
S. Tamulevičius[1,2], N. Kašėtienė[3], M. Malakauskas[3], R. Lelešius[4,5], D. Zienius[4,5],
A. Šalomskas[4], K. Šmits[6], T. Tamulevičius[1,2]

[1] Institute of Materials Science of Kaunas University of Technology, LT-51423 Kaunas, Lithuania
[2] Department of Physics, Kaunas University of Technology, LT-51368 Kaunas, Lithuania
[3] Department of Food Safety and Quality, Lithuanian University of Health Sciences,
LT-47181 Kaunas, Lithuania
[4] Department of Veterinary Pathobiology, Lithuanian University of Health Sciences,
LT-47181 Kaunas, Lithuania
[5] Institute of Microbiology and Virology, Lithuanian University of Health Sciences,
LT-47181 Kaunas, Lithuania
[6] Institute of Solid State Physics, University of Latvia, LV-1063 Riga, Latvia

Copper compound-rich films and coatings are effective against widespread viruses and bacteria. Even though the killing mechanisms are still debated, it is agreed that the metal ion, nanoparticle release, and surface effects are of paramount importance to the antiviral and antibacterial efficacy of the surfaces. In this work we have investigated the behavior of the reactive magnetron sputtered nanocomposite diamond-like carbon thin films with copper nanoparticles (DLC:Cu). The films were etched employing oxygen plasma and/or exposed to ultra-pure water, aiming to investigate the differences of the Cu release in the medium and changes in film morphology. The presence of metallic copper and Cu_2O phases was confirmed by multiple analytical methods. Pristine films were more effective in the Cu release reaching up to 1.3 mg/L/cm^2 concentration. Plasma processing resulted in the oxidation of the films which released less Cu, but after exposure to water, their average roughness increased more, up to 5.5 nm. Pristine and O_2 plasma processed DLC:Cu films were effective against both model coronavirus and herpesvirus after 1-hour contact time and reached virus reductions of up to 2.23 and 1.63 $\log_{10}$, respectively. Pristine DLC:Cu films were more effective than plasma-processed ones against herpesvirus, while less expressed difference was found for coronavirus. The virucidal efficacy over up to 24 h exposures in the aqueous medium was validated. A bactericidal study confirmed that pristine DLC:Cu films were effective against gram-negative *E. coli* and gram-positive *E. faecalis* bacteria. After 3 h, 100 % antibacterial efficiency (ABE) was obtained for *E. coli* and 99.97 % for *E. faecalis*. After 8 h and longer exposures, 100 % ABE was reached. The half-life inactivation of viruses was 8.10–11.08 min and for *E. faecalis* 15.1–72.2 min.

Published in:
S. Bakhet, A. Tamulevičienė, A. Vasiliauskas, M. Andrulevičius, Š. Meškinis, S. Tamulevičiu, N. Kašėtienė, M. Malakauskas, R. Lelešius, D. Zienius, A. Šalomskas, K. Šmits, T. Tamulevičius, Appl. Surf. Sci. 670 (2024) 160642. Doi: 10.1016/j.apsusc.2024.160642.

Radiation Stability of Electron Beam Irradiated High Degree Sulfonated Poly(Ether Ether Ketone) Membranes for the Applications in Nuclear Facilities

E. Pajuste[1,2], I. Reinholds[2,3,7], G. Vaivars[1,4], J. Zicans[6], R.M. Meri[6], L. Avotina[1],
E. Sprugis[1], M. Rzepna[5]

[1]Institute of Chemical Physics, University of Latvia, Riga, Latvia
[2] Faculty of Chemistry, University of Latvia, Riga, Latvia
[3] Baltic Scientific Instruments, Riga, Latvia
[4]Institute of Solid State Physics, University of Latvia, Riga, Latvia
[5] Centre for Radiation Research and Technology, Institute of Nuclear Chemistry and Technology, Warsaw, Poland
[6] Institute of Polymer Materials, Faculty of Materials Science and Applied Chemistry, Riga Technical University, Riga, Latvia
[7] Institute of Food Safety, Animal Health and Environment "BIOR", Riga, Latvia

Plastics when exposed to UV radiation start to degrade via photooxidative aging including free radical formation, oxidation, chain scission and/or crosslinking reactions. These chemical changes can cause loss in mechanical strength, surface embrittlement, and eventually surface erosion. The eroded particles are microplastics (MPs), which have been identified as a potentially serious threat to the environment and its inhabitants. In general, photodegradation of virgin plastics has been studied extensively, but there is not much literature on the degradation of recycled plastics. The goal of the study was to investigate the changes caused by photodegradation in recycled plastics and assess the potential risks of MPs formation. And eventually, knowing the chemical and physical transformations occurring on the surface understand the mechanism behind surface microcracking, which is the first step of MPs formation. Pellets of five industrially recycled plastics (low-density polyethylene (rLDPE), linear low-density polyethylene (rLLDPE), high-density polyethylene (rHDPE), and two polypropylenes (rPP)) from different waste sources were analysed. UV irradiation was performed in an accelerated weathering chamber for milled (< 400 µm) plastic powder to ensure homogeneous changes throughout the sample. The properties were investigated by ATR-FTIR, HT-SEC, XPS and DSC. Formation of microcracks was studied on plastic pellets by SEM. The results showed that the degradation significantly differed between the recycled plastics, and the waste source was more important than the plastic type. rLDPE and one of the rPP samples showed a significant increase in carbonyl index as well as decrease in molar mass during the first 500 h of UV exposure. The other rPP and rHDPE samples showed considerable signs of degradation only after 1000 h of UV exposure. Minor changes were observed for the rLLDPE sample during the whole test. The SEM revealed microcracking on the surface of all samples, which also had noticeable degradation identified by other methods. These recycled plastics can be considered the ones with the highest potential of MPs formation. From the chemical and physical transformations identified on the surface, the mechanism leading to microcracking, which is the first step in the formation of MPs, is proposed.

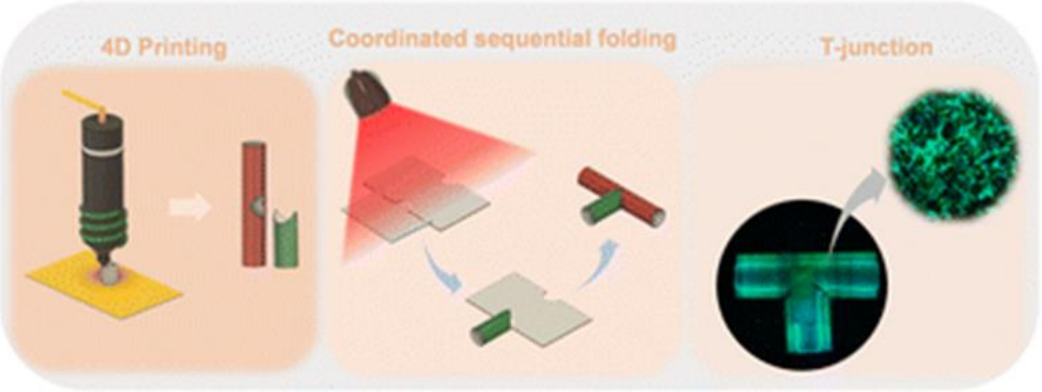
Published in:
E. Pajuste, I. Reinholds, G. Vaivars, J. Zicans, R.M. Meri, L. Avotina, E. Sprugis, M. Rzepna, Polym. Degrad. Stab. 219 (2024) 110615. Doi: 10.1016/j.polymdegradstab.2023.110615.

Modular Photoorigami-Based 4D Manufacturing of Vascular Junction Elements

A. Biswas[4], I. Apsite[4], S. Rosenfeldt[2], I. Bite[3], V. Vitola[3], L. Ionov[1]

[1] Faculty of Engineering Sciences and Bavarian Polymer Institute, University of Bayreuth,
Bayreuth 95447, Germany
[2] Faculty of Biology, Chemistry and Earth Sciences and Bavarian Polymer Institute,
University of Bayreuth, Bayreuth 95447, Germany
[3] Institute of Solid State Physics, University of Latvia, Riga, Latvia
[4] Faculty of Engineering, University of Bayreuth, Bayreuth 95447, Germany

Four-dimensional (4D) printing, combining three-dimensional (3D) printing with time-dependent stimuli-responsive shape transformation, eliminates the limitations of the conventional 3D printing technique for the fabrication of complex hollow constructs. However, existing 4D printing techniques have limitations in terms of the shapes that can be created using a single shape-changing object. In this paper, we report an advanced 4D fabrication approach for vascular junctions, particularly T-junctions, using the 4D printing technique based on coordinated sequential folding of two or more specially designed shape-changing elements. In our approach, the T-junction is split into two components, and each component is 4D printed using different synthesized shape memory polyurethanes and their nanohybrids, which have been synthesized with varying hard segment contents and by incorporating different weight percentages of photo-responsive copper sulfide-polyvinyl pyrrolidone nanoparticles. The formation of a T-junction is demonstrated by assigning different shape memory behaviors to each component of the T-junction. A cell culture study with human umbilical vein endothelial cells reveals that the cells proliferate over time, and almost 90% of cells remain viable on day 7. Finally, the formation of the T-junction in the presence of near-infrared light has been demonstrated after seeding the endothelial cells on the programmed flat surface of the two components and fluorescence microscopy at day 3 and 7 reveals that the cells adhered well and continue to proliferate over time. Hence, the proposed alternative approach has huge potential and can be used to fabricate vascular junctions in the future.



Published in:
A. Biswas, I. Apsite, S. Rosenfeldt, I. Bite, V. Vitola, L. Ionov, J. Mater. Chem. B 12 (2024) 5405-5417. Doi: 10.1039/D4TB00236A.

Publications with the authorship of ISSP UL in Web of Science and Scopus Databases

[1] A. Abdikadirova, L. Sembiyeva, Z. Temirkhanov, A. I. Popov, Y. Suchikova, Evaluating the nexus of funding and scientific output in Kazakhstan, Knowledge and Performance Management 8 (2024) 17–31.

[2] D. Agarkov, M. Borik, G. Korableva, A. Kulebyakin, B. Komarov, Kuritsyna, E. Lomonova, F. Milovich, V. Myzina, V. Pankratov, N. Tabachkova, D. Zakharov, Effect of ceria on the properties of yttria-stabilized zirconia-based electrolytic membranes, Journal of Solid State Electrochemistry 28 (2024) 1901–1908.

[3] G. Aiello, C. Bonnekoh, J. Gabrusenoks, B. Gorr, A. Meier, A. I. Popov, T. Scherer, S. Schreck, K. Seemann, D. Strauss, C. Wild, E. Woerner, On the characterization of MPA CVD diamond for fracture toughness measurements, International Conference on Infrared, Millimeter, and Terahertz Waves, IRMMW-THz (2024) 1–2.

[4] A. Akilbekov, D. Kenbayev, A. Dauletbekova, A. Shalaev, A. Akylbekova, G. Aralbayeva, Z. Baimukhanov, M. Baizhumanov, E. Elsts, A. I. Popov, The Effect of 147 MeV 84Kr and 24.5 MeV 14N Ions Irradiation on the Optical Absorption, Luminescence, Raman Spectra and Surface of BaFBr Crystals, Crystals 14 (2024) 480.

[5] O. Aksimentyeva, Y. Y. Horbenko, V. Savchyn, P. Y. Demchenko, A. Popov, Micro-and Nanocomposites of Barium Zirconate Incorporated in Polymer Matrix, Springer Proceedings in Physics 253 SPP (2024) 1-12.

[6] A. Akylbekova, A. Dauletbekova, Z. Baimukhanov, L. A. Vlasukova, A. Usseinov, N. Saduova, A. T. Akilbekov, V. A. Pankratov, A. I. Popov, Annealing Effect on Structural, Optical and Electrophysical Properties of ZnSe Nanocrystals Synthesized into SiO_2/Si Ion Track Template, Materials 17 (2024) 4149.

[7] A. K. Alina, K. K. Kadyrzhanov, A. A. Kozlovskiy, M. Konuhova, A. I. Popov, D. D. Shlimas, D. B. Borgekov, WO_3/$ZnWO_4$ microcomposites with potential application in photocatalysis, Optical Materials 150 (2024) 115280.

[8] A. Alzhanova, Y. Mastrikov, D. Yerezhep, Ab Initio Modelling of g-ZnO Deposition on the Si (111) Surface, Journal of Composites Science 8 (2024) 281.

[9] D. V. Andreev, V. V. Andreev, M. Konuhova, A. I. Popov, Technique of High-Field Electron Injection for Wafer-Level Testing of Gate Dielectrics of MIS Devices, Technologies 12 (2024) 102.

[10] L. Ansone-Bertina, L. Arbidans, E. Borska, U. Ozola, O. Purmalis, K. Sarsuns, L. Dobkevica, A. Sarakovskis, M. Klavins, L. Klavins, Modification and activation of hydrochar obtained by the hydrothermal carbonisation process of invasive plant biomass, Bioresource Technology Reports 26 (2024) 101863.

[11] A. Antuzevics, G. Krieke, G. Doke, P. Rodionovs, D. Nilova, J. Cirulis, A. Fedotovs, U. Rogulis, Role of Paramagnetic Aluminum Hole Centers in UV-C Persistent Luminescence of $Ca_2Al_2SiO_7$:Pr^{3+}, Journal of Physical Chemistry C 128 (2024) 21846–21854.

[12] A. Antuzevics, G. Krieke, G. Doke, A. Zarins, L. Avotina, E. Sprugis, J. Stadulis, A. Beganskiene, A. Kareiva, A. Zarkov, Electron paramagnetic resonance and luminescence spectroscopy of transition metal ion impurities and X-ray-induced radicals in brushite, Journal of Alloys and Compounds 996 (2024) 174779.

[13] A. Antuzevics, A. Zarins, J. Cirulis, A. Fedotovs, A. Ansone, M. Rzepna, J. M. Leys, R. Knitter, Hyperfine interactions of paramagnetic radiation-induced defect centres in advanced ceramic breeder pebbles, Nuclear Materials and Energy 40 (2024) 101698.

[14] H. Arslan, A. Kuzmin, I. Aulika, D. Moldarev, M. Wolff, D. Primetzhofer, I. Pudza, K. Kundzins, A. Sarakovskis, J. Purans, S. Z. Karazhanov, Chemical state and atomic

structure in stoichiovariants photochromic oxidized yttrium hydride thin films, Zeitschrift fur Physikalische Chemie 238 (2024) 2075–2100.

[15] H. Arslan, I. Pudza, A. Kuzmin, S. Karazhanov, Evidence of local structural distortions and subtle thermal disorder in transparent photochromic yttrium oxyhydride, Applied Physics Letters 124 (2024) 151901.

[16] A. Åsland, S. Cooil, D. Mamedov, H. Rost, J. Bakkelund, Z. Li, S. Karazhanov, J. Wells, Initial stages of water absorption on CeO_2 surfaces at very low temperatures for understanding anti-icing coatings, Materials Research Express 11 (2024) 116403.

[17] L. Avotina, A. E. Goldmane, A. Zaslavskis, M. Romanova, E. Vanags, H. Sorokins, G. Kizane, Y. Dekhtyar, Estimation of Thermal Stability of Si-SiO_2-W Nanolayered Structures with Infrared Spectrometry, Materials 17 (2024) 7.

[18] E. Bacher, S. Cartiel, J. Garcia-Pueyo, J. Stopar, A. Zore, R. Kamnik, I. Aulika, A. Ogurcovs, J. Grube, A. Bundulis, J. Butikova, M. Kemere, A. Munoz, M. Laurenzis, OptoSkin: Novel LIDAR Touch Sensors for Detection of Touch and Pressure within Wave guides, IEEE Sensors Journal 24 (2024) 33268–33280.

[19] Z. Baimukhanov, A. Dauletbekova, D. Junisbekova, V. Kalytka, A. Akilbekov, A. Akylbekova, G. Baubekova, G. Aralbayeva, A.-D. Bazarbek, A. Usseinov, A. I. Popov, Synthesis of orthorhombic tin dioxide nanowires in track templates, Materials 17 (2024) 1226.

[20] S. Bakhet, A. Tamuleviciene, A. Vasiliauskas, M. Andrulevicius, S. Meskinis, S. Tamulevicius, N. Kasetiene, M. Malakauskas, R. Lelesius, D. Zienius, A. Salomskas, K. Smits, T. Tamulevicius, Antiviral and antibacterial efficacy of nanocomposite amorphous carbon films with copper nanoparticles, Applied Surface Science 670 (2024) 160642.

[21] G. Bakradze, E. Welter, A. Kuzmin, Structure of Polaronic Centers in Proton-Intercalated AWO_4 Scheelite-Type Tungstates, Materials 17 (2024) 3071.

[22] N. Bakute, E. Andriukonis, K. Kasperaviciute, J. Dobilas, M. Sapurov, G. Mozolevskis, A. Stirke, Microphysiological system with integrated sensors to study the effect of pulsed electric field, Scientific Reports 14 (2024) 18713.

[23] S. Balu, S.-W. Chen, S. Piskunov, H. Venkatesvaran, L. W.-C. Lee, T. C.-K. Yang, In-co-doped $Bi_{1-x}VO_4$ drenched sulfur-doped g-C_3N_4 nanocomposite: A type-II photo(electro)catalytic system for visible-light-driven water-splitting and toxic removal applications, Advanced Composites and Hybrid Materials 7 (2024) 32.

[24] V. Bezrukovs, V. Bezrukovs, M. Konuhova, D. Bezrukovs, I. Kaldre, A. I. Popov, Numerical Simulations of Thermodynamic Processes in the Chamber of a Liquid Piston Compressor for Hydrogen Applications, Technologies 12 (2024) 266.

[25] A. Biswas, I. Apsite, S. Rosenfeldt, I. Bite, V. Vitola, L. Ionov, Modular photoorigami-based 4D manufacturing of vascular junction elements, Journal of Materials Chemistry B 12 (2024) 5405–5417.

[26] E. Blumbergs, A. Shishkin, K. Markus, V. Serga, D. Goljandin, A. Klauson, V. Abramovskis, J. Baronins, A. Zarkov, V. Pankratov, Economic Aspects of Mechanical Pre-Treatment’s Role in Precious Metals Recovery from Electronic Waste, Metals 14 (2024) 95.

[27] D. B. Borgekov, A. T. Zhumazhanova, K. B. Kaliyekperova, S. B. Azambayev, A. L. Kozlovskiy, M. Konuhova, A. I. Popov, D. I. Shlimas, The effect of oxygen vacancies on the optical and thermophysical properties of $(1 - x)Si_3N_4$-xAl_2O_3 ceramics, Optical Materials 157 (2024) 116056.

[28] M. Borik, S. Bukarev, A. Kulebyakin, N. Larina, E. Lomonova, F. Milovich, V. Myzina, V. Pankratov, A. Reu, P. Ryabochkina, N. Y. Tabachkova, T. Volkova, A. Zyuzin, Spectral-luminescence characteristics of solid solutions ZrO_2-Eu_2O_3 crystals, Journal of Luminescence 275 (2024) 120790.

[29] M. Borik, A. Chislov, A. Kulebyakin, E. Lomonova, F. Milovich, V. Myzina, V. Pankratov, A. Poselennov, P. Ryabochkina, N. Sidorova, N. Tabachkova, D. Zakharov, D. Kiselev, Effect of Ceria Doping on the Mechanical Properties and Phase Stability of Partially Samaria-Stabilized Zirconia Crystals, Crystals 14 (2024) 736.

[30] A. Bunkas, K. Kalnins, V. Kim, A. N. K. Reddy, A. Bundulis, A. Atvars, A. Sarakovskis, A. Ubelis, R. Ganeev, Influence of NaCl on the morphological, spectral, and nonlinear optical characteristics of laser-produced silver and gold nanoparticles, Applied Physics B: Lasers and Optics 130 (2024) 21.

[31] E. Butanovs, M. Zubkins, E. Strods, V. Vibornijs, K. Kadiwala, L. Ignatane, B. Polyakov, S. Vlassov, J. Purans, Impact of temperature and film thickness on α- and β- phase formation in Ga_2O_3 thin films grown on a-plane sapphire substrate, Thin Solid Films 803 (2024) 140467.

[32] J. Butikova, J. Pervenecka, K. Vitols, E. Tropins, E. Vanags, A. Bundulis, E. Einbergs, A. Vembris, J. Grube, Exposure and post-bake thermal treatment in one step for SU8 photoresist, Nano-Structures and Nano-Objects 38 (2024) 101139.

[33] J. Cipa, E. Endzelins, A. Abols, N. Romanchikova, A. Line, G. W. Jenster, G. Mozolevskis, R. Rimsa, Elucidating Extracellular Vesicle Isolation Kinetics via an Integrated Off-Stoichiometry Thiol-Ene and Cyclic Olefin Copolymer Microfluidic Device, Polymers 16 (3579).

[34] S.-W. Chen, B.-Y. Hung, S. Piskunov, J.-H. Li, T.-C. Lin, J.-H. Lin, Bioinspired photonic crystal structures from Papilio Ulysses butterfly wings for versatile laser applications, Optics and Lasers in Engineering 178 (2024) 108199.

[35] G. Colibaba, D. Rusnac, V. Fedorov, M. Koltsov, O. Volobujeva, R. Grzibovskis, A. Vembris, N. Spalatu, ZnO thin films co-doped with III-valence metals and halogens: theory and experiment, Physica Scripta 99 (2024) 105967.

[36] E. Damerchi, S. Oras, E. Butanovs, A. Liivlaid, M. Antsov, B. Polyakov, A. Trausa, V. Zadin, A. Kyritsakis, L. Vidal, K. Mougin, S. Pikker, S. Vlassov, Heat-induced morphological changes in silver nanowires deposited on a patterned silicon substrate, Beilstein Journal of Nanotechnology 15 (2024) 435–446.

[37] A. Dauletbekova, S. Zvonarev, S. Nikiforov, A. Akilbekov, T. Shtang, N. Karavannova, A. Akylbekova, A. Ishchenko, G. Akhmetova-Abdik, Z. Baymukhanov, G. Aralbayeva, G. Baubekova, A. I. Popov, Luminescence Properties of ZrO_2: Ti Ceramics Irradiated with Electrons and High-Energy Xe Ions, Materials 17 (2024) 1307.

[38] A. Dauletbekova, D. Junisbekova, Z. Baimukhanov, A. Kareiva, A. I. Popov, A. Platonenko, A. Akilbekov, A. Abdrakhmetova, G. Aralbayeva, Z. Koishybayeva, J. Khamdamov, Synthesis and Study of Oxide Semiconductor Nanoheterostructures in SiO_2/Si Track Template, Crystals 14 (2024) 1087.

[39] I. Derkaoui, M. Achehboune, R. I. Eglitis, A. I. Popov, I. Boukhoubza, M. A. Basyooni-M. Kabatas, A. Rezzouk, Influence of the Hubbard U Correction on the Electronic Properties and Chemical Bands of the Cubic (Pm-3m) Phase of $SrTiO_3$ Using GGA/PBE and LDA/CA-PZ Approximations, Molecules 29 (2024) 3081.

[40] G. Doke, Red Persistent Luminescence and Trap Properties of Mg_2SiO_4:Mn^{2+}, M^{3+} (M3+ = B^{3+}; Al^{3+}; Ga^{3+}; In^{3+}) Material, Latvian Journal of Physics and Technical Sciences 61

(2024) 3–12.

[41] M. Dunce, A. Plyushch, E. Birks, S. Svirskas, J. Banys, P. Jankauskas, L. Bikse, A. Atvars, O. Freimanis, M. Leimane, A. Bundulis, Free-standing $0.9Na_{0.5}Bi_{0.5}TiO_3$-$0.1Sr_{0.7}4Bi_{0.2}TiO_3$ thick films produced by water-based tape-casting method, Journal of the American Ceramic Society 107 (2024) 6532–6543.

[42] R. Eglitis, J. Purans, A. Popov, S. Piskunov, R. Jia, S. Kruchinin, ABO_3 perovskite as well as BaF_2, SrF_2 and CaF_2 bulk and surface F-center first principles predictions, Modern Physics Letters B 38 (2024) 2342004.

[43] R. Eglitis, A. Popov, R. Jia, S. Kruchinin, I. Derkaoui, M. A. B.-M. Kabatas, B3LYP and B3PW computations of $BaSnO_3$ and $BaZrO_3$ perovskite (001) surfaces, Low Temperature Physics 50 (2024) 905–910.

[44] E. Feldbach, A. Krasnikov, A. Popov, V. Seeman, E. Shablonin, A. Lushchik, Cathodoluminescence as a tool for monitoring radiation damage recovery in corundum, Journal of Luminescence 269 (2024) 120490.

[45] R. Ganeev, V. Kim, D. Vorobyov, U. Gross, A. Ubelis, D. Ozols, J. Butikova, J. Grube, A. Sarakovskis, The First Application of Laser-Induced Breakdown Spectroscopy: A Fast-Analytical Technique in Targeted Search for Elements in Geological Samples from Deep Boreholes in Latvia, Latvian Journal of Physics and Technical Sciences 61 (2024) 2332.

[46] C. Gauckler, G. Kucinskis, L. F. Pfeiffer, A. A. Abdellatif, Y. Tang, C. Kubel, F. Maroni, R. Gong, M. Wohlfahrt-Mehrens, P. Axmann, M. Marinaro, MgO coated P2-$Na_{0.67}Mn_{0.75}Ni_{0.25}O_2$ layered oxide cathode for Na-Ion batteries, Journal of Power Sources Advances 25 (2024) 100135.

[47] K. Goluba, V. Parfejevs, E. Rostoka, K. Jekabsons, I. Blake, A. Neimane, A. A. Ule, R. Rimsa, R. Vangravs, A. Pcolkins, U. Riekstina, Personalized PDAC chip with functional endothelial barrier for tumour biomarker detection: A platform for precision medicine applications, Materials Today Bio 29 (2024) 101262.

[48] K. Goluba, V. Parfejevs, K. Jekabsons, E. Rostoka, Blake, L. Kunrade, A. Neimane, R. Rimsa, A. Pcolkins, D. Riekstina, Nanoparticle delivery in a human pancreatic ductal adenocarcinoma-on-a-chip model, 2024, pp. 1–4.

[49] S. V. Gopi, N. Spalatu, A. Katerski, J. Kulicek, B. Razek, E. Ukraintsev, M. S. Barinkova, G. Zoppi, R. Grzibovskis, A. Vembris, L. Ignatane, M. Krunks, I. O. Acik, An alternative chlorine-assisted optimization of CdS/Sb_2Se_3 solar cells: Towards understanding of chlorine incorporation mechanism, Journal of Alloys and Compounds 1005 (2024) 176175.

[50] M. Gorev, I. Flerov, M. Molokeev, K. Bormanis, E. Birks, S. Sapozhnikov, E. Mikhaleva, Thermal expansion, T-x phase diagram and polarization of $(1–x)Na_{1/2}4Bi_{1/2}TiO_{3–x}BaTiO_3$ solid solutions, Journal of the European Ceramic Society 44 (2024) 116769.

[51] R. Grzibovskis, A. Aizstrauts, A. Ruduss, K. Traskovskis, Novel dicyanomethylene-functionalized s-indacene-tetraone-based materials as non-fullerene acceptors for ternary organic solar cells, Proceedings of SPIE - The International Society for Optical Engineering 13013 (2024) 1301305.

[52] R. Grzibovskis, A. Aizstrauts, A. Pidluzhna, M. Marcinskas, A. Magomedov, S. Karazhanov, T. Malinauskas, V. Getautis, A. Vembris, Energy-Level Interpretation of Carbazole Derivatives in Self-Assembling Monolayer, Molecules (Basel, Switzerland) 29 (2024) 1910.

[53] M. Iesalnieks, M. Vanags, L. L. Alsina, R. Eglitis, L. Grinberga, P. C. Sherrell, A. Sutka, Efficient Decoupled Electrolytic Water Splitting in Acid through Pseudocapacitive TiO_2,

Advanced Science 11 (2024) 2401261.

[54] L. Ignatane, R. Ignatans, J. Prikulis, A. Trausa, C. F. Tipaldi, E. Vanags, M. Zubkins, K. Smits, A. Sarakovskis, Fabrication of Large-Area High-Resolution Templates by Focused Ion Beam Combined with Colloidal Nanoparticle Dimer Deposition for SERS Substrates, Nanomaterials 14 (2024) 1784.

[55] T. Inerbaev, A. Akilbekov, D. Kenbayev, A. Dauletbekova, A. Shalaev, E. Polisadova, M. Konuhova, S. Piskunov, A. I. Popov, Color Centers in BaFBr Crystals: Experimental Study and Theoretical Modeling, Materials 17 (2024) 3340.

[56] T. M. Inerbaev, A. U. Abuova, Z. Y. Zakiyeva, F. U. Abuova, Y. A. Mastrikov, M. Sokolov, D. Gryaznov, E. A. Kotomin, Effect of Rh Doping on Optical Absorption and Oxygen Evolution Reaction Activity on $BaTiO_3$ (001) Surfaces, Molecules 29 (2024) 2707.

[57] G. Inkrataite, M. Skruodiene, R. Skaudzius, Synthesis and investigation of novel boron- and magnesium-doped YAG:Ce and LuAG:Ce phosphor ceramics, Luminescence 39 (2024) e4673.

[58] O. Ismagambetov, N. Aldiyarov, N. Almas, I. Irgibaeva, Z. Baitassova, S. Piskunov, A. Aldongarov, O. Abdirashev, Atomistic modeling of natural gas desulfurization process using task-specific deep eutectic solvents supported by graphene oxide, Molecules 29 (2024) 5282.

[59] A. Istlyaup, L. Myasnikova, D. Sergeyev, M. Konuhova, A. I. Popov, Computer simulation of the density of states and band structure of NaF nanotubes, Low Temperature Physics 50 (2024) 569–573.

[60] A. Istlyaup, L. Myasnikova, V. Bezrukovs, A. Zalga, A. I. Popov, Computer simulation of the electrical properties of carbon nanotubes encapsulated with alkali metal iodide crystals, Low Temperature Physics 50 (2024) 898–904.

[61] N. Juneja, S. Daskeviciute-Geguziene, N. Spalatu, S. Mandati, A. Katerski, R. Grzibovskis, A. Vembris, S. Karazhanov, V. Getautis, M. Krunks, I. Oja Acik, Employment of dopant-free fluorene-based enamines as innovative hole transport materials to boost the transparency and performance of Sb_2S_3 based solar cells, Materials Science in Semiconductor Processing 169 (2024) 107934.

[62] N. Juneja, A. Jegorove, R. Grzibovskis, A. Katerski, M. Daskeviciene, T. Malinauskas, A. Vembris, S. Karazhanov, N. Spalatu, V. Getautis, M. Krunks, I. Oja Acik, Dopant-free fluorene based dimers linked with thiophene units as prospective hole transport materials for Sb_2S_3 solar cells, Sustainable Energy and Fuels 8 (2024) 4324–4334.

[63] K. Kadiwala, L. Dipane, E. Dipans, A. Bundulis, M. Zubkins, A. Ogurcovs, J. Gabrusenoks, D. Bocharov, E. Butanovs, B. Polyakov, Synthesis and Investigation of $ReSe_2$ Thin Films Obtained from Magnetron Sputtered Re and ReO_x, Crystals 14 (2024) 690.

[64] K. Kadiwala, E. Dipans, L. Dipane, E. Butanovs, B. Polyakov, Towards Scalable Synthesis of $TiSe_2$ and VSe_2 Thin Films, Latvian Journal of Physics and Technical Sciences 61 (2024) 13–22.

[65] K. K. Kadyrzhanov, A. A. Kozlovskiy, M. Konuhova, A. I. Popov, D. D. Shlimas, D. B. Borgekov, Determination of gamma radiation shielding efficiency by radiation-resistant composite ZrO_2-Al_2O_3-TiO_2-WO_3-Nb_2O_5 ceramics, Optical Materials 154 (2024) 115752.

[66] K. Kalnins, V. V. Kim, A. N. K. Reddy, A. Sarakovskis, R. A. Ganeev, Spatially variable ripple and groove formation on gallium arsenide using linear, radial, and azimuthal polarizations of laser beam, Photonics 11 (2024) 710.

[67] V. Karitans, M. Ozolinsh, S. Fomins, Phase Retrieval of One-Dimensional Objects by the Multiple-Plane Gerchberg-Saxton Algorithm Implemented into a Digital Signal Processor, Optics 5 (2024) 514–522.

[68] S. Khartsev, A. Sarakovskis, L. Grinberga, M. Hammar, N. Nordell, A. Hallen, Electrical and Optical Properties of a $Cu_2O/\beta\text{-}Ga_2O_3$ pn-Junction, Physica Status Solidi (A) Applications and Materials Science 221 (2024) 2300958.

[69] A. Kizalaite, A. Dubnika, A. Antuzevics, T. Murauskas, O. Stewart, S. L. Stoll, T. Goto, T. Sekino, A. Zarkov, Low-temperature aqueous synthesis and biocompatibility of manganese whitlockite, Ceramics International 50 (2024) 28490–28497.

[70] A. Knoks, L. Grinberga, J. Kleperis, Novel Anodic TiO_2 Synthesis Method with Embedded Graphene Quantum Dots for Improved Photocatalytic Activity, Coatings 14.

[71] M. Konuhova, Modeling of induction motor direct starting with and without considering current displacement in slot, Applied Sciences (Switzerland) 14 (2024) 9230.

[72] E. A. Kotomin, V. N. Kuzovkov, A. Lushchik, A. I. Popov, E. Shablonin, T. Scherer, E. Vasil'chenko, The Annealing Kinetics of Defects in CVD Diamond Irradiated by Xe Ions, Crystals 14 (2024) 546.

[73] A. L. Kozlovskiy, M. Konuhova, D. I. Shlimas, D. B. Borgekov, M. V. Zdorovets, R. I. Shakirziyanov, Y. A. Garanin, N. O. Volodina, A. I. Popov, Study of the Effect of Nanostructured Grains on the Radiation Resistance of Zirconium Dioxide Ceramics During Gas Swelling in the Case of High-Dose Irradiation with He2+ Ions, ES Materials and Manufacturing 24 (2024) 1165.

[74] A. L. Kozlovskiy, M. Konuhova, D. B. Borgekov, P. Anatoli I, Study of irradiation temperature effect on radiation-induced polymorphic transformation mechanisms in ZrO_2 ceramics, Optical Materials 156 (2024) 115994.

[75] N. Krainyukova, D. Diachenko, E. Kotomin, Selective uptake and desorption of carbon dioxide in carbon honeycombs of different sizes, Low Temperature Physics 50 (2024) 97–102.

[76] G. Krieke, A. Antuzevics, A. Kalinko, A. Kuzmin, T. Murauskas, A. Kareiva, A. Zarkov, Matrix-dependent high-contrast photochromism in Eu-doped $M_3MgSi_2O_8$ (M = Ca, Sr, Ba), Journal of Materials Chemistry C 12 (2024) 16989–16998.

[77] S. P. Kruchinin, R. I. Eglitis, D. S. Kruchinin, I. V. Krak, V. P. Babak, V. E. Novikov, A. P. Polishchuk, Modeling of mechanical and electrical systems with fractal structure under impulse action and coherent acceleration, Symmetry 16 (2024) 1700.

[78] E. Kuka, D. Cirule, I. Andersone, L. O. Vasiljevs, J. Merna, A. Sarakovskis, N. Kurnosova, E. Sansonetti, L. Vevere, B. Andersons, A step to microplastic formation: Microcracking and associated surface transformations of recycled LDPE, LLDPE, HDPE, and PP plastics exposed to UV radiation, Polymer Degradation and Stability 229 (2024) 110967.

[79] A. Kuzmin, X-ray absorption spectroscopy in high-entropy material research, in High-Entropy Alloys: Design, Manufacturing, and Emerging Applications, G. Yasin, M. Abubaker Khan, M. Afifi, T. Anh Nguyen, Y. Zhang (Eds.), pp. 121-155 (Elsevier, 2024).

[80] V. Kuzovkov, E. Kotomin, A. Lushchik, A. Popov, E. Shablonin, The annealing kinetics of the F-type defects in $MgAl_2O_4$ spinel single crystals irradiated by swift heavy ions, Optical Materials 147 (2024) 114733.

[81] K. Laganovska, I. Bite, A. Zolotarjovs, V. Vitola, M. Dile, E. Einbergs, M. Leimane, G. Tunens, Eu3+ ion incorporation characteristics and impact on defects in monoclinic

HfO_2, Journal of Materials Science 59 (2024) 22024–22033.

[82] K. Laganovska, V. Vitola, E. Einbergs, I. Bite, A. Zolotarjovs, M. Leimane, G. Tunens, K. Smits, Impact of Europium and Niobium Doping on Hafnium Oxide (HfO_2): Comparative Analysis of Sol-Gel and Combustion Synthesis Methods, Ceramics 7 (2024) 15–28.

[83] V. Lazarenko, R. Meija, Y. Rublova, A. Kons, V. Voikiva, J. Andzane, R. Lohmus, A. Sarakovskis, X. Kong, T. Kallio, A. Viksna, D. Erts, Bi_2Se_3@SWCNT heterostructures with beyond theoretical capacity as perspective binder-free anodes for lithium-ion batteries, Journal of Power Sources 593 (2024) 233964.

[84] E. Letko, A. Bundulis, G. Mozolevskis, Lossy Mode Resonance Sensors Based on Planar Waveguides: Theoretical and Experimental Comparison, IEEE Photonics Journal 16 (2024) 6800107.

[85] E. Letko, A. Bundulis, E. Vanags, G. Mozolevskis, Lossy mode resonance in photonic integrated circuits, Optics and Lasers in Engineering 181 (2024) 108387.

[86] R. Levinas, V. Pakstas, A. Selskis, T. Murauskas, R. Viter, A. Anspoks, I. Pudza, A. Kuzmin, L. Tamasauskaite-Tamasiunaite, H. Cesiulis, E. Norkus, Plasma Electrolytic Oxidation Synthesis of Heterostructured TiO_2/Cu_xO Films for Photoelectrochemical Water Splitting Applications, Journal of the Electrochemical Society 171 (2024) 036501.

[87] Y.-P. Lin, E. Neilande, H. Bandarenka, S. Zavatski, I. Isakovica, S. Piskunov, D. Bocharov, E. A. Kotomin, Excited State Calculations of Cu-Doped Anatase TiO_2 (101) and (001) Nanofilms, Crystals 14 (2024) 247.

[88] W. C. Mackrodt, A. Platonenko, F. Pascale, R. Dovesi, The energies and charge and spin distributions in the low-lying levels of singlet and triplet N_2V defects in diamond from direct variational calculations of the excited states, Journal of Chemical Physics 160 (2024) 034705.

[89] L. Maskova, R. Ignatans, A. Viksna, A. Sarakovskis, M. Knite, G. Kucinskis, Wet-Chemical Synthesis of a Protective Coating on NCM111 Cathode: The Quantified Effects of Washing, Sintering and Coating, Journal of the Electrochemical Society 171 (2024) 100520.

[90] J. Mikelsone, A. Vembris, Sodium citrate and polyvinylpyrrolidone captured silver nanoparticles transfer to organic solvents, Latvian Journal of Physics and Technical Sciences 61 (2024) 23–34.

[91] K. Milenković, I. Zeković, B. Milicević, Z. Ristić, K. Smits, A. I. Popov, M. D. Dramicanin, V. Dordević, Microwave-assisted solvothermal synthesis of Eu3+-doped CsY_2F_7 and RbY_2F_7 phosphorescent nanoparticles, Ceramics International 50 (2024) 26663–26669.

[92] E. Moradpur-Tari, S. Vlassov, S. Oras, M. Ernits, E. Damerchi, B. Polyakov, A. Kyritsakis, V. Zadin, Nano1D: An accurate computer vision software for analysis and segmentation of low-dimensional nanostructures, Ultramicroscopy 261 (2024) 113949.

[93] M. Novita, A. S. Chauhan, R. M. D. Ujianti, D. Marlina, H. Kusumo, M. T. Anwar, M. Piasecki, M. G. Brik, Exploring deep learning and machine learning for novel red phosphor materials, Journal of Luminescence 269 (2024) 120476.

[94] E. Pajuste, I. Reinholds, G. Vaivars, J. Zicans, R. Meri, L. Avotina, E. Sprugis, M. Rzepna, Radiation stability of electron beam irradiated high degree sulfonated poly(ether ether ketone) membranes for the applications in nuclear facilities, Polymer Degradation and Stability 219 (2024) 110615.

[95] R. Palmbahs, P. Lesnicenoks, A. Knoks, V. Vitola, J. Kleperis, Synthesis Method Comparison of N-Doped Carbons for Electrochemical Energy Storage,

ChemEngineering 8 (2024) 80.

[96] V. Pankratova, J. Butikova, A. Kotlov, A. Popov, V. Pankratov, Influence of swift heavy ions irradiation on optical and luminescence properties of $Y_3Al_5O_{12}$ single crystals, Optical Materials: X 23 (2024) 100341.

[97] V. Pankratova, K. Chernenko, A. Popov, V. Pankratov, Temperature behavior of Ce3+ emission in $(Lu,Y)_2SiO_5$ single crystals excited by vacuum ultraviolet synchrotron light, Optical Materials: X 22 (2024) 100322.

[98] V. Pankratova, K. Chernenko, D. Bocharov, A. Chesnokov, Y. Sychikova, A. I. Popov, V. Pankratov, Unveiling of UV intrinsic luminescence in $(Lu,Y)_2SiO_5$:Ce3+ single crystals, Optical Materials 152 (2024) 115554.

[99] P. Paulsone, I. Aulika, J. Butikova, A. Maurucaite, K. Stucere, A. Vembris, Single-layer films of organic compounds studied by spectroscopic ellipsometry, Proceedings of SPIE - The International Society for Optical Engineering 13013 (2024) 1301308.

[100] P. Paulsone, J. Pervenecka, E. Zarins, V. Kokars, A. Vembris, Optical and Amplified Spontaneous Emission Properties of 4H-Pyran-4-Ylidene-2-Cyanoacetate Fragment Containing 2-Cyanoacetic Acid Derivative in PVK, PSU, or PS Matrix, Solids 5 (2024) 520–532.

[101] A. Pidluzhna, A. Vembris, R. Grzibovskis, M. A. Zommere, O. Bezvikonnyi, J. Simokaitiene, M. Baronaite, D. Volyniuk, J. V. Grazulevicius, A. Ali, G. Baryshnikov, K. Ivaniuk, H. Starykov, P. Stakhira, The Effect of Molecular Structure on the Properties of Fluorene Derivatives for OLED Applications, Molecules 29 (2024) 4918.

[102] A. Platonenko, S. Piskunov, T. C.-K. Yang, J. Juodkazyte, I. Isakovica, A. I. Popov, D. Junisbekova, Z. Baimukhanov, A. Dauletbekova, Electronic Structure of Mg-, Si-, and Zn-Doped SnO_2 Nanowires: Predictions from First Principles, Materials 17 (2024) 2193.

[103] A. Platonenko, V. Pankratov, E. A. Kotomin, A. Dauletbekova, A. I. Popov, Ab Initio Study on the Vibrational and Electronic Properties of Radiation-Induced Defects in Potassium Bromide, Crystals 14 (2024) 161.

[104] A. Platonenko, F. Gentile, K. E. El-Kelany, R. Dovesi, The role of the exact Hartree-Fock exchange in the investigation of defects in crystalline systems, Physical Chemistry Chemical Physics 26 (2024) 25919–25924.

[105] B. Polyakov, K. Kadiwala, E. Butanovs, L. Dipane, A. Trausa, D. Bocharov, S. Vlassov, Synthesis of $ZnS/Al_2O_3/TaSe_2$ Core/Shell Nanowires Using Thin Ta Metal Film Precursor, ChemEngineering 8 (2024) 25.

[106] B. Polyakov, L. Dorogin, S. Oras, R. Lohmus, S. Vlassov, Tribological aspects of in situ manipulation of nanostructures inside scanning electron microscope, NanoScience and Technology Part F3377 (2024) 173–212.

[107] E. Popova, D. Bezrukovs, V. Bezrukovs, Y. Suchikova, A. I. Popov, Radio-astronomical monitoring of active regions in the microwave range in the service of forecasting solar flares, Modern Physics Letters A 39 (2024) 2450069.

[108] M. Priedols, G. Paidere, P. Kaukis, C. Bajo-Santos, A. Spule, A. Miscenko, G. Mozolevskis, R. Rimsa, A. Abols, Single Step Isolation of Extracellular Vesicles from Large-Volume Samples with a Bifurcated A4F Microfluidic Device, Journal of Visualized Experiments 2024 (2024) e66019.

[109] I. Pudza, B. Polyakov, K. Pudzs, E. Welter, A. Kuzmin, Temperature-dependent local structure and lattice dynamics of 1T-$TiSe_2$ and 1T-VSe_2 probed by X-ray absorption spectroscopy, Physica B: Condensed Matter 685 (2024) 415995.

[110] E. Raudonyte-Svirbutaviciene, G. Klydziute, L. Lukaviciute, A. Antuzevics, A. Balciunaite, E. Norkus, A. Beganskiene, A. Zarkov, A. Kareiva, Hydrothermal synthesis of Mn2+- and Cu2+-doped calcium hydroxyapatite: morphological features and importance of EPR insights, Ceramics International 50 (2024) 4005–4013.

[111] A. N. K. Reddy, V. V. Kim, V. Karcher, H. Zacharias, A. Bundulis, A. Sarakovskis, A. Atvars, A. Ubelis, R. A. Ganeev, Spatial shaping of low- and high-order harmonics generated using vortex beams, Journal of Physics D: Applied Physics 57 (2024) 305105.

[112] N. Rizzieri, L. Dall'Asta, M. Ozolins, Diabetic Retinopathy Features Segmentation without Coding Experience with Computer Vision Models YOLOv8 and YOLOv9, Vision (Switzerland) 8 (2024) 48.

[113] N. Rizzieri, L. Dall'Asta, M. Ozoliņš, Myopia Detection from Eye Fundus Images: New Screening Method Based on You Only Look Once Version 8, Applied Sciences (Switzerland) 14 (2024) 11926.

[114] A. Robalds, O. Bikovens, A. Delina, N. P. Ponomarev, O. Purmalis, L. Elina Tomsone, E. Vanags, Data on the characterization of seaweed, wheat bran, and other food processing byproducts as feasible biosorbents, Data in Brief 53 (2024) 110214.

[115] U. Rogulis, A. Fedotovs, D. Berzins, G. Krieke, L. Skuja, A. Antuzevics, Low temperature recombination luminescence of $Mg_3Y_2Ge_3$O12:Tb3+, Optical Materials: X 24 (2024) 100368.

[116] Y. Rublova, X. Kong, A. Sarakovskis, T. Kallio, D. Erts, Passivated Bi_2Se_3 electrode in Na_2CO_3 solution to improve anode efficiency in aqueous Li-ion batteries, Materials Letters 356 (2024) 135634.

[117] Y. Rublova, R. Meija, X. Kong, V. Lazarenko, J. Andzane, A. Sarakovskis, A. Viksna, T. Kallio, D. Erts, Binder-free $Cu_{1.9}Bi_{0.1}Se$@SWCNT hybrid anodes for lithium-ion and sodium-ion batteries, Ceramics International 50 (2024) 14808–14822.

[118] I. Rudavskyi, H. Klym, Y. Kostiv, I. Karbovnyk, I. Zhydenko, A. I. Popov, M. Konuhova, Utilizing an Arduino Uno-Based System with Integrated Sensor Data Fusion and Filtration Techniques for Enhanced Air Quality Monitoring in Residential Spaces, Applied Sciences (Switzerland) 14 (2024) 9012.

[119] A. Ruduss, A. Jece, K. A. Stucere, K.-W. Chen, B. Turovska, S. Belyakov, A. Vembris, C.-H. Chang, K. Traskovskis, Sulfonyl-functionalized benzo[d]imidazo[5,1-b]thiazole-based carbenes as building blocks for two-coordinate Cu(i) complexes exhibiting fast and efficient thermally activated delayed fluorescence, Journal of Materials Chemistry C 12 (2024) 2968–2980.

[120] L. L. Rusevich, M. G. Brik, D. Gryaznov, A. M. Srivastava, I. Chervyakov, G. Zvejnieks, D. Bocharov, E. A. Kotomin, First-Principles Linear Combination of Atomic Orbitals Calculations of K_2SiF_6 Crystal: Structural, Electronic, Elastic, Vibrational and Dielectric Properties, Materials 17 (2024) 4865.

[121] L. Rusevich, E. Kotomin, A. Popov, G. Aiello, T. Scherer, A. Lushchik, The electronic, vibrational and dielectric properties of diamond crystals with neutral vacancies: first principles study, Optical Materials 150 (2024) 115222.

[122] R. Ruska, A. Sarakovskis, E. Zutis, G. Paidere, I. Vozny, J. Cipa, J. Gabrusenoks, T. Freimanis, R. Zalubovskis, A. Anspoks, Off-Stoichiometry Thiol-Ene Surface Functionalization: Example with Gold Nanoparticles, Materials 17 (2024) 6135.

[123] A. E. Ryskulov, I. A. Ivanov, A. L. Kozlovskiy, M. Konuhova, The effect of residual mechanical stresses and vacancy defects on the diffusion expansion of the damaged layer during irradiation of BeO ceramics, Optical Materials: X 24 (2024) 100375.

[124] V. Serga, A. Zarkov, A. Shishkin, M. Melnichuks, V. Pankratov, Investigation of the Impact of Electrochemical Hydrochlorination Process Parameters on the Efficiency of Noble (Au, Ag) and Base Metals Leaching from Computer Printed Circuit Boards, Metals 14 (2024) 65.

[125] E. Shablonin, I. Kudryavtseva, A. Popov, V. Seeman, E. Vasil'chenko, A. Lushchik, Thermal annealing of lattice defects in $MgAl_2O_4$ single crystals irradiated by swift heavy ions, Journal of Nuclear Materials 590 (2024) 154874.

[126] R. Shendrik, E. Kaneva, V. Pankratova, E. Pankrushina, T. Radomskaya, V. Gavrilenko, P. Loginova, V. Pankratov, Intrinsic luminescence and radiation defects in scapolite, Chemical Physics Letters 838 (2024) 141081.

[127] A. Smekhova, D. Gaertner, A. Kuzmin, A. G. Buzanich, G. Schuck, I. Zizak, G. Wilde, K. V. Yusenko, S. Divinski, Anomalies in the short-range local environment and atomic diffusion in single crystalline equiatomic CrMnFeCoNi high-entropy alloy, Nano Research 17 (2024) 5336–5348.

[128] D. Sofich, A. Myasnikova, A. Bogdanov, V. Pankratova, V. Pankratov, E. Kaneva, R. Shendrik, Crystal Growth and Spectroscopy of Yb2+-Doped CsI Single Crystal, Crystals 14 (2024) 500.

[129] M. Sokolov, Y. A. Mastrikov, D. Bocharov, V. Krasnenko, G. Zvejnieks, K. S. Exner, E. A. Kotomin, Computational study of oxygen evolution reaction on flat and stepped surfaces of strontium titanate, Catalysis Today 432 (2024) 114609.

[130] Y. Su, H. Xue, Y. Fu, S. Chen, Z. Li, L. Li, A. Knoks, O. Bogdanova, P. Lesnicenoks, R. Palmbahs, M.-M. Laurila, M. Mantysalo, M. Hammar, A. Hallen, N. Nordell, J. Li, Monolithic Fabrication of Metal-Free On-Paper Self-Charging Power Systems, Advanced Functional Materials 34 (2024) 2313506.

[131] Y. Suchikova, I. Bohdanov, S. Kovachov, A. Popov, Thin CIGS Films Obtained by Spray Pyrolysis, Springer Proceedings in Physics 253 SPP (2024) 237-252.

[132] Y. Suchikova, S. Kovachov, I. Bohdanov, D. Drozhcha, I. Kosogov, Z. T. Karipbayev, A. I. Popov, Synthesis and Characterization of β-Ga_2O_3/por-GaAs/mono-GaAs Heterostructures for Enhanced Portable Solar Cells, Physics and Chemistry of Solid State 25 (2024) 546–552.

[133] Y. Suchikova, S. Kovachov, I. Bohdanov, Z. T. Karipbayev, Y. Zhydachevskyy, A. Lysak, V. Pankratov, A. I. Popov, Advanced Synthesis and Characterization of CdO/CdS/ZnO Heterostructures for Solar Energy Applications, Materials 17 (2024) 1566.

[134] Y. Suchikova, S. Kovachov, I. Bohdanov, M. Konuhova, A. Popov, Synthesis of periodic porous structures on the surface of indium phosphide, Latvian Journal of Physics and Technical Sciences 61 (2024) 3–15.

[135] Y. Suchikova, S. Kovachov, I. Bohdanov, M. Konuhova, Y. Zhydachevskyy, K. Kumarbekov, V. Pankratov, A. I. Popov, Wet Chemical Synthesis of $Al_xGa_{1-x}As$ Nanostructures: Investigation of Properties and Growth Mechanisms, Crystals 14 (2024) 633.

[136] Y. Suchikova, S. Kovachov, I. Bohdanov, I. Kosogov, D. Drozhcha, A. I. Popov, Synthesis and Characterization of Hierarchical ZnO/ZnS Nanostructures on Porous Silicon for Advanced MEMS Applications, International Conference on Perspective Technologies and Methods in MEMS Design (2024) 124–127

[137] Y. Suchikova, S. Kovachov, I. Bohdanov, I. Kosogov, D. Drozhcha, A. I. Popov, Design and structural characteristics of Ga_2O_3/por-GaAs/mono-GaAs Heterostructures for Advanced MEMS Applications, International Conference on Perspective Technologies

and Methods in MEMS Design (2024) 48–51

[138] Y. Suchikova, S. Kovachov, Z. Karipbaev, Y. Zhydachevskyy, Bohdanov, A. I. Popov, Investigation of Photoluminescence and Raman Emission of Porous Gallium Phosphide, 2024, pp. 227–230.

[139] Y. Suchikova, S. Kovachov, Z. Karipbaev, Y. Zhydachevskyy, Bohdanov, A. I. Popov, Passivating Oxide Layers on the Surface of InP, 2024, pp. 223–226.

[140] Y. Suchikova, S. Kovachov, I. Kosogov, I. Bohdanov, A. I. Popov, Improvement of *β*-SiC/por-Si/mono-Si Heterostructures for Supercapacitor Applications by Mitigating Lattice Mismatch and Improving Electrochemical Performance, 2024.

[141] Y. Suchikova, S. Kovachov, I. Bohdanov, I. Kosogov, D. Drozhcha, A. I. Popov, Ga_2O_3/por-GaAs/mono-GaAs Heterostructures for Advanced Electronic Applications, IEEE 7th International Conference on Smart Technologies in Power Engineering and Electronics, STEE 2024.

[142] Y. Suchikova, S. Kovachov, I. Bohdanov, I. Kosogov, D. Drozhcha, A. I. Popov, Electrochemical Synthesis and Characterization of AlGaAs/GaAs Nanostructured Heterostructures for Advanced Electronic and Optoelectronic Applications, IEEE 7th International Conference on Smart Technologies in Power Engineering and Electronics, STEE 2024.

[143] Y. Suchikova, A. Lysak, S. Kovachov, M. Konuhova, Y. Zhydachevskyy, A. I. Popov, Investigation of the impact of crystalline arsenolite oxide formations on porous gallium arsenide, Physica Status Solidi (A) Applications and Materials Science 221 (2024) 2400365.

[144] Y. Suchikova, S. Nazarovets, A. I. Popov, Ga_2O_3 solar-blind photodetectors: From civilian applications to missile detection and research agenda, Optical Materials 157 (2024) 116397.

[145] A. Šutka, S. Bitina, K. Smits, A. Sutka, L. Bikse, M. Maiorov, T. Kaambre, M. Timusk, L. Laipniece, K. Lazdovica, Rapid, high-yield aqueous synthesis of ultrafine magnetite nanoparticles from Fe(III) precursor at room temperature, Journal of Materials Science 59 (2024) 447–457.

[146] L. M. Svirskaite, E. Kasparavicius, M. Steponaitis, R. Grzibovskis, M. Franckevicius, A. Katerski, A. Naujokaitis, S. Karazhanov, S. V. Gopi, A. Aizstrauts, A. Vembris, V. Getautis, T. Malinauskas, Fluorene- and fluorenone-based molecules as electron-transporting SAMs for photovoltaic devices, RSC Advances 14 (2024) 14973–14981.

[147] J. Sydorenko, M. Krunks, A. Katerski, R. Grzibovskis, A. Vembris, A. Mere, N. Spalatu, I. O. Acik, Development of spray pyrolysis-synthesised Bi_2O_3 thin films for photocatalytic applications, RSC Advances 14 (2024) 19648–19657.

[148] M. Szymczak, A. Antuzevics, P. Rodionovs, M. Runowski, U. R. Rodriguez-Mendoza, D. Szymanski, V. Kinzhybalo, L. Marciniak, Bifunctional Luminescent Thermometer-Manometer Based on Cr^{3+}-Cr^{3+} Pair Emission, ACS Applied Materials and Interfaces 16 (2024) 64976–64987.

[149] H. Teng, X. Sun, R. Eglitis, X. Wang, W. Zhang, H. Wang, S. Qu, Z. Yu, S. Liu, Y. Zhao, Chiisanoside from the leaves of acanthopanax sessiliflorus can resist cisplatin-induced ototoxicity by maintaining cytoskeletal homeostasis and inhibiting ferroptosis, Journal of Agricultural and Food Chemistry 72 (2024) 25720–25742.

[150] C. F. Tipaldi, J. Gabrusenoks, G. Chikvaidze, Vibrational Spectroscopy of $YAlO_3$, Physica Status Solidi (B) Basic Research 261 (2024) 2300481.

[151] C. F. Tipaldi, K. Vitols, T. Kokis, A. Trausa, A. Sarakovskis, Experimental and Theoretical Comparison and Analysis of Surface-Enhanced Raman Scattering Substrates with Different Morphologies, Applied Sciences (Switzerland) 14 (2024) 9040.

[152] A. Trausa, C. F. Tipaldi, L. Ignatane, B. Polyakov, S. Oras, E. Butanovs, E. Vanags, K. Smits, Heat-induced fragmentation and adhesive behaviour of gold nanowires for surface-enhanced raman scattering substrates, ChemEngineering 8 (2024) 15.

[153] L. Trinkler, J. Gabrusenoks, D. Nilova, B. Berzina, M.-C. Chou, L. Chang, Polarized luminescence of bound excitons in Cu_2O single crystal, Optical Materials 157 (2024) 116051.

[154] A. Trukhin, J. Gabrusenoks, A. Sarakovskis, R. Mashkovtsev, Luminescence, XPS and Raman of crystalline quartz affected to high pressure by detonation, Journal of Physics Condensed Matter 36 (2024) 394001.

[155] R. Truksa, S. Fomins, Z. Jansone-Langina, L. Tenisa, Colour Vision Changes across Lifespan: Insights from FM100 and CAD Tests, Vision (Switzerland) 8 (2024) 53.

[156] T. Tsebriienko, A. Popov, Investigation of phase separation and morphology of organic-inorganic interpenetrating polymer networks, Latvian Journal of Physics and Technical Sciences 61 (2024) 3–11.

[157] N. Tsybuliak, H. Lopatina, L. Shevchenko, A. Popova, S. Kovachov, Y. Suchikova, A. I. Popov, Researchers of Ukrainian universities in wartime conditions: Needs, challenges and opportunities, Regional Science Policy and Practice 16 (2024) 100012.

[158] G. Tunens, E. Einbergs, K. Laganovska, A. Zolotarjovs, K. Vilks, L. Skuja, K. Smits, Optical fiber-based open source low cost portable spectrometer system, HardwareX 18 (2024) e00530.

[159] M. Urbonavicius, S. Varnagiris, A. Knoks, A. Mezulis, J. Kleperis, C. Richter, R. Meirbekova, G. Gunnarsson, D. Milcius, Enhanced Hydrogen Generation through Low-Temperature Plasma Treatment of Waste Aluminum for Hydrolysis Reaction, Materials 17 (2024) 2637.

[160] M. Urbonavicius, S. Varnagiris, A. Mezulis, P. Lesnicenoks, A. Knoks, C. Richter, D. Milcius, R. Meirbekova, G. Gunnarsson, J. Kleperis, Hydrogen from industrial aluminium scraps: Hydrolysis under various conditions, modelling of pH behaviour and analysis of reaction by-product, International Journal of Hydrogen Energy 50 (2024) 431–446.

[161] E. Vanags, I. Bite, L. Ignatane, R. Ignatans, A. Trausa, C. F. Tipaldi, K. Vilks, K. Smits, Zinc oxide tetrapods doped with silver nanoparticles as a promising substrate for the detection of biomolecules via surface-enhanced Raman spectroscopy, ChemEngineering 8 (2024) 19.

[162] S. Varnagiris, M. Urbonavicius, A. Knoks, D. Milcius, Enhanced hydrogen generation in low-range acidic solutions using Mg_2NiH_4 powders and their mixtures ball-milled with NaCl and fused silica, International Journal of Hydrogen Energy 50 (2024) 614–626.

[163] B. R. Vasiljević, D. Odobaša, I. Vujicić, M. B. Filimonović, K. Smits, D. Mijin, D. Marinković, Sustainable and fast synthesis of zinc-phthalocyanine for gamma radiation dosimeter application, Radiation Physics and Chemistry 222 (2024) 111816.

[164] D. Venkateshvaran, M. T. Cervantes, L. J. Spalek, K.-H. Hwang, K. Pudzs, M. Rutkis, G. Schweicher, P. Padilla-Longoria, Understanding the Thermoelectric Transport Properties of Organic Semiconductors through the Perspective of Polarons, Advanced Devices and Instrumentation 5 (2024) 67.

[165] V. Vibornijs, M. Zubkins, E. Strods, Z. Rudevica, K. Korotkaja, A. Ogurcovs, K. Kundzins, J. Purans, A. Zajakina, Analysis of Antibacterial and Antiviral Properties of ZnO and Cu Coatings Deposited by Magnetron Sputtering: Evaluation of Cell Viability and ROS Production, Coatings 14 (2024) 14.

[166] S. Vlassov, S. Oras, A. Trausa, T. Tiirats, E. Butanovs, B. Polyakov, Zadin, A. Kyritsakis, Reshaping covalent nanowires by exploiting an unexpected plasticity mediated by deformation twinning, Small 20 (2024) 2304614.

[167] I. Weisbord, M. Barzilay, R. Cai, E. Welter, A. Kuzmin, A. Anspoks, T. Segal-Peretz, The development and atomic structure of zinc oxide crystals grown within polymers from vapor phase precursors, ACS Nano 18 (2024) 18393–18404.

[168] G. Yusibova, K. Ping, M. Kaarik, J. Leis, J. Aruvali, K. Smits, T. Kaambre, V. Kisand, Y. Karpichev, K. Tammeveski, N. Kongi, Optimizing post-treatment strategies for enhanced oxygen reduction/evolution activity in Co-N-C electrocatalyst, International Journal of Hydrogen Energy 82 (2024) 398–406.

[169] R. Zabolockis, M. Sondars, G. Vaivars, I. Reinholds, V. Gostilo, V. Malgin, A. Kizilov, A. Lescinskis, A. Felsharuk, L. Avotina, A. Teimane, E. Sprugis, E. Pajuste, Graphene-based electrochemical system for tritium enrichment, Nuclear Fusion 64 (2024) 026022.

[170] S. Zavatski, E. Neilande, H. Bandarenka, A. Popov, S. Piskunov, D. Bocharov, Density functional theory for doped TiO_2: current research strategies and advancements, Nanotechnology 35 (2024) 192001.

[171] E. Zeglio, Y. Wang, S. Jain, Y. Lin, A. E. Avila Ramirez, K. Feng, X. Guo, H. Ose, G. Mozolevskis, D. Mawad, W. Yue, M. M. Hamedi, A. Herland, Mixing Insulating Commodity Polymers with Semiconducting n-type Polymers Enables High-Performance Electrochemical Transistors, Advanced Materials 36 (2024) 2302624.

[172] H. Zhairabany, H. Khaksar, E. Vanags, L. Marcinauskas, Effect of Molybdenum Concentration and Deposition Temperature on the Structure and Tribological Properties of the Diamond-like Carbon Films, Crystals 14.

[173] D. Zhou, D. Semenok, M. Galasso, F. G. Alabarse, D. Sannikov, A. Troyan, Y. Nakamoto, K. Shimizu, A. R. Oganov, Raisins in a Hydrogen Pie: Ultrastable Cesium and Rubidium Polyhydrides, Advanced Energy Materials 14 (2024) 2400077.

[174] A. M. Zhunusbekov, Z. T. Karipbayev, A. Tolegenova, K. K. Kumarbekov, E. E. Nurmoldin, M. M. Baizhumanov, A. Kotlov, A. I. Popov, Comparative VUV Synchrotron Excitation Study of YAG:Eu and YAG:Cr Ceramics, Crystals 14 (2024) 897.

[175] J. Zidani, I. H. Alaoui, M. Zannen, E. Birks, Z. Chchiyai, M. Majdoub, B. Manoun, M. El Marssi, A. Lahmar, On the Lanthanide Effect on Functional Properties of $0.94Na_{0.5}Bi_{0.5}TiO_3$-$0.06BaTiO_3$ Ceramic, Materials 17 (2024) 1783.

[176] M. A. Zommere, N. Tetervenoka, A. Pidluzhna, R. Grzibovskis, D. Blazevicius, G. Krucaite, D. Tavgeniene, S. Grigalevicius, A. Vembris, Original Blue Light-Emitting Diphenyl Sulfone Derivatives as Potential TADF Emitters for OLEDs, Coatings 14 (2024) 1294.

[177] M. Zubkins, E. Strods, V. Vibornijs, A. Sarakovskis, R. Nedzinskas, R. Ignatans, E. Butanovs, J. Purans, A. Azens, Deposition and photoluminescence of zinc gallium oxide thin films with varied stoichiometry made by reactive magnetron co-sputtering, Journal of Alloys and Compounds 976 (2024) 173218.

[178] G. Zvejnieks, L. L. Rusevich, E. Heifets, E. Kotomin, D. Gryaznov, A Visual Representation for Accurate Local Basis Set Construction and Optimization: A Case Study of $SrTiO_3$ with Hybrid DFT Functionals, Crystals 14 (2024) 671.

[179] J. Hodakovska, L. Britala, A. Mezulis, L. Grinberga, G. Bajars, G. Kucinskis, State of health as a function of voltage hysteresis in Li-ion battery half-cells, Journal of Solid State Electrochemistry (2024) [in press].

[180] A. Kuzmin, V. Dimitrijevs, I. Pudza, A. Kalinko, The Use of the Correlated Debye Model for Extended X-Ray Absorption Fine Structure-Based Thermometry in Body-Centered Cubic and Face-Centered Cubic Metals, Physica Status Solidi (A) Applications and Materials Science (2024) 2400623 [in press].

Theses

Doctor Theses

No.	Author	Title	Supervisor	Degree
1.	Kaspars Kaprāns	The study of transition metal oxide electrode materials for applications in lithium – ion batteries	Dr. chem. Gunārs Bajārs	Ph.D.
2.	Katrīna Laganovska	Defects and optical properties in undoped and rare-earth-doped HfO_2/ZrO_2	Dr. phys. Krišjānis Šmits	Ph.D.
3.	Annamarija Trausa	Determination of physical properties of metal and metal oxide nanowires using in situ microscopy nanomanipulation method	Ph.D. Edgars Butanovs	Ph.D.

M.Sc. Theses

No.	Author	Title	Supervisor	Study programme
1.	Anete Bērziņa	Third and higher order nonlinear optical effects of organic materials	Ph.D. Arturs Bundulis	Physics
2.	Vitalijs Dimitrijevs	Investigation of lattice dynamics anisotropy in metals using x-ray absorption spectroscopy	Dr.phys. Aleksejs Kuzmins	Chemistry
3.	Sofija Grietēna	Preparation of optical waveguides from SU−8 and organic dyes using optical lithography	Ph.D. Arturs Bundulis	Material Science and Nanotechnologies
4.	Julija Lukasevica	Studies of nickel oxide lattice dynamics before and after magnetic phase transition using x-ray absorption spectroscopy	Dr.phys. Aleksejs Kuzmins	Chemistry
5.	Roberts Palmbahs	Research on carbon materials for energy storage	Dr.phys. Gints Kučinskis	Chemical technology
6.	Edvards Strods	The effect of MoO_3 film on the UV-induced light absorption of YHO/MoO_3 structure	Dr.phys. Mārtiņš Zubkins	Medical Engineering and Physics
7.	Kitija Alise Štucere	Origin of white light emission in carbene-copper-amide complexes	Asoc. prof. Dr. phys. Aivars Vembris	Physics

B.Sc. Thesis

No.	Author	Title	Supervisor	Study programme
1.	Artūrs Aizstrauts	Research of indacene-tetrone based molecules for applications in ternary organic solar cells	Dr. phys. Raitis Gržibovskis	Physics
2.	Artis Dēze	The influence of electrode fabrication on the cathode performance of NCM811 lithium-ion batteries	Dr.phys. Gints Kučinskis	Chemistry
3.	Katrīna Križmane	Influence of various precursors on activated strontium aluminate synthesized by microwave-assisted hydrothermal method	MSc. Chem. Madara Leimane and Dr. Phys. Virgīnija Vītola	Chemistry
4.	Emija Ļetko	Fabrication and study of photochromic YHO thin films by high-power pulsed magnetron sputtering	Dr.phys. Mārtiņš Zubkins	Physics
5.	Raitis Kaspars Sika	Impact of carbon additive on photo-physical properties of anodic titanium dioxide nanostructure	Mg. Ainārs Knoks	Chemical technology
6.	Ansis Emīls Zīvers	Producing turquoise hydrogen by methane pyrolysis	Mg. Ainārs Knoks	Physics