WARSAW UNIVERSITY OF TECHNOLOGY
Faculty of Electronics and Information Technology

Institute of Microelectronics and Optoelectronics

annual report 2022

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Institute of Microelectronics and Optoelectronics

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From the Director

This Annual Report summarizes the activities of the Institute of Microelectronics and Optoelectronics (IMiO) in the year 2022, with particular attention given to its research and educational potential. The Institute is a part of the Faculty of Electronics and Information Technology, the biggest Faculty of the Warsaw University of Technology. Among six institutes constituting the Faculty, the Institute of Microelectronics and Optoelectronics is the one most focused on advanced technologies of modern electronics and photonics.

It should be noted that the Institute has its roots deep in history. Although formally founded in 1970, it evolved from the Chair of Radio Engineering established in 1929 by Professor Janusz Groszkowski, who is often called "the father of Polish electronics". The Institute is linked with the beginnings of the Faculty of Electronics and Information Technology not only by the person of Prof. Groszkowski, who worked in IMiO until the end of his career, but also by its location – part of the Institute is situated in the Building of Radio Engineering at the Warsaw University of Technology – the main campus where the Faculty started its operation in 1951 (as the Faculty of Communications). Currently, the Institute's Technology Centre is located there. It includes laboratories specializing in silicon processing (clean-room), hybrid technologies and assembly techniques, fiber optics and integrated optoelectronics, laser optoelectronics, and characterization of new electronic and photonic materials. All 11 high-tech laboratories in the field of electronic and photonic technologies, established as a result of investments conducted in recent years within the Innovative Economy Operational Program framework, have reached their full operational capacity and are extensively used to conduct advanced research and provide research services.

The current research activities of the Institute are focused on the fields of microelectronics, nanoelectronics, and photonics. These include, in particular: VLSI circuits, design of ASICS's and electronic circuits, microsystems, microelectronic and nanoelectronic semiconductor devices (among others based on Si and wide-band semiconductors), ultra-thin films, hybrid circuits (e.g., microwave, optoelectronic), photonic systems (including design of ASPIC's circuits), sensors, lasers, active photonic materials, fiber optics and integrated photonics, nanophotonics, metamaterials, plasmonics, topological photonics, photovoltaics, and image processing. It is worth noting that the research activities of the Institute include modelling, CAD, manufacturing, and versatile characterization.

In teaching, the Institute meets the challenges imposed by the development of modern technology and information society. The educational offer (at all levels – B.Sc., M.Sc., and Ph.D.) corresponds to the main fields of advanced electronics and photonics and, simultaneously, the primary research expertise of the Institute. The Institute's involvement in distance learning studies of Electronics and Telecommunications is also worth mentioning, mostly postgraduate studies in the domain of tools and techniques of virtual education that began in 2004. Several student laboratories in electronics, microelectronics, and photonics, located in the recently expanded wings of the Faculty building, have reached their full operational capacity in 2017, improving considerably the quality of the education offered by IMiO.

In the year 2022, our staff authored and co-authored 139 publications, including 68 papers in scientific journals from the JCR list. Moreover, the Institute's expertise and infrastructure made it possible to involve in numerous international and domestic projects.

I want to thank all the colleagues working at the Institute of Microelectronics and Optoelectronic for their constant commitment and effort to make the Institute a unique place to be. Without our collective achievements, the Institute could not be what it is today.

Professor Jan Szmidt

CONTENTS

1. GENERAL INFORMATION

1.1. Board of Directors

Director of the Institute

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1.2. Organisation of the Institute and Areas of its Activities

The Institute of Microelectronics and Optoelectronics is a part of the Faculty of Electronics and Information Technology – the largest among all units of Warsaw University of Technology. At present, the Institute consists of four divisions with primary competence covering the significant areas of modern electronics and photonics. These are:

- Microelectronics and Nanoelectronics Devices Division;
- VLSI Engineering and Design Automation Division;
- Microsystem and Electronic Material Technology Division;
- Optoelectronics Division.

During almost fifty years of research, the Institute has built and developed its competence in:

- modelling of physical effects in modern semiconductor devices;
- advanced technologies of silicon-based microelectronics and photonics;
- non-standard dielectric layer deposition techniques;
- characterization of electronic materials and devices;
- designing and development of application specific VLSI circuits;
- design and technology of thick-film hybrid circuits; fabrication of thick-film microsystems;
- modelling and design of sensors and optical-waveguide microsystems;
- laser physics and laser technique;
- optical spectroscopy of solids;
- fiber-optic photonics, including fiber-optic communication; sensing as well as design and development of fiber lasers and amplifiers;
- design and development of photonic integrated circuits (PICs);
- 2-D and 3-D image processing systems, including monitoring systems;
- photovoltaics;
- plasmonics;
- microwaves, microwave photonics, and microwave measurement techniques;
- new materials for high-temperature, high-power, and high-frequency electronics;
- new materials and structures for modern photonics.

The research activity is supported by a number of projects financed by the National Science Centre and National Centre for Research and Development, projects funded within EU Framework Programmes, as well as industry-funded.
The results are systematically published in a number of papers submitted to prestigious international scientific journals and presented at national and international conferences.
In parallel to scientific activity also the didactic offer of the Institute has been recently expanded with completely new specializations: "Electronics and Photonics" (for first-degree education) and "Integrated Electronics and Photonics Systems" (for second-degree education), which have been developed within the framework of the project "NERW PW Science-Education-Development-Cooperation" financed from Axis III Higher Education for the Economy and Development of the Operational Programme Science Education Development 2014–2020.

1.3. Electronic Materials and Microsystem Technology Division

The research activity of the Division concentrates on optoelectronics (e.g., measuring systems using fiber optic sensors), and hybrid technologies and the development of wide bandgap semiconductor technology in the design, modelling and manufacturing of microelectronic devices operating at high temperatures, including power semiconductor devices. Fundamental and applied research are carried out. Research groups are organised for defined tasks

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Michał Borecki, Ph.D., D.Sc.	Professor
Ryszard Kisiel, Ph.D., D.Sc.	Professor
Marcin Koba, Ph.D, D.Sc.	Assistant Professor
Piotr Firek, Ph.D.	Assistant Professor
Monika Janik, Ph.D.	Assistant Professor
Jerzy Kalenik, Ph.D.	Assistant Professor
Krystian Król, Ph.D.	Assistant Professor
Aleksander Werbowy, Ph.D.	Assistant Professor

Junior academic staff

Dariusz Burnat, M.Sc.	Ph.D. Student
Piotr Ciszewski, M.Sc.	Ph.D. Student
Tomasz Gabler, M.Sc.	Ph.D. Student
Maciej Kamiński, M.Sc.	Ph.D. Student, Assistant
Marek Kościelski, M.Sc.	Ph.D. Student
Norbert Kwietniewski, M.Sc.	Research Assistant
Agnieszka Martychowiec, M.Sc.	Ph.D. Student, Constructor
Emil Pituła, M.Sc.	Ph.D. Student, Constructor
Mehdi Raji, M.Sc.	Ph.D. Student
Oskar Sadowski, M.Sc.	Ph.D. Student
Jakub Sikora, M.Sc.	Ph.D. Student

Science, technical and administrative staff

Ryszard Biaduń
Bartłomiej Stonio, M.Sc.
Jakub Warszewski, M.Sc.

The main research areas are as follows:

- the use of graphene in the design of photodetectors for the far-infrared range with the electrical and optical characterization of graphene produced on different substrates, or a transferred onto the substrate;
- design, modelling, fabrication and characterization visible-blind UV photodetectors and radiation detectors based on wide bandgap semiconductors and heterostructures;
- the design, modelling, fabrication and characterization of power devices based on silicon carbide (SiC) technology including high voltage PiN diodes;
- the development of electrical characterization methods for the determination of energy distribution of traps in MOS and junction devices;
- designing, modelling and fabrication of microelectronic and optoelectronic devices using transparent dielectric and conductive oxides;
- fabrication and characterization of high-k dielectric layers;
- fabrication and investigation of the following optoelectronic devices: integrated passive and active light wave guiding

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structures (modulators, bistable switches etc.) and fibre optic sensors;
- computer engineering for fibre optics;
- new Surface Mount Technologies (SMT) on rigid, semi-rigid and fully flexible printed circuit boards (PCBs);
- application of thin and thick film technology in hybrid devices and thick film sensors fabrication;
- investigation of the electronic structure, stability and optical properties of amorphous silicon and its devices (thin film transistors, solar cells, etc.);
- design, fabrication and characterization of multi-junction photovoltaic cells with high energy efficiency;
- design and monitoring of photovoltaic systems, strategy for development of photovoltaics;
- electronic packaging technology including power devices;
- plasma deposition of nanocrystalline diamond (NCD), diamond-like carbon (DLC) thin films and their application in fibre optic and waveguide sensing structures;
- development of state-of-the-art power supplies and advanced power electronics for renewable energy conversion and storage, e-mobility, electric drives and vehicles, smart buildings, smart grids, smart city and military applications based on silicon carbide and gallium nitride power devices.

1.4. Microelectronics and Nanoelectronics Devices Division

The research carried out in the Microelectronics and Nanoelectronics Devices Division falls into three main areas: technology, diagnostics, modelling of semiconductor structures, and applications of microcontrollers.

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Lidia Łukasiak, Ph.D., D.Sc.	Professor
Jarosław Judek, Ph.D., D.Sc.	Research Assistant Professor
Jakub Jasiński, Ph.D.	Assistant Professor
Konrad Kiełbasiński, Ph.D.	Assistant Professor
Andrzej Mazurak, Ph.D.	Assistant Professor
Sławomir Szostak, Ph.D.	Assistant Professor
Jakub Walczak, Ph.D.	Assistant Professor
Agnieszka Zaręba, Ph.D.	Assistant Professor

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Mateusz Nieborek, M. Sc.	Ph.D. Student
Mirosław Puźniak, M.Sc.	Ph.D. Student
Piotr Różański, M. Sc.	Ph.D. Student
Yevgen Syryanyy, M.Sc.	Ph.D. Student

Technical and administrative staff

Witold Ciemiewski,
Kazimierz Dalbiak,
Krzysztof Krogulski

To name a few examples of its research topics:

- Fabrication of novel semiconductor, dielectric and conductive materials, including amorphous and transparent semiconductors and oxides, as well as high-k dielectric layers employing magnetron sputtering, ALD, or plasma techniques;
- Electrical (bulk properties, interface properties, contact properties, DC and high-frequency range, pulse measurements, charge-pumping) and structural characterization (surface properties, cross-section, chemical composition, and topography) of fabricated materials and periodic structures;
- Optimization of electrical and optical properties of fabricated materials using Design-of-Experiments (DoE) method to obtain tailored properties (transparency, reflection, etc.) of obtained layers that can be used in novel nanophotonic structures which possess tailorable and dynamically controllable spectral and angular optical properties;
- Integration and studies of two-dimensional (2D) and nanocrystalline materials in novel nanoelectronic and photonic devices;
- Design, modeling, and fabrication of nanophotonic periodic and metamaterial structures in thin- and ultra-thin regime (primarily planar hyperbolic metamaterials) based on novel semiconductor, dielectric, and conductive materials;
- Design and assembly of dedicated measurement tools, power supplies, and embedded systems with the integrated optoelectronic and photonic devices; SMD assembly and reliability tests;

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- Design autonomous nodes of wireless sensor networks such as smart mesh, smart dust, and IoT, using energy-harvesting technology;
- Hardware solutions of the problems with wireless short-range and long-range communication based on technologies and standards (NFC, HDX, FDX, EPC, Bluetooth, SubGHz, WiFi, GSM, ZigBee, and others in the 802.15.4 standard);
- Design, assembly, and programming customized, precise laboratory measurement devices;
- Wear-out and degradation processes in MOS/MIS structures and devices (breakdown of dielectrics layers, hot carriers effects, radiation damage effects);
- Advanced design and modeling of semiconductor and photonic structures using in-house software development capabilities based on well-established models of electromagnetic field interaction with matter;
- Transport mechanisms and quantum effects in MOS/MIS structures (transistors, memories, resonance, and tunnel diodes) with ultra-thin dielectric materials.

1.5. Optoelectronics Division

The main activity of the Optoelectronics Division is concentrated on research and education in all major areas of optoelectronics. This covers, in particular, the fields of laser physics and laser technique, laser spectroscopy, fiber-optic communication and sensing, microwave photonics, 2-D and 3-D image processing, photovoltaics, as well as integrated photonics (including photonic integrated circuits). In all of these fields the Optoelectronic Division offers top-level research expertise of the staff complemented with state-of-the-art research laboratories.

Head of the Division

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Muhammad Ali Butt, Ph.D.	Research Assistant Professor
Bartosz Fetliński, Ph.D.	Research Assistant Professor
Piotr Garbat, Ph.D.	Assistant Professor
Anna Jusza, Ph.D.	Assistant Professor
Andrzej Kaźmierczak, Ph.D.	Research Assistant Professor
Krzysztof Madziar, Ph.D.	Assistant Professor
Agnieszka Mossakowska-Wyszyńska, Ph.D.	Assistant Professor
Stanisław Stopiński, Ph.D.	Assistant Professor
Marek Sutkowski, Ph.D.	Assistant Professor
Agnieszka Szymańska, Ph.D.	Assistant Professor
Anna Tyszka-Zawadzka, Ph.D.	Assistant Professor
Piotr Warda, Ph.D.	Assistant Professor
Piotr Witoński, Ph.D.	Assistant Professor

Junior academic staff

Krzysztof Anders, M.Sc.	Assistant
Aleksandra Bieniek, M.Sc.	Ph.D. Student
Paweł Bortnowski, M.Sc.	Ph.D. Student, Research Assistant
Dawid Budnicki, M.Sc.	Ph.D. Student
Krzysztof Czuba, M.Sc.	Ph.D. Student
Aleksandra Dzieniszewska, M.Sc.	Ph.D. Student
Maciej Fokt, M.Sc.	Ph.D. Student
Bartosz Janaszek, Ph.D.	Research Assistant
Mateusz Kałuża, M.Sc.	Ph.D. Student
Marcin Kieliszczyk, M.Sc.	Ph.D. Student, Research Assistant
Marcin Kowalczyk, M.Sc.	Ph.D. Student
Łukasz Kozłowski, M.Sc.	Research Assistant
Marcin Lelit, M.Sc.	Ph.D. Student
Filip Łabaj, M.Sc.	Ph.D. Student
Andrzej Połatyński, M.Sc.	Ph.D. Student
Muhammad Shahbaz, M.Sc.	Research Assistant

Science, technical and administrative staff

Mateusz Bieniek, M.Sc.
Aleksandra Paśnikowska, M.Sc.
Michał Żakowski, M.Sc.

The academic staff of the Division provides lectures in photonics fundamentals, laser physics and laser technique, laser spectroscopy, integrated optoelectronics, digital image processing, fiber-optic and microwave photonics and photovoltaics not only to the students of the Faculty of Electronics and Information Technology, but also supporting Faculty of Physics and Faculty of Mechatronics. The lectures

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are provided in Polish and/or English and are accompanied by top-level laboratory classes.

The main research topics of the Optoelectronic Division covers:

- photonic integrated circuits for applications in telecom, datacom and sensing;
- design and development of solid state lasers and amplifiers (especially fiber lasers and amplifiers);
- new materials for optoelectronics, which includes spectroscopic investigations of novel rare-earth doped crystals and glasses emitting in UV-VIS-NIR-MIR spectral range, nanocomposites, plasmonic structures, metamaterials etc.;
- theoretical investigations of laser action in planar, fiber and hollow waveguide lasers, analysis of light generation in DFB (distributed feedback) structures, metamaterials, plasmonic and photonic crystals structures, investigation of the statistical properties of the light generated in various laser structures;
- 2-D and 3-D multispectral image analysis and processing;
- terahertz imaging;
- microwave technique and microwave photonics – measurement techniques, modelling and computer aided design of microwave devices and circuits, optical-microwave frequency conversion processes, optoelectronic and microwave devices for data transmission networks;
- photovoltaic systems and applications.

1.6. VLSI Engineering and Design Automation Division

The research carried out in the division falls into several main areas: development of IC design methodologies and tools, design of digital and analog integrated circuits for nonstandard demanding applications, investigations of new devices and circuits for future generations of microelectronic systems.

Head of the Division

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Andrzej Pfitzner, Ph.D., D.Sc.	Professor
Tomasz Borejko, Ph.D.	Assistant Professor
Zbigniew Jaworski, Ph.D.	Assistant Professor
Dominik Kasprowicz, Ph.D.	Assistant Professor
Arkadiusz Łuczyk, Ph.D.	Assistant Professor
Marek Niewiński, Ph.D.	Assistant Professor
Krzysztof Siwiec, Ph.D.	Assistant Professor
Andrzej Wielgus, Ph.D.	Assistant Professor
Adam Wojtasik, Ph.D.	Assistant Professor

Junior academic staff

Andrzej Berent, M.Sc.	Ph.D. Student
Adam Borkowski, M.Sc.	Ph.D. Student
Konrad Bruliński, M. Sc.	Assistant
Bartosz Dec, M.Sc.	Assistant
Marika Grochowska, M.Sc.	Ph.D. Student
Paweł Pieńczuk, M.Sc.	Ph.D. Student
Andrzej Wojciechowski M.Sc.	Ph.D. Student

Science, technical and administrative staff

Igor Butryn, M.Sc.
Stanisław Jeszka, M.Sc.
Marcin Ludwiniak, M.Sc.
Kamil Stępniewski, M.Sc.

Current research projects in the Division include:

- methodologies of integrated circuit design for manufacturability: application of statistical process and device simulation in IC design, investigations of spatial on-chip correlation of random process disturbances, analysis of layout sensitivity to spot defects;
- development of CAD tools for integrated circuit design and verification, with special emphasis on analog full custom ASICs design;
- design of digital, analog and mixed signal VLSI circuits for special applications such as microprocessors, Global Navigation Satellite Systems, innovative AD converters, data processing in physical experiments and medical equipment, RF front ends for wireless data transmission etc.;
- modelling and control of leakage currents in nanometer digital circuits;
- investigations and development of new VESTIC microelectronic technology.

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1.7. Statistical Data

SPECIFICATION	2021	2022	DIFFERENCE
Academic staff	**87**	**92**	**+5**
Tenured professors	8	9	+1
Professors	9	8	-1
Assistant professors	29	35	+6
Senior lecturers	7	0	-7
Assistants	4	8	+4
Ph.D. Students	30	32	+2
Science, Technical and Administrative staff	**26**	**26**	**0**
Teaching activities	**75**	**82**	**+7**
Basic courses	43	41	-2
Advanced courses	21	22	+1
Special courses	11	19	+8
Degrees awarded	**34**	**30**	**-4**
D.Sc. degrees	0	0	0
Ph.D. degrees	1	3	+2
M.Sc. degrees	9	4	-5
B.Sc. degrees	24	23	-1
Research projects	**31**	**27**	**-4**
Granted by the University	18	16	-2
Granted by State Institutions	11	10	-1
Granted by International Institutions	2	1	-1
Publications	**84**	**139**	**+55**
Sci.-tech. books	3	0	-3
Sci.-tech. papers in journals	65	85	+20
Sci.-tech. papers in conference proceedings	16	54	+38
Patents	**6**	**0**	**-6**
Reports	**55**	**87**	**+32**
Conferences	**9**	**24**	**+15**
Awards	**8**	**16**	**+8**

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Microelectronics and Nanoelectronics Devices Division

2. STAFF

2.1. Senior Academic Staff

Romuald B. Beck, M.Sc. ('76), Ph.D. ('82), D.Sc. ('96), Microelectronics, Electronics, Tenured Professor, full time, Head of Microelectronics and Nanoelectronics Devices Division ('04–'21), Leader of the Technology, Diagnostics and Modelling Group ('85–), Vice President of the Microelectronics Section of the Electronics and Telecommunication Committee of the Polish Academy of Sciences ('93–'08), Member od Programme Committee of: Diagnostics & Yield Conference ('88–), Member of the Faculty Council ('96–), Co-chairman ('03–), Chairman ('06); Member of Programme Committee of ELTE ('84, '04, '07, '13), Member ('05–'13) and Vice-Chair of Technical Programme Committee ESSDERC'2019, Senior Member of IEEE ('97–'06), Head of CEZAMAT Project Office ('08–'12), Vice-President for Scientific Affairs of CEZAMAT PW Ltd ('12–), Vice-Director for Scientific Affairs of CEZAMAT (,16–), WUT Rector's Collective Award for Scientific Achievements ('06, '08,'12, '19).

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Michał Borecki, M.Sc. ('91), Ph.D. ('96), D.Sc. ('11), Electronics, Optoelectronics, Sensor Devices, Professor, full time, Electronic Materials and Microsystem Technology Division, Member of Scientific Committee of Sensordevices Conference ('12–), Member of Optoelectronics Section of the Electronics and Telecommunication Committee of the Polish Academy of Sciences ('99–), Member of Association of Polish Electrical Engineers SEP ('99–), Member of Photonics Society of Poland ('08–), Member of the Faculty Council ('11–).

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Muhammad Ali Butt, M.Sc. ('10), Ph.D. ('15) at Universitat Rovira i Virgili, Spain, Research Assistant Professor, full time, Optoelectronics Division, Visiting scholar at Optoelectronics Research Centre (ORC) University of Southampton U.K. ('13), Research Assistant Professor at Nicolaus Copernicus University Poland ('18–'19), Senior Scientist at Samara National Research University Russia ('15––'20), WUT Rector's Collective Award for Scientific Achievements ('22).

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Tomasz Borejko M.Sc. ('03) with distinction, Ph.D. ('13) with distinction, Microelectronics and VLSI Design, Assistant Professor, half time, VLSI Engineering and Design Automation Division, Member of the "DDECS" Programme Committee (IEEE Symposium on Design and Diagnostics of Electronic Circuits and Systems) ('12–).

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Piotr Firek, M.Sc. ('04), Ph.D. ('10), Microelectronics, Electron Technology, Thin Films, Sensors, Assistant Professor, full time, Electronic Materials and Microsystem Technology Division, WUT Rector's Collective Award for Scientific Achievements ('08,'09,'11), WUT Rector's Individual Award for Scientific Achievements in ('11), Conference Diagnostics & Yield Award with distinction ('09), VII Science Conference ELTE Award with distinction of ('10), Member of IMAPS Poland Chapter ('11–) and PTTS – Polish Society of Sensor Technology ('12–), Associate Dean for Academic Affairs of the Faculty of Electronics and Information Technology WUT ('20–), WUT Rector's Collective Award for Didactic Achievements in the 2019/2020 Academic Year (1st stage) ('21), WUT Rector's Collective Award for Organizing Achievements ('22).

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Monika Janik, B.Eng. ('14), M.Sc. ('15) in Biotechnology from the Wroclaw University of Science and Technology, Poland. Ph.D. ('19) with distinctions in Science and Information Technology (specialization: photonics) from Photonics Research Center, University du Quebec en Outaouais, Canada as a part of the Industrial Research Chair project. Optoelectronics: optical fiber sensors and biosensors, optical resonance devices, micro-interferometers, fs laser micromachining. Biomedical sensing technologies designing, sensors' surface modifications. Assistant Professor, half time, Electronic Materials and Microsystem Technology Division. Award with a research project funded by National Science Center, Poland, under the "MINIATURA" program ('19), Laureate of the START 2021 Program of the FNP Foundation for Polish Science, WUT Rector's Collective Award for Scientific Achievements (1st stage) ('21).

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Zbigniew Jaworski, M.Sc. ('90), Ph.D. ('97), Microelectronics, Assistant Professor, full time, VLSI Engineering and Design Automation Division, Minister's of Education and Science Team Prize ('06), Medal of National Education Commission ('19), Member of the Faculty Council ('20–).

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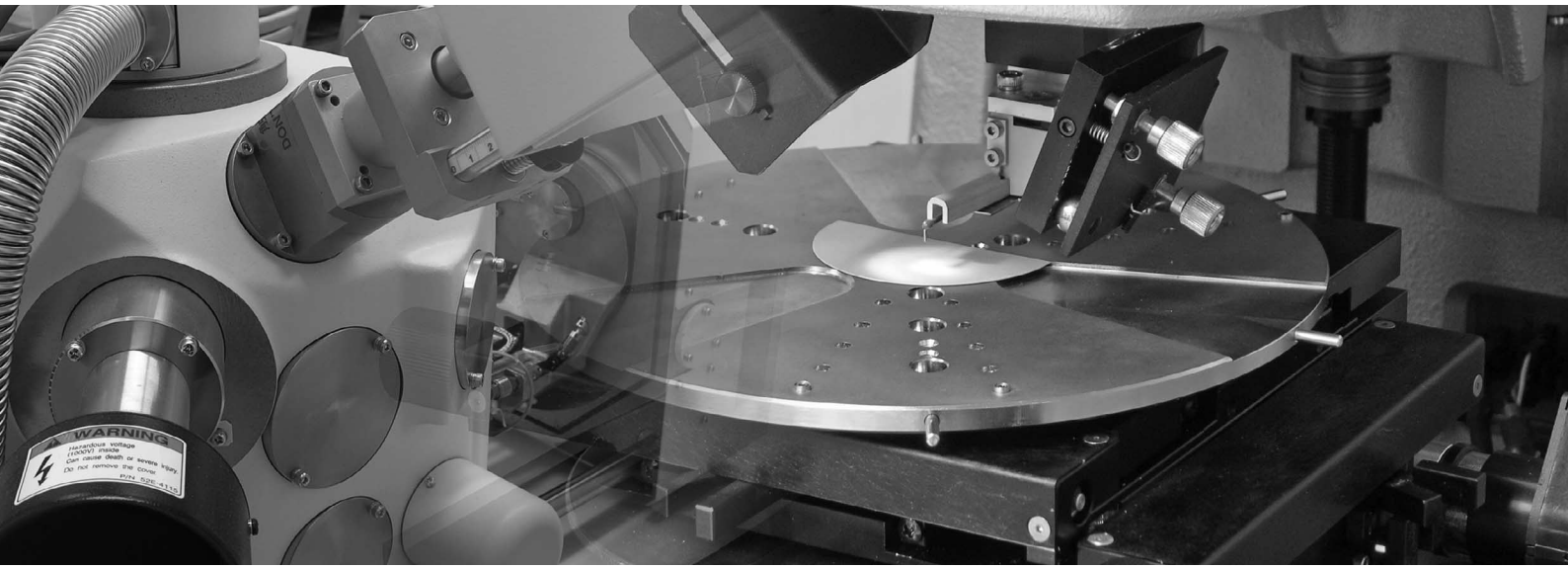

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VLSI Engineering
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3. TEACHING ACTIVITIES

3.1. Basic Courses

[Edu1] **AISDE, Algorithms and Data Structures** (Algorytmy i struktury danych), Adam Wojtasik

[Edu2] **APIOS, Programming for mobile Apple iOS and MacOS X** (Programowanie dla systemów: mobilnego iOS oraz MacOS X), Adam Wojtasik

[Edu3] **ELFO, Photonics elements** (Elementy Fotoniczne), Ryszard Piramidowicz

[Edu4] **ELIU, Electronic Elements and Circuits** (Elementy i układy elektroniczne), Andrzej Pfitzner, Agnieszka Zaręba

[Edu5] **ELIUL, Electronic Elements and Circuits – Laboratory** (Elementy i układy elektroniczne – laboratorium), Andrzej Pfitzner, Agnieszka Zaręba

[Edu6] **ESO, Optoelectronic Devices and Systems** (Elementy i systemy optoelektroniczne), Marcin Kaczkan

[Edu7] **FOS, Fiber Optics** (Fotonika światłowodowa), Ryszard Piramidowicz

[Edu8] **FOT, Fundamentals of Photonics** (Podstawy fotoniki), Michał Malinowski

[Edu9] **FPEF, Semiconductor Physics in Electronics and Photonics** (Fizyka półprzewodników w elektronice i fotonice), Piotr Firek, Agnieszka Zaręba

[Edu10] **FPPI, Physical Fundamentals of Information Processing** (Fizyczne podstawy przetwarzania informacji), Jan Szmidt, Agnieszka Zaręba

[Edu11] **LFPEF, Semiconductors Physics in Electronics and Photonics – Laboratory** (Laboratorium fizyki półprzewodników w elektronice i fotonice), Agnieszka Zaręba

[Edu12] **LKP, Fundamentals of Lasers** (Lasery – kurs podstawowy), Paweł Szczepański

[Edu13] **LPPP, Introduction to Semiconductor Devices – Laboratory** (Laboratorium podstaw przyrządów półprzewodnikowych), Jakub Jasiński, Konrad Kiełbasiński, Agnieszka Zaręba

[Edu14] **MAKO, Materials and constructions** (Materiały i konstrukcje) Ryszard Kisiel, Marcin Myśliwiec, Aleksander Werbowy

[Edu15] **MZMO, Application of Matlab in Calculation Methods** (Matlab w zastosowanych metodach obliczeniowych), Krystian Król

[Edu16] **OZT, Integrated Optoelectronics** (Optoelektronika zintegrowana), Michał Malinowski, Agnieszka Mossakowska-Wyszyńska, Ryszard Piramidowicz

[Edu17] **PADS, Computer-Aided Design of Printed-Board Circuits** (Projektowanie obwodów drukowanych), Jerzy Kalenik

[Edu18] **PAPRO, Programming Paradigms** (Paradygmaty programowania), Dominik Kasprowicz, Adam Wojtasik

[Edu19] **PELEL, Fundamentals of Electronic Devices and Circuits** (Podstawy elementów i układów elektronicznych), Sławomir Szostak, Lidia Łukasiak

[Edu20] **PMIK, Programming microcontrollers in C language** (Programowanie mikrokontrolerów w języku C), Sławomir Szostak

[Edu21] **PMK, Introduction to Microelectronics** (Podstawy mikroelektroniki), Andrzej Pfitzner

[Edu22] **POCY, Fundamentals of Digital Circuits** (Podstawy techniki cyfrowej), Andrzej Wielgus, Elżbieta Piwowarska

[Edu23] **POMAK, Fundamentals of materials and constructions** (Podstawy materiałów i konstrukcji), Piotr Firek, Jerzy Kalenik

[Edu24] **POMIK, Introduction to Microcontrollers** (Podstawy mikrokontrolerów), Jakub Jasiński

[Edu25] **PP, Semiconductor Devices** (Przyrządy półprzewodnikowe), Lidia Łukasiak, Agnieszka Zaręba

[Edu26] **PPP, Introduction to Semiconductor Devices** (Podstawy przyrządów półprzewodnikowych), Lidia Łukasiak, Agnieszka Zaręba, Sławomir Szostak

[Edu27] **PROO, Object-Oriented Programming** (Programowanie obiektowe), Dominik Kasprowicz

[Edu28] **PROS, Structured Programming** (Programowanie strukturalne), Michał Borecki

[Edu29] **PWJC, Fundamentals of modern C++** (Podstawy współczesnego języka C++), Marek Niewiński

[Edu30] **SCK, Digital and Computer Systems** (Systemy cyfrowe i komputerowe), Arkadiusz Łuczyk, Elżbieta Piwowarska

[Edu31] **SOE, Operating Systems** (Systemy operacyjne), Andrzej Wielgus

[Edu32] **TELFO, Electronic and Photonic Technologies** (Technologie elektroniczne i fotoniczne), Romuald Beck, Piotr Firek

[Edu33] **TEOP, Ligthwave Telecommunication** (Telekomunikacja optofalowa), Agnieszka Szymańska

[Edu34] **TMIK, Fundamentals of Microprocessor Techniques** (Podstawy techniki mikroprocesorowej), Lidia Łukasiak

[Edu35] **TWCZ, Fundamentals of Microwave Engineering** (Podstawy techniki w.cz.), Jerzy Piotrowski

[Edu36] **USUX, Introduction to the UNIX System** (Użytkowanie systemu UNIX), Andrzej Wielgus

[Edu37] **WDOF, Introduction to Photonics** (Wstęp do fotoniki), Michał Malinowski, Ryszard Piramidowicz, Anna Jusza, Stanisław Stopiński, Krzysztof Anders

[Edu38] **WINF, Introduction to Computer Science** (Wstęp do Informatyki), Michał Borecki, Dominik Kasprowicz, Marek Niewiński, Andrzej Wielgus, Adam Wojtasik

[Edu39] **WMS, Introduction to Microsystems** (Wstęp do mikrosystemów), Andrzej Mazurak, Robert Mroczyński

[Edu40] **WNUM, Introduction to Numerical Methods** (Wstęp do metod numerycznych), Krystian Król

[Edu41] **WPROJ, Preliminary project** (Projekt wstępny), Andrzej Mazurak

3.2. Advanced Courses

[Edu42] **ASO, Semantic Image Analysis** (Analiza semantyczna obrazu), Piotr Garbat

[Edu43] **FUS, Photonic integrated circuits** (Fotoniczne układy scalone), Ryszard Piramidowicz, Anna Jusza, Krzsztof Anders, Stanisław Stopiński

[Edu44] **IPEF, Integration of Electronic and Photonic Devices** (Integracja przyrządów elektroniki i fotoniki), Robert Mroczyński

[Edu45] **KROMF, Development Trends in Microelectronics and Photonics** (Kierunki rozwoju mikroelektroniki i fotoniki), Jan Szmidt, Paweł Szczepański, Tomasz Skotnicki

[Edu46] **MEF, Mathematical Methods in Electronics and Photonics** (Metody matematyczne w elektronice i fotonice), Andrzej Pfitzner, Agnieszka Mossakowska, Dominik Kasprowicz

[Edu47] **MMC, Monte Carlo Methods** (Metody Monte Carlo), Dominik Kasprowicz, Marek Niewiński

[Edu48] **NAN, Nanotechnologies** (Nanotechnologie), Jan Szmidt, Aleksander Werbowy

[Edu49] **OBRO, Computational Imaging** (Obrazowanie obliczeniowe), Piotr Garbat

[Edu50] **PAUS, Integrated Analog Circuit Design** (Projektowanie analogowych układów scalonych), Krzysztof Siwiec, Tomasz Borejko

[Edu51] **PSSV, VLSI System Design** (Projektowanie systemów scalonych w technice VLSI), Zbigniew Jaworski

[Edu52] **SEN, Sensors** (Czujniki), Mateusz Śmietana, Marcin Koba, Monika Janik

[Edu53] **SSCV, Digital VLSI Systems** (Scalone systemy cyfrowe VLSI), Zbigniew Jaworski, Elżbieta Piwowarska

[Edu54] **SVR, VR and AR Systems** (Systemy wirtualnej i wzbogaconej rzeczywistości), Piotr Garbat

[Edu55] **SWIZ, 3D Vision Systems** (Systemy wizji 3D), Piotr Garbat

[Edu56] **SYWIZ, Vision Systems** (Systemy wizyjne), Piotr Garbat

[Edu57] **TSP, Spectroscopic Methods** (Techniki spektroskopowe), Michał Malinowski

[Edu58] **UMFO, Machine Learning in Image Photonics** (Uczenie maszynowe w fotonice obrazowej), Piotr Garbat

[Edu59] **ZEUS, Zero-power Electronics for Self-supplied IOT Sensors** (Elektronika o zerowym poborze energii dla układów samozasilających IOT), Tomasz Skotnicki

[Edu60] **ZOUL, Photonic Integrated Circuits for Optical Logic** (Zintegrowane optoelektroniczne układy logiczne), Michał Malinowski, Agnieszka Mossakowska-Wyszyńska

[Edu61] **ZPB, Joint Research Project** (Zespołowy projekt badawczy), Robert Mroczyński

[Edu62] **ZPDM, Advanced Multimedia Signal Processing** (Zaawansowane przetwarzanie danych multimedialnych), Piotr Garbat

[Edu63] **ZUKO, Radio Frequency Integrated Circuits** (Zintegrowane układy do komunikacji bezprzewodowej), Tomasz Borejko

3.3. Courses in English

[Edu64] **EELE1, Electronics 1**, Bogdan Majkusiak, Jakub Walczak, Andrzej Mazurak

3.4. Courses for other Faculties

[Edu65] **FPTUZ, Physical Basis of Information Transmission and Storage, WUT Distance Learning Center** (Fizyczne podstawy transmisji i przechowywania informacji, Ośrodek Kształcenia Na Odległość PW), Agnieszka Szymańska

[Edu66] **LFO, Laboratory of Photonics, Faculty of Physics** (Laboratorium fotoniki, Wydział Fizyki), Ryszard Piramidowicz

[Edu67] **PFZ, Principles of Physics, WUT Distance Learning Cente**r (Podstawy Fizyki, Ośrodek Kształcenia na Odległość PW), Agnieszka Szymańska

[Edu68] **POBZ, Object-Oriented Programming, WUT Distance Learning Center** (Programowanie obiektowe, Ośrodek Kształcenia Na Odległość PW), Piotr Witoński

[Edu69] **TINZ, Internet Techniques, WUT Distance Learning Center** (Techniki internetu, Ośrodek Kształcenia Na Odległość PW), Piotr Witoński

[Edu70] **TL, Laser Technology, Faculty of Mechatronics** (Technika laserów, Wydział Mechatroniki), Ryszard Piramidowicz

[Edu71] **TL, Laser Technology, Faculty of Physics** (Technika laserów, Wydział Fizyki), Ryszard Piramidowicz

[Edu72] **TOZ, Lightwave Telecommunications, WUT Distance Learning Center** (Telekomunikacja optofalowa, Ośrodek Kształcenia Na Odległość PW), Krzysztof Madziar

[Edu73] **TTSZ, Signal Transmission Technology. WUT Distance Learning Center** (Technika transmisji sygnałów, Ośrodek Kształcenia Na Odległość PW), Krzysztof Madziar

[Edu74] **ZJ1Z, Laboratory 1 – Introduction to Information Technologies, WUT Distance Learning Center** (Zjazd 1 – Podstawy technologii informacyjnej, Ośrodek Kształcenia Na Odległość PW), Krzysztof Madziar

[Edu75] **ZJ4Z, Laboratory 4 – Advanced Specialization Laboratory, WUT Distance Learning Center** (Zjazd 4 – Zaawansowane laboratorium kierunkowe, Ośrodek Kształcenia Na Odległość PW), Agnieszka Szymańska

3.5. Courses in English for other Faculties

[Edu76] **FOC, Fiber Optic Communication Systems, Faculty of Physics**, Ryszard Piramidowicz

[Edu77] **LT, Laser Technique, Faculty of Mechatronics**, Ryszard Piramidowicz

[Edu78] **LT, Laser Technique, Faculty of Physics**, Ryszard Piramidowicz

[Edu79] **OFT, Optical Fiber Technology, Faculty of Mechatronics**, Ryszard Piramidowicz

[Edu80] **PIC, Photonic Integrated Circuits, Faculty of Physics**, Ryszard Piramidowicz

[Edu81] **PTIA, Photographic Techniques in Image Acqusition, Faculty of Mechatronics**, Marek Sutkowski

[Edu82] **SOP, Semiconductor Optoelectronics, Faculty of Physics**, Paweł Szczepański

4. RESEARCH PROJECTS

Project definitions and descriptions – prepared by Project Leaders.

4.1. Projects Granted by the University

[Pro1] **Analysis of the posture of female soccer players, participating in the Polish Women' Extraleague** (Analiza postawy zawodniczek uprawiających piłkę nożną kobiet, uczestniczących w rozgrywkach Ekstraligi Kobiet PZPN, Inżynieria Biomedyczna), project leader: Marek Sutkowski, May 2021–November 2022

This work will be the results of measurements of the posture of young female soccer players and its analysis in two planes from the back in relation to the evaluation and diagnosis of compensation processes of the spine. Photogrammetric measurements allow to determine a 3D coordinates of selected anatomical points. The evaluation and analysis of posture changes is based on the set of vectors calculated from measurements results. Additionally, the horizontal vector will be analysed.

[Pro2] **Application of the terahertz spectroscopy to the investigation of the charge transport phenomena occurring in the electroactive materials** (Zastosowanie spektroskopii terahercowej w badaniu transportu ładunku w materiałach elektroaktywnych, Energytech 2 IDUB), project leader: Marcin Kaczkan, co-workers: Bartosz Fetliński, Piotr Garbat, January 2021–October 2022

The project concerns the use of terahertz spectroscopy for the study on charge carriers transport, which is one of the phenomena responsible for the operation of galvanic and fuel cells. Terahertz spectroscopy will be directly used to analyze changes in the basic parameters of electrochemical processes, e.g. the mobility of charge carriers. The project is realized in the collaboration of three research groups originating form three Faculties of Warsaw University of Technology. In addition to that an international partner DTU Energy Department of Energy Conversion and Storage, Technical University of Denmark will provide competencies in quantum mechanics-based modelling of the investigated systems. Finally, the outcome of the project will prove the applicability of the terahertz spectroscopy to the direct observation of the charge transport phenomena in the electrochemical systems and with the positive results achieved will open a new approach allowing for their characterization and optimization.

[Pro3] **Arrays of diffractive optical elements for applications in optical interface systems of photonic integrated circuits** (Macierze elementów dyfrakcyjnych do zastosowań w układach interfejsów optycznych układów scalonych, Fotech 2 IDUB), project leader: Andrzej Kaźmierczak, co-workers: Krzysztof Anders, Ryszard Piramidowicz, Stanisław Stopiński, January 2021–December 2022

This project aims on development of an innovative solution for the photonic integrated circuits (PICs) optical interfacing, requiring an efficient optical coupling mechanism between single-mode optical fibers (typically used in telecommunications and sensory systems) and strip waveguides of a semiconductor PIC. Typically this interface is implemented by using lensed or tapered fibers or by equipping PIC input waveguides with spot size converters. In each solution, bringing optical fibers close to the PIC facet ($<1\,\mu$m) is necessary. This is detrimental in a majority of real cases, limiting the PIC designer freedom and complicating design of PICs equipped with multiple optical ports (especially in the case of angled output waveguides, implemented to avoid parasitic reflections from the end facet).

This project assumes the use of properly designed diffraction optics elements (in the form of micro-optical diffraction elements arrays) constituting the interface between the SMFs array and PIC waveguides. The proposed solution ensures the proper distance between the optical interface and the PIC facet ($>200\,\mu$m), while maintaining the acceptable optical coupling efficiency.

Diffraction elements are used to accurately depict the SMF cross-section of 5–9 μm diameter on the integrated waveguide face (having rectangular 2.0 μm $\times$ 0.32 μm cross-section). Consequently individual diffraction elements diameters are comparable with their distances from PIC and fiber array. Therefore, diffraction deflections are large, implicating the need of accurate off-axis design approach.

Designed diffraction elements will be produced using electron beam lithography allowing components shape 3D mapping with nanometer precision. Fabricated structures operation will be verified by implementing them in the PIC optical interface and checking the signal coupling efficiency and distance between PIC facet and the diffractive elements matrix.

[Pro4] **Development of an innovative technology for PVD deposition of a multilayer, nanocomposite transistor gate** (Opracowanie innowacyjnej technologii osadzania wielowarstwowej, nanokompozytowej bramki tranzystora metod[1] PVD), project leader: Piotr Firek, May 2022–December 2023

The goal of the project is to confirm the hypothesis that the prepared transistor with multuilayer gate will be selective to various gases and can also be used as a biosensor. It is planned to perform a number of technological processes leading to obtaining multilayer structures with a different number and thickness of palladium and carbon layers. In next step transistors will be tested in terms of their response to gas and the possibility of their biological activation.

[Pro5] **Development of optical interfaces for silicon-nitride-based photonic platform** (Rozwój interfejsów optycznych dla platformy fotonicznej na bazie azotku krzemu), project leader: Krzysztof Anders, co-workers: Mateusz Słowikowski, Marcin Lelit, Romuald Beck, Stanisław Stopiński, Ryszard Piramidowicz, January 2022–December 2023

Photonic Integrated Circuits (PICs) are considered as one of the most promising photonic technologies for biological sensors, environmental sensors, data- and telecoms and quantum engineering applications. One of the key challenges in the development of any photonic platform (including SiN platform developed by IMiO and CEZAMAT), is to develop low loss input/output interfaces for PICs. In commercial photonic platforms, these interfaces are designed depending on the parameters of a given platform, such as signal wavelength, waveguide refractive indices, waveguide cross-sections, available fabrication technologies and design rules resulting from their limitations, and system application and configuration. Interfaces are not standardized, and, for each new platform, it is necessary to go through the whole development path.

The project is part of the platform development. The scope of R&D work in the project includes numerical simulations, design and fabrication and characterization of two types of interfaces:

1. Spot Size Converters (SSCs) operating over a wide spectral range and with low polarization loss.

2. advanced Grating Couplers (GCs), operating vertically, out of plane of the PICs, selective in the wavelength domain and sensitive to polarization, containing additional reflective structures improving their efficiency.

The project has been created as a result of intertnal research of IMiO and CEZAMAT, as well as preimplementation work carried out in the project under "Innovation Incubator 4.0". The work to date has included a full development cycle of waveguide elements, optical power loggers and AWG de-/multiplexers, and attempts have been made to integrate photonic circuits with microfluidic circuits. The first phase of work is summarized in reviewed a paper ("Passive photonic integrated circuits elements fabricated on a silicon nitride platform" (MDPI Materials – 140 pts, in preparation).
The results so far were presented at national and international conferences (European Conference on Integrated Optics, Integrated Optics – Sensors, Sensing Structures and Methods, Krajowa Electronic Conference). Extending the library of platform elements developed at IMiO and CEZAMAT will allow producing circuits prepared for direct integration with external semiconductor light sources, detectors and direct integration in sensors, as well for the use of optical fibers with modal profiles tailored to the designed interfaces.

The silicon nitride platform, developed by IMiO and CEZMAT, features transparency over a wide spectral range (from VIS to MIR) and is an attractive alternative to SOI and InP platforms, especially in the area of sensor and biomedical applications.

Teams from IMiO and CEZAMAT cooperate with industry, such as: VIGO Systems S.A., Centrum Badań I Rozwoju Technologii dla Przemysłu S.A. and Orange Polska S.A. An expression of the commitment of industry and business to the development of integrated photonics platforms is also the project Techmatstrateg MIRPIC, in which both units of the Warsaw University of Technology participate, and the leader is VIGO System S.A.

[Pro6] **Development, fabrication and characterization of HBT phototransistor test structures for the UV detection with limited sensitivity to the visible spectrum range** (Opracowanie, wytwarzanie i charakteryzacja struktur testowych fototranzystorów HBT do detekcji promieniowania UV o ograniczonej czułości na promieniowanie widzialne), project leader: Mariusz Sochacki, co-workers: Krystian Król, Norbert Kwietniewski, Aleksander Werbowy, January 2022––December 2023

Ultraviolet detectors have drawn many attention in the past decade due to the growing number of applications in the civil and military field. For the purpose of optical detection, photodiodes are commonly used due to their simply biasing and operation. However, all the types of usual photodiodes (PiN, Schottky or avalanche diodes), have some drawbacks, such as frequency performance limitations or, more importantly, the lack of internal amplification, which is significant in the detection process. The use of transistor structures instead will significantly simplify the design of electronic converters for the photoresponse conditioning.

The aim of the project is to fabricate a ZnO/4H-SiC heterojunction bipolar transistor (HBT) and to study its photosensitive properties within ultraviolet-visible spectrum range (UV-VIS). The selected material structure of the photodetector results from many years of experience in the implementation of semiconductor devices in silicon carbide technology and the investigation carried out successfully in recent years to analyse the ZnO/4H-SiC heterostructure in terms of photodetection properties in the UV range. Due to the significant area of high-tech and high-end applications, the resulting semiconductor structure is expected to be characterized by the highest possible sensitivity in the UV range and the lowest possible sensitivity in the visible range without the use of additional optical filtration. At the same time, the detector should have the shortest possible response time to fast-modulated radiation intensity and have dynamic characteristics allowing for operation in the impulse mode.

The research carried out within the project will be divided into four main parts: modelling of epitaxial structures of 4H-SiC, construction of the device, technology and characterization of the fabricated device. Modelling the parameters of the structure prior to ordering fully customized 4H-SiC wafers is becoming one of the basic elements contributing to the success of the project as it can completely eliminate all potential mistakes at the design stage. After developing the topography of the photo-HBTs and test structures, the whole technology will be divided into individual steps of photolithography along with a description of all processes required to make the photo-HBTs. The most important part of the research plan is comprehensive characterization of electrophysical properties of individual layers of the epitaxial structure, and the output parameters of the photodetector, and their comparison with the results presented by other groups describing such structures in terms of the analysis of fundamental phenomena affecting the final quality and performance of the photosensitive detector under development.

[Pro7] **Diagnosis of skin cancer in the conditions of limited social mobility** (Diagnostyka zmian nowotworowych skóry w warunkach ograniczonej mobilności społecznej), project leader: Ryszard Piramidowicz, co-workers: Piotr Garbat, Anna Jusza, Krzysztof Anders, August 2020–February 2022

The freezing of social mobility for several months, implemented by the majority of governments as a method of stopping the migration of SARS-CoV-2 virus and focusing the effort of National Health Service on fighting against the COVID-19 pandemic, had dramatic side effects in the form of radical limitation of access to health care for patients affected by other diseases than COVID-19. In the case of malignant skin neoplasms, such as melanoma, a delay of several months in diagnostics allows the disease to develop into an advanced, difficult to treat or completely incurable form.

This project is an attempt to solve this problem by proposing a device supporting the early diagnosis of cancer threats, using advanced numerical methods to recognize dangerous skin lesions that require urgent specialist consultation.

The main goal of the project is to develop a new solution for a comprehensive automated skin analysis system and classification of changes based on multimodal image data and deep machine learning models. The system will allow the implementation of initial screening diagnostics of patients in conditions of limited access to specialists and is dedicated to complement the portfolio of diagnostic tools of family doctors, but also as a supporting tool of tele-medicine, allowing systematic monitoring and remote consultation of disturbing skin changes.

The project fits well not only in the theme of the IDUB against COVID-19 competition but also in the National Oncological Strategy.

[Pro8] **Fiber optic electro-optical modulator for studying electromagnetic interactions caused by high-energy laser radiation** (Światłowodowy modulator elektro-optyczny do badania oddziaływań elektromagnetycznych wywołanych wysokoenergetycznym promieniowaniem laserowym, grant AEE), project leader: Marcin Koba, co-worker: Mateusz Śmietana, July 2021–December 2022

The aim of the project is to develop a fiber optic lossy mode resonance sensor that is capable of indicating the level and fluctuation of the electromagnetic field (at radio or microwave frequencies) in systems with high-energy laser radiation.

[Pro9] **Hyperbolic metamaterials for enhancing energy yield of photovoltaic modules** (Zastosowanie metamateriału hiperbolicznego na potrzeby zwiększenia uzysku energetycznego modułów fotowoltaicznych), project leader: Bartosz Fetliński, co-workers: Bartosz Janaszek, Marcin Kieliszczyk, Robert Mroczyński, January 2022–December 2023

The aim of this project is to verify the feasibility of using hyperbolic metamaterials (HMM) as innovative coatings that allow the reduction of radiation heating of photovoltaic (PV) cells while ensuring antireflection properties in the spectral range useful for energy conversion. The main research assumption of the project is the statement that the structure with the above-mentioned properties will allow to increase the energy yield of the PV module by significantly reducing radiation heating, which is one of the dominant factors limiting the efficiency of energy conversion in PV cells. The proposed method is characterized by conceptual and implementational simplicity as well as high technological scalability (it can be used for any commercially available PV modules), which constitutes its significant competitive advantage over the previously proposed solutions that require significant interference in the cell or module structure. According to the preliminary theoretical research, a properly designed hyperbolic metamaterial can act as an edge filter, providing a unique possibility of simultaneously obtaining high transmission and strong reflection in the appropriate spectral ranges. In connection with the fact that so far hyperbolic metamaterials have not been used in the proposed application, the proposed project is characterized by high scientific innovation. The planned work will include a comprehensive theoretical analysis and preliminary experimental verification of the proposed metamaterial structures, which will be carried out in cooperation with renowned national research centers: the Institute of Microelectronics and Photonics of the Łukasiewicz research network (IMiF) and the Institute of Physics of the Polish Academy of Sciences (IFPAN). As part of the cooperation, prototype layers of component materials and HMM coatings will be fabricated and then structurally and optically characterized. It is also worth emphasizing that the use of hyperbolic metamaterial to increase energy yield from a PV module by limiting radiation heating is part of the current scientific research in the field of innovative optoelectronic elements and systems. In connection with the above, the results of the work carried out will be the subject of at least two publications in renowned scientific journals (Optics Express, Solar Energy) and conference announcements at international assemblies. The obtained results will also constitute the foundation for subsequent advanced research and the basis for applying for further funding under national programs. It should be emphasized that this research group has already published considerable achievements in highly scored magazines in the areas directly related to the subject of the proposed project.

[Pro10] **Inactivation of SARS-CoV-2 viruses using UV-C radiation from the surface of air filters** (Dezaktywacja wirusów SARS-CoV-2 za pomocą promieniowania UV-C z powierzchni filtrów powietrza, COVID-19 IDUB), project leader: Krzysztof Anders, co-worker: Ryszard Piramidowicz, April 2021–February 2022

The project deals with developing and creation of an air filtering mask with a plant fiber filter. The filtration process will be supported by the virus inactivation with the use of radiation from the UV-C spectrum. The research will be carried out in cooperation with the creator of the masks (built from the plant fibers) who is very interested in applying the technology of irradiating with the use of UV-C spectrum in order to increase the effectivity. The use of UV radiation in that case has two meanings. The first – more intuitive – is the virus inactivation on the surface of the filter. The second is generating photosynthesis of plants that the filter is built from.

Electromagnetic radiation in the UV-C spectrum allows virus inactivation. Inactivation occurs mainly by damaging the DNA chain (which causes the viruses to be unable to multiply) and consequently its decay.

During the implementation of the project an illuminator emitting UV-C radiation will be constructed and characterized. The illuminator is going to consist of LEDs and placed within the mask structure. Radiation (which is destructive for living organisms) will illuminate the outer part of the filter and a specially designed enclosure will not allow radiation to escape from the mask. The whole mask will be designed and made using 3D printing technology.

The efficiency of the technology will be tested at the design stage by a team of scientists working in the field of microbiology. During the tests a specific number of virus colonies will be generated on the surface of the mask. Then, the mask will be exposed to UV-C radiation and after a certain exposure time the impact of radiation on the number of virus colonies will be calculated. Using this methodology one will be able to optimize both radiation power and exposure time what is very important while optimizing the device costs and electricity consumption.

The use of UV-C illuminator technology will increase both the life of the mask and its efficiency.

The final result of the project will be development of a complete product which allows to increase the safety of mask users who have regular contact with a large number of people. Another measurable result of the project will be the development of air filtering technology with the use of a hybrid system consisting of filter + UV-C illuminator which can be implemented in many everyday applications.

[Pro11] **Influence of biological materials' charge on the functional parameters of opto-electrochemical biosensors** (Wpływ ładunku materiału biologicznego na parametry funkcjonalne światłowodowych biosensorów opto-elektrochemicznych), project leader: Monika Janik, May 2022–December 2023

To develop high-quality biosensing solutions, the ability to identify changes occurring at the sensor-biofilm-buffer surfaces and assess their impact on the obtained results are crucial, especially in sensing solutions utilizing the electrochemical (ECh) domain. Therefore, the aim of the project is to investigate the influence of the tested biological materials' charge on the functional parameters of opto-electrochemical optical fiber-based platforms, i.e., dual-domain lossy mode resonance (LMR) sensors. Various model biological materials and redox systems will be utilized. The immobilization of biological materials on LMR's surface in different configurations will be verified independently in optical and ECh domains and simultaneously with the LMR-ECh system developed by the team. All the planned actions will allow for determining the range of the introduced disturbances and their influence on the sensor's performance, e.g., detection limit.

[Pro12] **Novel glassy and nanocrystalline phosphors for white LED lighting safe for human vision** (Nowe szkliste i nanokrystaliczne luminatory do białego oświetlenia LED bezpiecznego dla ludzkiego wzroku, Fotech 2 IDUB), project leader: Bartosz Fetliński, January 2021–December 2022

Within the scope of the project it is planned to synthesize vitreous and nanostructured materials containing rare earth elements (REE) oxides and study their optical properties by several complementary methods. The optical and related physicochemical properties of the materials will be studied and reported in detail. The main practical goal of the project

is construction of a working prototype of a "natural" white LED light source based on a commercial near-UV/violet LED diode and a glassy/nanostructured phosphor, synthesized by us. The photoluminescent spectrum of this device should closely resemble that of the daylight, which is safe for sight. The research goal consists in explaining the major factors leading to white "natural" photoluminescence of the obtained materials.

Materials based on REE are widely used in many technology fields, e.g. in lighting industry as phosphors for white LEDs. Unfortunately, commonly used phosphors have a serious drawback. Their spectra substantially differ from that of the sunlight. In particular they contain a strong blue/violet component. This deviation from daylight is unhealthy for eyes and can even cause irreparable changes in human vision.

Recently, the research carried out by our group has shown that it is possible to synthesize Eu-doped glassy materials, whose photoluminescence spectra are smooth and close to that of daylight. We found out, that by controlling the synthesis parameters (time, temperature, atmosphere), one can modify the Eu3+/Eu2+ ions concentration ratio. As a result, one can optimize the spectra of the phosphors' photoluminescence and liken them to that of daylight. It is worth emphasizing that the used methods of glass synthesis (melt-quenching), but also nanocrystallization (resulting in nanostructured materials) are cheap, simple and reproducible.

Based on our previous experience, as part of the project, we plan to synthesize innovative glassy phosphors doped with selected REEs in strictly controlled conditions (atmosphere, temperature, time), which are crucial for oxidation states of these elements. Further, the process will be optimized to obtain a smooth photoluminescence spectrum resembling that of the natural daylight. The optical and physicochemical properties of the best samples will be comprehensively studied. The crowning of the project will be the construction of a prototype of a white "natural" LED based on a commercial LED (near-UV/violet) source with a glassy/nanostructured phosphor produced during this project.

Due to the widespread use of high-efficiency lighting with white "unhealthy" LEDs, the final results of this project have a great application potential, both in Poland and internationally.

[Pro13] **Plasmons and polariton on structured Surfaces of group IVb metal notrides** (Plazmony i polarytony na nanostrukturyzowanych powierzchniach azotków metali z grupy IVb), project leader: Jarosław Judek, co-workers: Mateusz Słowikowski, January 2022–December 2023

Group IVb metal nitrides, i.e., titanium nitride TiN, zirconium nitride ZrN and hafnium nitride HfN are well-known, extremely hard, thermally and chemically resistant conductive ceramics. However, they have been rediscovered recently due to previously rather ignored but very scientifically interesting plasmonic properties. The combination of plasmonic properties occurring in a wide spectral range, i.e., from below 400 nm to above 30 um, with such advantages as low production costs, resistance to high temperatures, and, importantly, compatibility with CMOS technology, makes metal nitrides from group IVb an interesting alternative to gold and silver – typical materials used in plasmonics today. The proposed project has two closely related goals. The first goal is to study the conditions of the deposition process and the plasmonic properties of titanium, zirconium, and hafnium nitrides resulting from the details of this process. The study of the interrelationship of the input parameters of the technological process with the obtained optical properties in the perspective of the application of nitride layers as plasmonic materials constitutes a signi cant scienti c challenge. The correlation of the phenomena during the formation of layers with the obtained plasmonic properties of the studied materials will be an important interdisciplinary research problem. It is worth emphasizing that these materials are interesting primarily due to their optical properties in the context of the proposed project. The second goal of the proposed project is research in the field of production and characterization of groove plasmonics nanograting, produced on the surface of plasmonic material as a series of parallel slits with an appropriately selected period, depth, and profile. The optical characterization of the produced structures is planned using the micro-re ectance technique, which is expected to allow both the determination of the plasmon propagation length and the observation of the photon-plasmon coupling. In order to demonstrate the maturity of the developed technology and the understanding of the physical

phenomena occurring on the structured surface, it is proposed to use the produced plasmonic diffraction grating as a substrate for the Surface Enhanced Raman Spectroscopy (SERS) experiment. As a probe, it is planned to use a single graphene layer grown by Chemical Vapor Deposition (CVD) and transferred to a structured plasmonc surface.

[Pro14] **Study on the charge transport mechanism and filament formation in Metal-Insulator-Metal (MIM) structures** (Badania mechanizmów transportu ładunków oraz formowania ścieżek przewodzących w strukturach typu metal-Izolator-Metal (MIM), Technologie-materiałowe-2 IDUB), project leader: Andrzej Mazurak, co-workers: Jakub Jasiński, Robert Mroczyński, January 2021–December 2022

The Resistive Random Access Memory (RRAM) devices are considered as a promising candidate to replace currently commercially available semiconductor memory devices. Due to its resistivity change process accumulative dynamics they are also used to implement the idea of a new generation computing, namely the neuromorphic computing. In the RRAM devices an insulator layer (or a multilayer stack of several insulator layers) is incorporated between the conductive electrodes. One RRAM device forms one memory cell, addressed with the outer electrodes of the device. The resistivity of the insulator layer is controlled by the bias implied to the electrodes, and thus a given logic state may be coded (set or erased). Several concepts of RRAM devices have been proposed and studied, however still there are several reliability issues that need to be addressed, e.g. the ones related to the limited switching speed or the retention time. The crucial subject that still remains not thoroughly understood is the mechanism of the resistivity modulation, which is the operation principle of such devices. In course of this project the effect of the electric field on the filament modulation (creation and reduction), and charge transport processes will be investigated. The study will be conducted for two types MIM (Metal-Insulator-Metal) structures: (1) the "classic" RRAIVI devices based on single- or periodical multi-layer insulators (several dielectric materials will be considered, and (2) the devices with metallic and semiconductor nanocrystals (NCs) incorporated in the insulator layer. The electrical and structural characterization will be conducted The idea of combining those two different and uncorrelated investigation techniques shall give insight into the effect of the electric field on the material structure and the obtained electrical parameters of the investigated devices. The project assumes the interdepartmental cooperation (the Faculty of Electronics and Information Technology and the Faculty of Material Science and Engineering) and it involves the contribution ofthree foreign scientific units. The knowledge gained with this project may lead in the future to additional studies related to neuromorphic (brain-inspired) computing in the hardware implementation context.

[Pro15] **System for measuring the noise parameters of mid-infrared photodetectors** (System do pomiarów parametrów szumowych fotodetektorów pracujących w zakresie średniej podczerwieni, Koło Naukowe Systemów Scalonych), project leader: Marek Niewiński, co-workers: Paweł Pieńczuk, Patryk Prusinowski, June 2021 – June 2022

"Application-Specific Photonic Integrated Circuits, ASPIC" are wildly used not only in telecommunications, but also in medicine or chemical composition analysis. The PIC market is still rapidly growing but mid-infrared solutions have not yet been standardized. During develop of such a system, it is very useful to know the noise characteristics of the detectors. Often they are characterized by noises lower than the sensitivity of basic spectrum analyzers, although still important from the point of view of the system operation. The main aim of this work is design, implement and test a dedicated a measuring adapter in the form of a PCB utilizing a low-noise amplifier (current or transimpedance). To achieve this, we plan to use dedicated commercially available integrated circuits, eg LTC6560, HMC799LP3E, LMH32401. Additionally due to use of the Raspberry Pi platform, the process of the characteristic measurement will be partly automated.

[Pro16] **The study of the robustness of GNSS positioning against signal disturbances** (Badania odporności pozycjonowania GNSS na zakłócenia sygnału, BEYOND POB), project leader: Krzysztof Siwiec, March 2021–February 2023

Global Satellite Navigation Systems (GNSS) are widely used positioning tools to monitor and navigate an object in space. The dynamic development of geoinformation technologies, in which the object location component is an essential element, also forces the continuous development and improvement of GNSS positioning algorithms and methods. As part of this development, one of the most critical elements is the broadly understood security of the use of GNSS positioning technology, in particular, to protect system users against malfunctions of the GNSS system caused by intentional (jamming, spoofing) and accidental (e.g. interference, navigation data errors) disturbances of measurement signals.

The proposed project's subject is related to the study of the robustness of the measurement data acquisition and processing algorithms to signal disturbances and the analysis of the impact of individual sources of disturbances on the positioning quality. As part of the project, it is planned to use a unique research infrastructure in the form of the GNSS Spirent GSSQOOO signal generator and the NaviSoC receiver by ChipCraft Sp. 2 0.0. (a spin-off company of the Warsaw University of Technology). The research tasks will include: analysis of the resistance of individual components of signal acquisition and positioning models to observation errors and disturbances in the operation of the GNSS systems; improvement and development of algorithms that increase the accuracy and reliability of GNSS positioning; development of methods of warning system users against its malfunctioning. The international research team, consisting of both specialists in the field of error analysis of GNSS observation and positioning models, as well as scientists in the field of electronics, telecommunications and the construction of GNSS receivers, will enable comprehensive research at the highest world level. The work will also result in developing a methodology for testing and metrological control of GNSS measurement systems. The planned effects can significantly increase the possibility of using GNSS technology in positioning applications requiring high accuracy and reliability.

4.2. Projects Granted by the Ministry of Science and Higher Education

[Pro17] **Biopolymer materials with chemically and genetically programmed heavy metal selectivity for new generation ultra-sensitive biosensors** (Materiały biopolimerowe o programowanej chemicznie i genetycznie selektywności do metali ciężkich dla ultraczułych biosensorów nowej generacji), TECHMATSTRATEG III, Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Mateusz Śmietana, co-workers: Monika Janik, Marcin Koba, Norbert Kwietniewski, Katarzyna Lechowicz, Emil Pituła, Jakub Warszewski, Kinga Kondracka, January 2021–December 2023

The project concerns research and development and pre-implementation work which will result in the development of an ultra-sensitive and mobile device allowing for simultaneous and rapid water detection of at least 8 different heavy metals using electrochemical and optical measurements. The device will be able to detect the presence of contaminants at the source of water intended for human consumption in accordance with the standards of permissible concentrations of heavy metals recommended, among others, by the WHO and the Ministry of Health. Its implementation on the market will allow for quick and precise analysis of drinking water contamination and, after proper preparation of the sample, the analysis of environmental and waste water. To ensure the success of the project implementation, three independent strategies were proposed to obtain biological receptor layer interacting selectively with heavy metals in the form of DNA aptamers, oligopeptides and modified GFPs. To create the final version of the device, allowing for rapid detection, these biomolecules will be selected from the above-mentioned three types of biological elements, which will provide the highest stability and the best qualitative and quantitative measurements of the presence of heavy metals in water. Thanks to the integration of research from renowned scientific centres, representing both chemical sciences and technical sciences, i.e. microelectronics and micro optics, with the cooperation with the business unit, a unique on the global market mobile instrument will be created, allowing to monitor environmental pollution in an extremely simple,

mobile way and ensuring simultaneous detection of at least 8 heavy metals. So far, no one has developed and marketed a solution, which enables almost immediate detection of several pollutants at once, and no mobile device combining both electrochemical and optical detection has been constructed, which guarantees its considerable market potential.

[Pro18] **Development and implementation of an artificial intelligence system of virtual characters allowing simulation of their realistic behaviour and interactions with the player based on an autonomous analysis of the game participants' image in real time** (Opracowanie i implementacja systemu sztucznej inteligencji wirtualnych postaci pozwalającego na symulację ich realistycznych zachowań i interakcji z graczem na podstawie autonomicznej analizy obrazu uczestników gry w czasie rzeczywistym), GAMEINN, Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Piotr Garbat, August 2020–June 2023

The aim of the project is to create a platform for the multiplayer- AR games (augmented reality multiplayer games) development based on cloud rendering and machine learning. The platform will be validated on an experimental test gameplay created for this purpose, making use of all functionalities of the system. The result of the project, i.e. a new product on the market – Pirxon platform, will be implemented directly in the company's activities of the consortium leader. The platform will be based on algorithms developed together with the consortium partner – Warsaw University of Technology (PW) and equipped with the first video system supporting augmented reality multiplayer games in real time.

[Pro19] **Development of a modular quantum computer infrastructure for special and military IT applications** (Opracowanie modularnej infrastruktury komputera kwantowego do specjalnych i wojskowych), TECHMATSTRATEG III, Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Jan Szmidt, December 2020–December 2024

The aim of the project is a prototype of a modular quantum computer infrastructure (MIKOK) for IX RTL for special and military purposes as well as general IT applications. The modularity of the infrastructure ensures a high degree of its versatility, availability, and security for a variety of implicit and explicit applications implemented by many independent users. The infrastructure created as part of the project's implementation consists of four basic modules: Quantum Computer Unit, Secure Multi-Access Platform, Quantum Computer Compiler, and Quantum Computer Simulator. The use of infrastructure enables multi-access testing and running quantum algorithms in both implicit and explicit modes. The adopted modular solution provides the opportunity to expand the infrastructure (e.g., multiplying modules) and their development (e.g., increasing the number of qubits).

[Pro20] **New Versatile Platform for Illumination and Sensing – NewILUMIS** (Nowa uniwersalna platforma oświetleniowo-sensoryczna, M-ERA NET call 2019), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Marcin Kaczkan, September 2020–August 2023

NewILUMIS project aims at developing a novel functional material based on a layered ceramic, associated to a surface plasmon resonance (SPR) structure and a mesoporous topcoat as an innovative photonic component for lighting/sensing. The target areas will be environmental protection and security, medical diagnostics, biosensing and chemical compound detection.

The core of the lightning structure will be a rare earth doped (RE3+) ceramic (YAG). Its layered construction will allow tailoring the spectral and spatial characteristics of the light source under LED excitation. The ceramic composition (active dopants, scattering phase material, etc.) will be modified to obtain the desired colour rendering index and a high efficiency of the resulting source. This light source will be used for sensing when combined to SPR and functionalized mesoporous coatings. Packaging issues will also be considered to produce a demonstrator whose performance will be tested in relevant industrial applications.

[Pro21] **Photonics Integrated Circuits technologies for MIDIR** (Technologie układów fotoniki scalonej na zakres średniej podczerwieni – MIRPIC), TECHMATSTRATEG III, Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Ryszard Piramidowicz, co-workers: Krzysztof Anders, Anna Jusza, Aleksandra Paśnikowska, Stanislaw Stopiński, April 2020–March 2024

The result of the project will be a "product innovation" in the form of Application Specific Photonic Integrated Circuits (ASPIC) designed to work in the midinfrared range, MIR (3–5.5 μm). In particular, different building blocks necessary to define ASPICs will be designed, manufactured and tested, which will allow to design, manufacture and test the parameters of the ASPIC demonstrator. The demonstrator will reflect the typical characteristics of integrated photonics, i.e. multi-channel, integration on a common substrate, electronic and optical interfaces, and packaging. The demonstrator will be a multi-channel receiver transmitter operating for least three wavelengths and designed for the detection of chemical compounds (e.g., CO_2, NOx, SOx) or for free-space optical communication. The result of the project will be "know-how" in the field of design and production of a basic set of functional blocks and their hybrid integration, which will allow to define the first in Poland technology platform of ASPIC circuits for the MIR range. Then as a result of the planned implementation will allow for the design and production of integrated photonics systems with different parameters corresponding to the changing needs of customers, in line with the concept of industry 4.0. Industry 4.0 assumes organization of production that allows reacting to changes in market demand for a product with specific parameters – "mass personalization". Strong competition and growing customer expectations mean that not only the systematic increase in production efficiency is needed but also the way to personalize it, i.e. produce short series of products designed according to the needs of a specific customer. Their price should not be higher than the price of mass-produced goods. Such flexibility is to be the result of the fourth industrial revolution and the product developed in the project is to meet these challenges.

4.3. Projects Granted by the National Science Centre for Research and Development

[Pro22] **Correlations between electromagnetic and magnetoelastic properties of thin ferromagnetic films** (Korelacje pomiędzy własnościami elektromagnetycznymi i magnetosprężystymi cienkich warstw ferromagnetycznych), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Jerzy Krupka, June 2019–June 2022

Thin magnetic films have been the subject of study for several decades, but to this day this area of research remains highly active. Their popularity can be attributed to the presence of surfaces and material interfaces, which make the properties of magnetic films very different from their bulk forms. While bulk (i.e. of dimensions measured beyond the nanoscale) magnets have already become an inseparable part of modern-day technology, low-dimensional magnetic structures have a huge potential of widespread practical applications as well.

Magnetic recording and mass storage systems have been very popular since the very beginnings of the computer industry. However, despite numerous advantages, magnetic random access memory (MRAM) still has a long way to go before it will replace semiconductor volatile computer memories for at least two reasons. The first one is outstandingly large scale of integration needed to obtain huge memory capacity counted in GB, while the second reason is still relatively high power consumption, which decreases with the Gilbert damping factor, α, of the used conductive magnetic films. Nonetheless, bit switching time increases as $1/\alpha$. Therefore, practical MRAM designs incorporate both low- and high-damping materials and there is high demand for their better and better quality. Understanding the origin of various damping mechanisms and their relation to structural properties of such films remains one of the key challenges, which is still insufficiently understood, especially at a quantitative level needed to control the damping properties of the films.

In view of the described technological problems, the main goal of the project is to determine the fundamental correlations between different physical mechanisms responsible for magnetic losses occurring in ferromagnetic thin films at microwave and millimeter wave frequencies, contributing to the homogeneous and inhomogeneous broadening

of the ferromagnetic linewidth, and structural parameters of the film, such as anisotropy, thickness, inhomogeneity, defects/doping, magnetoelasticity. As it is well known, magnetic loss mechanisms include Gilbert damping, two-magnon scattering, spin-orbital coupling, spin pumping (if non-magnetic electrically conductive layers are adjacent to the magnetic layer) or radiative damping, the contribution of which will need to be separated from each other in the course of the project. Special attention will be paid to the magnetoelastic effect, which can be usually correlated with strong spin-orbital coupling of the magnetic ions, while the latter one usually results also in strong magnetic damping, which manifests itself in the broadening of the ferromagnetic linewidth. However, the quantitative correlation between these two phenomena remains poorly understood.

In order to clarify the correlation between the magnetoelastic properties and magnetic damping in thin films, a rigorous quantitative study of various contributions to the magnetic damping occurring in thin films has to be undertaken in a broad electromagnetic spectrum. Commonly used methods, like VNA-FMR with a co-planar waveguide (CPW), suffer from low dynamics (i.e. poor accuracy) and does not allow easily de-embedding losses of the setup from the measurement in order to get a real FMR linewidth (i.e. unloaded from extrinsic losses of the measurement system). Much better performance can be achieved with resonant methods with the sample inserted in a hollow metallic cavity, as a rigorous (i.e. fully accurate) model of the electrodynamic phenomena occurring in the whole system, including the sample, can be developed. However, resonators operate at discrete frequencies (usually at just one frequency), providing substantially less information than is contained in a broad spectrum. Therefore, an auxiliary goal of the project will be to develop a rigorous broadband resonant method for FMR linewidth measurement of thin ferromagnetic films by means of a tunable cavity.

Thin films are most commonly studied with static and magnetic fields tangential its surface. However, interesting phenomena can be observed if the bias static magnetic field is normal to the film. In such a case, it is theoretically possible to excite surface modes in a thin ferromagnetic film, which may be also called magnetic plasmons in analogy to surface modes occurring in thin electrically conductive films. Such plasmons have been already discovered in spherical and cylindrical samples, however, it still lacks experimental confirmation in planar ferromagnetic structures. For those reasons, another auxiliary goal of research will be to find the necessary conditions for the excitation of a magnetic plasmon with the aid of rigorous electromagnetic modeling and, subsequently, confirm the existence of that kind of mode experimentally.

[Pro23] **Heterogenous diamond biosensing nanoarchitectures: opto-electro-chemical interactions with antibody complexes** (Heterogeniczne diamentowe nanoarchitektury biosensoryczne: opto-elektrochemiczne interakcje z układami przeciwciał), OPUS, Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Mateusz Śmietana, October 2022–October 2025

High demand for pathogen (viruses) detection has been giving a significant boost to recent research trends focusing on the development of fast, highly sensitive, label-free, miniature devices based on various principles. The efforts range from nanomaterials and heterostructures to novel device architectures. The aim of the efforts is to improve the sensor performance not only via enhanced analyte diffusion and surface area, but more importantly to deliver and explore physico-chemical phenomena in biosensing structures that would change our view on the present biosensing concepts. Prior examples here are for instance non-enzymatic glucose biosensors, aptamers as artificial antibodies, molecularly imprinted bioreceptors, or various use of surface plasmons.

The interdisciplinary team established for this project aims that simultaneous optical (OPT) and electrochemical (EC) interrogation of heterogenous diamond 3-dimensional nanoarchitectures (periodic nanowalls, nanocages or nanoneedles) could provide a fundamentally new sensing approach, when taking advantage of unique features of diamond.

EC materials are often not optically transparent and when they are, they suffer from a low potential EC range, low biocompatibility or unstable surface modification. However, electrically conductive and transparent boron-doped diamond nanoarchitectures will allow us to benefit from unique optical and EC performance to meet such challenging demands. Moreover, advanced nanofabrication of diamond will enable to form 3-dimensional structures with a heterogenous distribution of both OPT and EC properties, allowing to enhance specific interactions with locally grafted

antibodies. For instance, we assume that the EC polarization sweep will introduce the increase of the bioanalyte concentration close to the surface via migration transports and that sensing will also be locally optically amplified. Next, electromagnetic field distribution and electron transfer will be tailored by periodic nanoarchitectures enhancing and specifying interactions taking place at the diamond-molecule interface.

According to the literature, diamond-based nanostructured biosensors were never simultaneously interrogated in OPT and EC domains. The main scientific objective is thus to reveal fundamental mutual OPT-EC interactions at the diamond-based nanoarchitectures biofunctionalized with antibody complexes that can be beneficial for applications in label-free biosensing systems.

We will explore two complementary architectures: (A) application of nanopatterned silicon wafers such as photonic crystals (1D or 2D) coated with diamond film, and (B) synthesis of self-assembled 3D-diamond structures with periodic nanoarchitectures such nanowalls, nanocages or nanoneedles, where intrinsic and boron-doped structures will be combined with superior EC/OPT and biofunctional diamond properties. To achieve that we will use advanced deposition and surface processing techniques, such as electron beam lithography, reactive ion etching, and modified chemical vapour deposition (CVD) processes to obtain diamond films and their nanostructures. The nanoarchitecture device design and experimental data will be supported by multi-scale ab-initio and molecular dynamics simulations.

To make the sensing system specific to certain biological targets, the nanoarchitectures will be biofunctionalized with antibodies towards virus proteins as non-infectious proxies (i.e., specifically influenza, SARS, HSV antigen proxies), directly or via gold nanoparticles. The heterogeneous approach with nano-engineered diamond will induce targeted grafting of antibodies complexes, allowing for high specificity of biosensing system along with enhanced sensitivity delivered by simultaneous electronic (EC charge transfer) and OPT (photonic and plasmonic) interactions.

To successfully address the above aims, challenges, and required expertise in the interdisciplinary D4CZaPLa project, the new international and complementary team is formed where groups at Gdańsk University of Technology (GUT), Warsaw University of Technology (WUT), and Institute of Physics, Czech Academy of Sciences (FZU) join forces, expertise and facilities. FZU specializes in multi-scale computational simulations, synthesis and nanodiagnostics of diamond nanoarchitectures, while GUT are experts in doping, biofunctionalization and electrochemical analyses and WUT designs and studies thin film optical biosensors.

[Pro24] **Optical analysis of electrochemical reaction products in picoliter volumes** (Analiza optyczna pikolitrowych objętości produktów procesów elektrochemicznych), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Mateusz Śmietana, February 2019–February 2022

The main objective of this project is to study the optical response to electrochemical reactions in picoliter volumes inside a microcavity inline Mach-Zehnder interferomenter (μIMZI) fabricated in an optical fiber. We will focus on determination of neurotransmitter concentrations that are difficult to be measured by optical or electrochemical means individually. The work will be performed by a consortium of the group at Institute of Microelectronics and Optoelectronics, Warsaw University of Technology led by Prof. Mateusz Śmietana, the Charge Transfer in Hydrodynamic Systems group at the Institute of Physical Chemistry PAS led by Prof. Martin Jönsson-Niedziółka, and Prof. Marcin Koba from National Institute of Telecommunications.

[Pro25] **Optical fiber biosensing systems for fast and early identification of inflammatory factors** (Światłowodowe systemy biosensoryczne do szybkiego i wczesnego wykrywania czynników zapalnych), OPUS 18, Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Mateusz Śmietana, July 2020–July 2023

Accurate and fast medical diagnostics are crucial for fighting with majority of health issues, which include fast-spreading bacterial or viral infection, as well as progressing cancer disease. In medical practice an advanced experience is essential for correct diagnosis, which almost always needs to be supported by a series of examinations and laboratory analysis. These are often very time-consuming, which leads to more rapid spread of the disease, its fast progress or

makes the treatment less successful and more expensive. Thus, a great investments are made all over the world on development of novel, more effective, faster, and more functional biosensing architectures and procedures.

Out of available biosensors, these based on optical interactions between sensor and a target biological material are very often considered. The devices are designed for detection of changes in properties of liquids (typically refractive index - RI, absorption, or fluorescence) or changes at the interface of the liquid and the sensor active area (thickness, RI and absorption of the surface layer). When no florescent label is involved and only RI variation in proximity of the sensor surface is monitored, the sensing concept is often called as "label-free". These changes may result from formation of the bio-layer on the surface of the bio-sensor. Optical label-free biosensors offer greatly shortened vs florescent-based sensors sampling to result time and possibility of target biomaterial binding kinetics measurements. Moreover, when they are based on optical fibers, they offer probe-like character of the sensor, allowing for direct in-vivo analysis, as well as when fiber end-face is used, a small active surface of the sensor that makes possible precise in-spot analysis. However, obtaining highly sensitive and selective optical fiber label-free biosensor is highly challenging, especially when mass production of the sensors is considered.

The main aim of this project is to study the optical response to changes in optical properties at the surface of optical fiber sensors with stack of nano-films at the end-faces. Due to biofunctionalized surface of the stack changes in the optical properties will correspond to concentration of selected inflammatory markers. We claim that optimized in properties stacks can be targeted towards certain size or character of the bound biomolecules, what makes possible their identification in complex biological liquids. In this project we will consider such biological targets as myeloperoxidase and neutrophil elastase that are well-known inflammatory markers belonging to the group of enzymes produced locally by the activated immune cell and play an important role in the inflammation process underlying many pathological conditions. These markers are different in size and character and that is why require different architecture of the stack, but can be tuned using the same "generic" and mass-applicable technology. Moreover, we claim that the sensors can be applicable for in-vivo measurements, even in locations inside human body distant to other sensors, what may be impossible or dangerous for the patient when other types of interrogation are considered.

The work will be performed by a consortium of the group at Institute of Microelectronics and Optoelectronics, Warsaw University of Technology led by Prof. Mateusz Śmietana, group at Division of Immunology, Medical University of Warsaw led by Dr. Tomasz Rygiel, and the group of Surface Nanoengineering at the Institute of Physical Chemistry Polish Academy of Sciences led by Prof. Joanna Niedziółka-Jönsson. The project will include numerical analysis of the nano-film stacks based on measured properties of the films, developing fabrication process, functionalization of the sensor surface, determination of sensing parameters, as well as comparison of the results with other label-based and label-free sensing techniques, and finally determination of the sensor performance in conditions as at in-vivo examinations. For fabrication of the sensors we plan to use advanced physical and chemical vapor deposition techniques tuned towards their application for deposition on optical fibers. As thin film materials will be examined various metal and semiconductor oxides, nitrides and oxy-nitrides, as well as carbon-based materials. Material selection will be determined by the film robustness when stay in contact with pH expected in environments typical for in-vivo experiments.

[Pro26] **Translucent titanium dioxide nanostructures deposited on substrates with complex geometry for photoconversion and sensorics** (Nanostruktury półprzezroczystego ditlenku tytanu osadzane na podłożach o złożonej geometrii do fotokonwersji i sensoryki), CEUS-UNISONO, Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Mateusz Śmietana, co-workers: Monika Janik, Emil Pituła, Mariusz Sochacki, April 2022–March 2024

The project aims on fundamental material research on semi-transparent nanostructured surfaces with complex 3D geometry for enhancement of light harvesting and label-free sensing. Titania nanotube arrays with tunable absorption light spectra due to tailoring of the band-gap and nanotube dimension will be in particular studied. Well-defined nanotube arrays will be formed on surfaces with complex geometry to achieve unique light-matter interacting systems. In particular, a double-faced nanotube-array-based system with sequential light absorption and an optical-fibre-based sensor coated with nanotube arrays for label-free sensing of various gases and liquid analytes will be fabricated and investigated.

4.4. Projects Granted by the International Institutions

[Pro27] **New generation of high thermal efficiency components packages for space** (Nowa generacja obudów podzespołów o wysokiej skuteczności chłodzenia do zastosowań kosmicznych) EU Horizon project – HEATPACK, project leader: Ryszard Kisiel, August 2019–March 2022

HEATPACK project aims to develop and validate critical technology building blocks for enabling transformative packages for space applications with very low thermal resistance. This is to fully exploit the potential of widebandgap technologies which are now being considered as critical in numerous sectors and for space applications in particular, as enhanced thermal management solutions beyond state-of-the-art need to be provided. Benefits will range from improved performance to increased components reliability and lifetime. HEATPACK concepts for achieving high power / high thermal efficiency packages include: – Diamond based composite materials with a thermal conductivity >600W/m.K to be used as baseplate or insert; – Silver sintering based Thermal Interface Material (TIM 1) for components assembly – TIM2 for package to structure assembly with both electrical and thermal enhanced properties (in excess of 10W/m.K); – Innovative cooling solutions with strategic implementation possibilities (baseplate, lid, structure…). Using these technologies, two different modules implementing Gallium Nitride (GaN) components will be developed: -A power supply switching module based on a multilayer ceramic substrate -A L-band High Power Amplifier based on a single hermetic micro package, delivering up to 400W CW output power The main application targeted is the Galileo Second Generation satellite program since thermal management of the GaN HEMT based Solid State Power Amplifier and Electronic Power Conditioner sections currently provide a roadblock due to the very high power levels involved. Other needs are linked to power conditioning notably for digital transparent processor (DTP) targeting very high throughput satellite for telecommunication. To secure a fully European supply chain for high power components thermal management, the technologies developed will reach a TRL of 7, demonstrating commercial viable solutions providing reliability levels compliant with space environments.

9 partners from 7 different countries collaborate in the frame of HEATPACK. IMIO as the project partner is responsible for research and develop new advanced material for thermal interfaces at first level packages (TIM1).

Microelectronics and Nanoelectronics Devices Division

5. DISSEMINATION OF KNOWLEDGE

5.1. Students Scientific Associations

5.1.1. Students Scientific Association of Microelectronic and Nanoelectronics (KNMiN) (Koło Naukowe Mikroelektroniki i Nanoelektroniki KNMiN)

Association Tutor: Mateusz Śmietana, Ph.D., D.Sc.

In the interests of the Students Scientific Group of Microelectronics and Nanoelectronics are issues mainly related to the technology, design instruments, characterization and application of new materials in the field of optoelectronics and microelectronics. Examples of topics dealt with by the members of the Student Scientific Associacion: preparation and characterization of semiconductor structures, the organization of trips to conferences, workshops and symposia (where group members can get acquainted with the latest achievements in the field of micro-, nano- and optoelectronics, meetings of eminent personalities from the world of modern science and to present the results of their own research).

5.1.2. Student Scientific Association of Optoelectronics (KNO) (Koło Naukowe Optoelektroniki KNO)

Association Tutor: Ryszard Piramidowicz, Ph.D, D.Sc.

Student Association of Optoelectronics formally started in May 2006, however, the custom of nonobligatory student seminar meetings – foundation of our Association – has been successfully continued since 2002. Presently, the Association consists of several students and Ph.D. students of Institute of Microelectronics and Optoelectronics, however graduate professionals complement our ranks, as well.

Main scientific interest covers:

- fiber lasers and amplifiers,
- photonic integrated circuits,
- special optical fibers and fiber components,
- new optically active materials for light sources (polymers, composites, glasses and nanocrystals doped with rare-earth ions).

The goals of Student Association of Optoelectronics:

- popularizing optoelectronics and photonics technology disciplines,
- conducting research and development works in the field of optoelectronics,
- supporting all forms of activity leading to the development of professional skills of KNO members.

5.1.3. Students Scientific Association of Microsystems (ONYKS) (Koło Naukowe Mikrosystemów ONYKS)

Association Tutor: Jakub Jasiński, Ph. D.

The members of the Students Scientific Association are involved in the implementation of various projects (analog, microcontrollers, FPGAs) and have necessary tools to accomplish circuit boards. The scientific interest also includes popularization of electronics among the youth and students.

5.1.4. Student Scientific Association of Integrated Systems (Koło Naukowe Systemów Scalonych)

Association Tutor: Marek Niewiński, Ph. D.

The main areas of interest are: developing mixed analog-digital system using SoC board, designing extension board for SoC, programming microcontrollers and Integrated Circuit design.

5.2. Cooperation with schools

In 2022, two stages of the third edition of the STEM PW competition took place. It was attended by over 600 students from almost 50 secondary schools from all over Poland. In December, the first stage of the next 4th edition of this prestigious competition was organized. IMIO employees take an active part in the organization of this project. It is worth noting that schools from the top of the Perspektywy ranking entered the competition. Many young people who took part in this competition became students of the Warsaw University of Technology.

5.3. Photovoltaic Platform, Warsaw University of Technology (PVP) Platforma Fotowoltaiki Politechniki Warszawskiej (PF)

Coordinator:
Ryszard Piramidowicz, Ph.D, D.Sc. Warsaw University of echnology,
Institute of Microelectronics and Optoelectronics

The Photovoltaic Platform was established in 2014 at Warsaw University of Technology in order to increase utilization of the scientific potential and encouraging industry-oriented research services. The Photovoltaic Platform aims to bring together complementary competences of various research groups of WUT, thus creating strong multidisciplinary photovoltaic group capable of successful realization of both large research projects and development of complete solutions for the industry partners. The Photovoltaic Platform core consists of teams from the Faculty of Electronics and Information Technology and Faculty of Physics, as well as teams from other faculties involved in research on various aspects of photovoltaic technologies.

Range of competences of PVP covers all levels of photovoltaics – from physics of the solar cells, structure of modules, inverters and mounting large methods, design, development and performance evaluation of photovoltaic systems up to energy profiles prediction and assessment of grid integration issues. The Platform teams also help prospective investors to evaluate their models of engagement in the photovoltaic market, taking into consideration technical challenges, legal environment and economic feasibility.

Cooperation with industry partners is critical for long term development of photovoltaics at the Warsaw University of Technology. The Photovoltaic Platform cooperates closely with a number of companies interested in taking part in expected rapid development of photovoltaic market. Broad knowledge of Polish photovoltaic market provides the Photovoltaic Platform basis for further development of competences in connection with identified needs of the industry. In parallel with involvement in the cooperation with business partners the Photovoltaic Platform teams remain engaged in a number of research project.

6. DEGREES AWARDED

6.1. Ph.D. Degrees

[DSc1] Janaszek Bartosz, **Effect of spatial dispersion on the optical properties of passive and active photonic structures based on hyperbolic metamaterials**, (Wpływ dyspersji przestrzennej na właściwości optyczne pasywnych i aktywnych struktur fotonicznych utworzonych z metamateriałów hiperbolicznych), scientific supervisor: Szczepański Paweł, November 18

[DSc2] Marcin Osiniak, **Methods of improving the effectiveness of monitoring of steel structures using inclinometer sensors**, (Metody poprawy skuteczności monitoringu konstrukcji stalowych przy użyciu czujników inklinometrycznych), scientific supervisor: Łukasiak Lidia, April 26

[DSc3] Słowikowski Mateusz, **Integrated photonic interrogators for applications in fiber optic sensor systems**, (Zintegrowane interrogatory fotoniczne do zastosowań w światłowodowych systemach czujnikowych), scientific supervisor: Piramidowicz Ryszard, December 12

6.2. M.Sc. Degrees

[MSc1] Drawc Adam, **Implementation, verification, and analysis of network on chip solutions in nanometer and submicron CMOS processes**, (Realizacja, weryfikacja i analiza układów NoC w nanometrowych i sub-mikrometrowych technologiach CMOS), supervisor: Pleskacz Witold, March 4

[MSc2] Karczewska Maria, **Investigation of luminescent properties in the visible spectral range of dysprosium-doped ZBLAN and TZN glasses**, (Badania właściwości luminescencyjnych w zakresie widzialnym szkieł ZBLAN i TZN domieszkowanych jonami dysprozu), supervisor: Piramidowicz Ryszard, October 14

[MSc3] Krajewska Katarzyna, **Mid-infrared laser beam characterization and collimation** (Charakteryzacja oraz kolimacja wiązki laserowej w średniej podczerwieni), supervisor: Piramidowicz Ryszard, October 14

[MSc4] Lechowicz Radosław, **The comparative analysis of web applications of Polish football clubs**, (Analiza porównawcza systemów internetowych polskich klubów piłkarskich), supervisor: Witoński Piotr, June 29

6.3. B.Sc. Degrees

[BSc1] Antoszewska Aleksandra, **Optimisation of control unit and calculation for iterative ADC**, (Optymalizacja modułu sterowania i obliczaniaestymat dla iteracyjnego przetwornika A/C), supervisor: Jaworski Zbigniew, February 17

[BSc2] Cieszyński Kamil, **Implementation of algorithms for processing polarization images**, (Implementacja algorytmów przetwarzania obrazów polaryzacyjnych), supervisor: Garbat Piotr, March 4

[BSc3] Drecka Dagmara, **Automated stand for registering photographs with use of focus stacking method**, (Zautomatyzowane stanowisko rejestracji obrazów z wykorzystaniem techniki FS), supervisor: Sutkowski Marek, February 18

[BSc4] Głozak Piotr, **Project of DWDM network based on a commercial solution**, (Projekt sieci DWDM na przykładzie rozwiązania komercyjnego), supervisor: Szymańska Agnieszka, October 10

[BSc5] Golczyk Tadeusz, **The estimation of the object size from the image sequence**, (Estymacja rozmiaru obiektów w opaciu o serie obrazów), supervisor: Garbat Piotr, February 17

DEGREES AWARDED

[BSc6] Kamiński Jerzy, **Structures based on two-dimensional materials – technology and characterization**, (Struktury bazujące na materiałachdwuwymiarowych – technologia i charakteryzacja), supervisor: Mroczyński Robert, March 4

[BSc7] Kamiński Krzysztof, **Comparative analysis of chosen template matching methods**, (Analiza porównawcza wybranych metod wykrywania znaczników na zdjęciach), supervisor: Sutkowski Marek, October 7

[BSc8] Kobuszewski Michał, **Smart falling detector for the elderly**, (Inteligentny system wykrywania upadku u osób w podeszłym wieku), supervisor: Jaworski Zbigniew, June 24

[BSc9] Kosińska Dominika, **Optimization of the optical properties of dielectric layers fabricated by reactive magnetron sputtering process**, (Optymalizacja właściwości optycznych warstw dielektrycznych wytwarzanych za pomocą reaktywnego rozpylania magnetronowego), supervisor: Mroczyński Robert, March 4

[BSc10] Martyniak Jacek, **Intelligent devices supporting the process of human sleep and wake up**, (Inteligentne urządzenia wspomagające proces snu i budzenia czowieka), supervisor: Sutkowski Marek, February 18

[BSc11] Mroczko Eryk, **Universal music notepad application for iOS, iPadOS and macOS systems**, (Uniwersalna aplikacja notatnika muzycznego na systemy iOS, iPadOS i macOS), supervisor: Wojtasik Adam, February 18

[BSc12] Müller Artur, **Avionics OSD Algorithms Implementation on the STM32F303 Microcontroller,** (Implementacja algorytmów OSD dla potrzeb awioniki na mikrokontrolerze STM32F303), supervisor: Madziar Krzysztof, September 30

[BSc13] Nerć Jakub, **Automated stand for registering high resolution photographs**, (Automatyczne stanowisko rejestracji obrazów wysokorozdzelczych), supervisor: Sutkowski Marek, June 22

[BSc14] Piotrowski Marcin, **Construction of a dedicated Internet of Things service station using a single board computer**, (Konstrukcja dedykowanej stacji usługowej Internetu Rzeczy z zastosowaniem komputera jednopłytkowego), supervisor: Borecki Michał, February 17

[BSc15] Rękawek Michał, **Development of fiber optic sensors utilizing thin-film layers of metal oxides deposited using ALD technique**, (Opracowanie czujników światłowodowych wykorzystujących cienkie arstwy tlenków metali osadzanych techniką ALD), supervisor: Śmietana Mateusz, September 30

[BSc16] Rosołowski Błażej, **Monitor of vital function**, (Monitor funkcji życiowych), supervisor: Jaworski Zbigniew, June 24

[BSc17] Salamonik Przemysław, **Characterization of optical fiber sensor structures based on optically transparent and electrically conducting nanometer films**, (Charakteryzacja światłowodowych struktur czujnikowych opartych na nanometrycznych warstwach transparentnych optycznie i przewodzących elektrycznie), supervisor: Śmietana Mateusz, February 18

[BSc18] Stus Adrian, **Designing a reference voltage source in UMC 55nm technology**, (Zaprojektowanie źródła napięcia odniesienia w technologii UMC 55 nm), supervisor: Jaworski Zbigniew, October 14

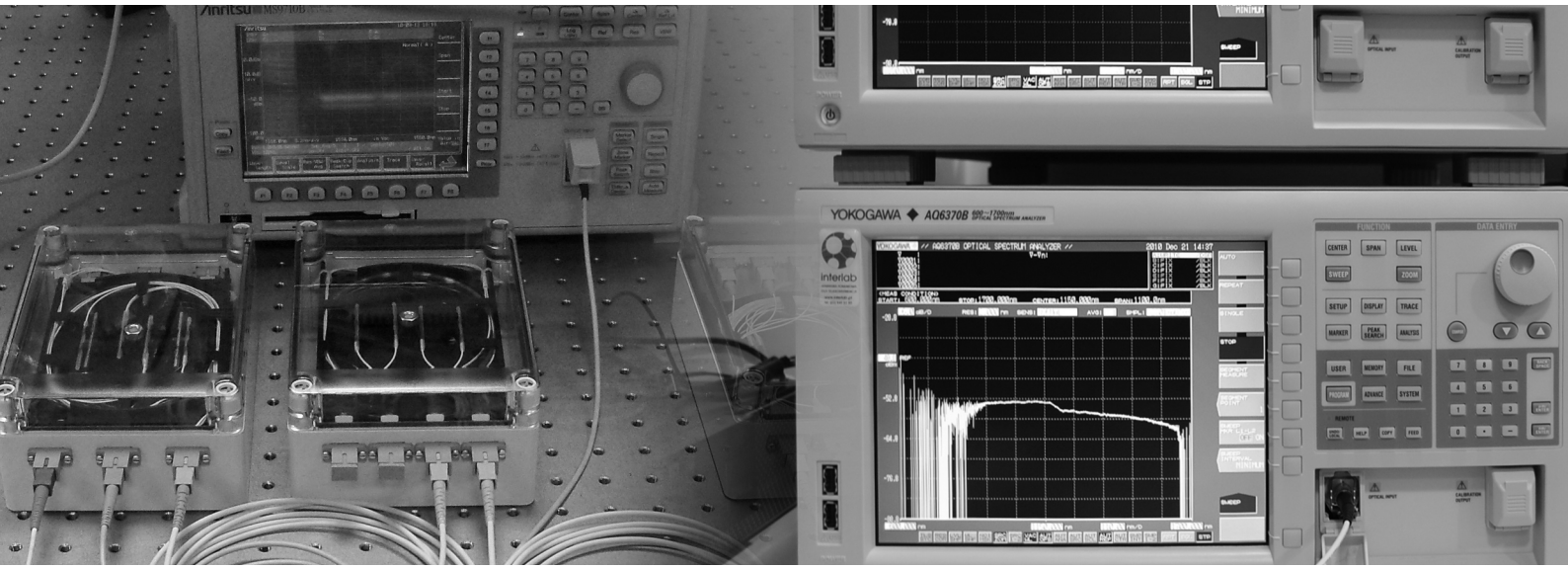
[BSc19] Szczerbetka Piotr, **The influence of the shape of a microcavity made with the use of laser ablation in an optical fiber on the possibility of its use for testing liquids,** (Wpływ kształtu mikrownęki wykonanej z wykorzystaniem ablacji laserowej we włóknie światłowodowym na możliwości jej wykorzystania do badania cieczy), supervisor: Śmietana Mateusz, February 18

[BSc20] Szewczyński Jan, **Application of shortest path search algorithms in applications developed with 3D Reality technology**, (Zastosowanie algorytmów poszukiwania najkrótszej ścieżki w aplikacjach tworzonych w technologii 3D Reality), supervisor: Wojtasik Adam, March 4

[BSc21] Szmidt Jakub, **Noise reduction method in high-resolution registration systems**, (Metoda redukcji szumóww wysokorozdzielczych systemach rejestracji), supervisor: Sutkowski Marek, March 4

[BSc22] Troć Patryk, **Software and hardware implementation of the remote firmware update algorithm in wireless sensor network nodes**, (Programowo-sprzętowa implementacja algorytmu zdalnej wymiany oprogramowania wbudowanego w węzłach bezprzewodowej sieci czujnikowej), supervisor: Jasiński Jakub, October 7

[BSc23] Żakowski Adam, **Solar cells electroluminescence measurement setup**, (Stanowisko pomiarowe do badań elektroluminescencji ogniw fotowoltaicznych), supervisor: Piramidowicz Ryszard, October 10



Optoelectronics Division

7. PUBLICATIONS

7.1. Scientific and Technical Papers published in Journals Included in the JCR[1] Database

NUMBER	JOURNAL	AUTHORS	TITLE	DOI	VOLUME, NUMBER	PAGES, ARTICLE NUMBER
[Pub1]	ACS Sensors	Drozdowska K., Rehman A., Sai P., Stonio B., Krajewska A., Dub M., Kacperski J., Cywiński G., Haras M., Rumyantsev S., Österlund L., Smulko J., Kwiatkowski A.	Organic Vapor Sensing Mechanisms by Large-Area Graphene Back-Gated Field-Effect Transistors under UV Irradiation	10.1021/acssensors.2c01511	vol. 7, no. 10	pp. 3094–3101
[Pub2]	Applied Sciences-Basel	Stelmaszczyk K., Karpierz-Marczewska E., Mikhnev V., Cywinski G., Skotnicki T., Knap W.	Ultrafast Time-of-Flight Method of Gasoline Contamination Detection Down to ppm Levels by Means of Terahertz Time-Domain Spectroscopy	10.3390/app12031629	vol. 12, no. 3	pp.1–25, no.1629
[Pub3]	Biosensors & Bioelectronics	Janik M., Sosnowska M., Gabler T., Koba M., Myśliwiec A., Kutwin M., Sawosz-Chwalibóg E., Śmietana M.	Life in an optical fiber: Monitoring of cell cultures with microcavity in-line Mach-Zehnder interferometer	10.1016/j.bios.2022.114718	vol. 217	pp.1–9, no. 114718
[Pub4]	Coatings	Butt M.	Thin-Film Coating Methods: A Successful Marriage of High-Quality and Cost-Effectiveness—A Brief Exploration	10.3390/coatings12081115	vol. 12, no. 8	pp.1–22, no.1115
[Pub5]	Crystals	Ahmed U., Khan Y., Ehsan M., Amirzada M., Ullah N., Khatri A., Ur Rehman A., Butt M.	Investigation of Spectral Properties of DBR-Based Photonic Crystal Structure for Optical Filter Application	10.3390/cryst12030409	vol. 12, no. 3	pp.1–10, no.409
[Pub6]	Crystals	Khan Y., Rehman A., Batool B., Noor M., Butt M., Kazanskiy N., Khonina S.	Fabrication and Investigation of Spectral Properties of a Dielectric Slab Waveguide Photonic Crystal Based Fano-Filter	10.3390/cryst12020226	vol. 12, no. 2	pp.1–13, no.226
[Pub7]	Electronics (Switzerland)	Ahmed O., Khan Y., Butt M., Kazanskiy N., Khonina S.	Performance Comparison of Silicon- and Gallium-Nitride-Based MOSFETs for a Power-Efficient, DC-to-DC Flyback Converter,	10.3390/electronics11081222	vol. 11, no. 8	pp.1–16, no.1222
[Pub8]	Electronics (Switzerland)	Bilal M., Shahid S., Khan Y., Rauf Z., Wagan R., Butt M., Khonina S., Kazanskiy N.	A Miniaturized FSS-Based Eight-Element MIMO Antenna Array for Off/On-Body WBAN Telemetry Applications	10.3390/electronics11040522	vol. 11, no. 4	pp.1–15, no.522
[Pub9]	Electronics (Switzerland)	Butt M., Kazanskiy N., Khonina S.	Revolution in Flexible Wearable Electronics for Temperature and Pressure Monitoring—A Review	10.3390/electronics11050716	vol. 11, no. 5	pp.1–24, no.716
[Pub10]	Electronics (Switzerland)	Kuźmicz W.	A Thermally Stable Quasi-CMOS Bipolar Logic	10.3390/electronics11010006	vol. 11, no. 1	pp.1–15, no.6

[1] Journal Citation Reports; https://jcr.clarivate.com

[Pub11]	Electronics (Switzerland)	Narczyk P., Pleskacz W.	Analog Frontend for Reliable Human Body Temperature Measurement for IoT Devices	10.3390/electronics 11030434	vol. 11, no. 3	pp.1–20, no.434
[Pub12]	Energies	Piotrowski P., Parol M., Kapler P., Fetliński B.	Advanced Forecasting Methods of 5-Minute Power Generation in a PV System for Microgrid Operation Control	10.3390/en 15072645	vol. 15, no. 7	pp.1–23, no.2645
[Pub13]	European Physical Journal B	Krupka J., Salski B., Pacewicz A., Kopyt P.	Mode spectra of magnetic and dielectric plasmon spheres obtained from Mie scattering and free oscillation theories	10.1140/epjb/s 10051-021-00257-x	vol. 95, no. 1	pp.1–7
[Pub14]	IEEE Microwave and Wireless Components Letters	Krupka J., Salski B., Karpisz T., Kopyt P., Jensen L., Wojciechowski M.	Irradiated Silicon for Microwave and Millimeter Wave Applications	10.1109/LMWC. 2022.3161393	vol. 32, no. 6	pp. 700–703
[Pub15]	IEEE Microwave and Wireless Components Letters	Warecka M., Fotyga G., Kowalczyk P., Lech R., Mrozowski M., Pacewicz A., Salski B., Krupka J.	Modal FEM analysis of ferrite resonant structures	10.1109/LMWC. 2022.3154532	vol. 32, no. 7	pp. 819–822
[Pub16]	IEEE Sensors Journal	Salski B., Czekała P., Krupka J., Kopyt P	A Microwave Sensor of Moisture Content and Salinity of Soil	10.1109/JSEN. 2021.3137370	vol. 22, no. 3	pp.2135––2141, no. 21589206
[Pub17]	IEEE Transactions on Microwave Theory and Techniques	Kopyt P., Salski B., Krupka J.	Measurements of the Complex Anisotropic Permittivity of Laminates with TM0n0 Cavity	10.1109/TMTT. 2021.3073426	vol. 70, no. 1	pp. 432–443, no. 9419775
[Pub18]	IEEE Transactions on Microwave Theory and Techniques	Pacewicz A., Salski B., Krupka J., Kopyt P., Nabialek A., Chumak O.	Electromagnetic Characterization of Shielded Spherical Gyromagnetic Resonators	10.1109/tmtt. 2021.3131977	vol. 70, no. 2	pp. 1016––1025
[Pub19]	IEEE Transactions on Ultrasonics Ferroelectrics and Frequency Control	Zhao Z., Goryachev M., Krupka J., Tobar M.	Precision Multi-Mode Dielectric Characterization of a Crystalline Perovskite Enables Determination of the Temperature-Dependent Phase Transitions	10.1109/tuffc. 2021.3108118	vol. 69, no. 1	pp. 423–429
[Pub20]	International Journal of Molecular Sciences	Butt M., Tyszkiewicz C., Wojtasik K., Karasiński P., Kaźmierczak A., Piramidowicz R.	Subwavelength Grating Waveguide Structures Proposed on the Low-Cost Silica–Titania Platform for Optical Filtering and Refractive Index Sensing Applications	10.3390/ijms 23126614	vol. 23, no. 12	pp.1–15, no.6614
[Pub21]	Journal of Lightwave Technology	Burnat D., Kwietniewski N., Bartnik K., Koba M., Kochanowska O., Kondracka K., Śmietana M.	Tailoring Refractive Index and Surface Sensitivity of an Optical Fiber Fabry-Perot Interferometer by a Thin Layer Deposition	10.1109/jlt.2022. 3227030	vol. 41, no. 6	pp.1865––1873
[Pub22]	Journal of Lightwave Technology	Esposito F., Stancalie A., Srivastava A., Śmietana M., Mihalcea R., Negut C., Campopiano S., Iadicicco A.	The impact of gamma irradiation on optical fibers identified using Long Period Gratings	10.1109/jlt.2022. 3191163	vol. Early Access	pp.1–8

[Pub23]	Journal of Thermal Analysis and Calorimetry	Głuchowska H., Łyszczek R., Jusza A., Piramidowicz R.	Effect of N,N -dimethylformamide solvent on structure and thermal properties of lanthanide(III) complexes with flexible biphenyl-4,4 -dioxydiacetic acid	10.1007/s10973-020-10435-1	vol. 147, no. 2	pp. 1187––1200
[Pub24]	Materials	Borecki M., Gęca M., Korwin-Pawlowski M.	Automotive Diesel Fuel Internal Stability Testing with the Use of UV and Temperature as Degradation Factors	10.3390/ma15238548	vol. 15, no. 23	pp.1–27, no.8548
[Pub25]	Materials	Butt M., Tyszkiewicz C., Karasiński P., Zięba M., Kaźmierczak A., Zdończyk M., Duda Ł., Guzik M., Olszewski J., Martynkien T., Bachmatiuk A., Piramidowicz R.	Optical Thin Films Fabrication Techniques-Towards a Low-Cost Solution for the Integrated Photonic Platform: A Review of the Current Status	10.3390/ma15134591	vol. 15, no. 13	pp.1–25, no.4591
[Pub26]	Materials	Janaszek B., Szczepański P.	Spatial Dispersion in Hypercrystal Distributed Feedback Lasing	10.3390/ma15103482	vol. 15, no. 10	pp.1–17, no.3482
[Pub27]	Materials	Khan Y., Butt M., Kazanskiy N., Khonina S.	Numerical Study of Fabrication-Related Effects of the Structural--Profile on the Performance of a Dielectric Photonic Crystal-Based Fluid Sensor	10.3390/ma15093277	vol. 15, no. 9	pp.1–17, no.3277
[Pub28]	Materials	Kuźmicz-Mirosław E., Kuśmierz M., Terpiłowski K., Śmietana M., Barczak M., Staniszewska M.	Effect of Various Surface Treatments on Wettability and Morphological Properties of Titanium Oxide Thin Films	10.3390/ma15124113	vol. 15, no. 12	pp.1–11, no.4113
[Pub29]	Materials	Lelit M., Słowikowski M., Filipiak M., Juchniewicz M., Stonio B., Michalak B., Pavłov K., Myśliwiec M., Wiśniewski P., Kaźmierczak A., Anders K., Stopiński S., Beck R., Piramidowicz R.	Passive Photonic Integrated Circuits Elements Fabricated on a Silicon Nitride Platform	10.3390/ma15041398	vol. 15, no. 4	pp.1–23, no.1398
[Pub30]	Materials	Łyszczek R., Vlasyuk D., Podkościelna B., Głuchowska H., Piramidowicz R., Jusza A.	A Top-Down Approach and Thermal Characterization of Luminescent Hybrid BPA. DA-MMA@Ln2L3 Materials Based on Lanthanide(III) 1H-Pyrazole-3,5-Dicarboxylates	10.3390/ma15248826	vol. 15, no. 24	pp.1–18, no.8826
[Pub31]	Materials	Racka-Szmidt K., Stonio B., Żelazko J., Filipiak M., Sochacki M.	A Review: Inductively Coupled Plasma Reactive Ion Etching of Silicon Carbide	10.3390/ma15010123	vol. 15, no. 1	pp.1–23, no.123
[Pub32]	Materials	Su X., Tkach A., Krupka J., Vilarinho P.	High Q Dielectric Titanium Tellurite Thick Films on Alumina Substrates for High Frequency Telecommunications	10.3390/ma15020467	vol. 15, no. 2	pp.1–10, no.467
[Pub33]	Materials	Terpilowska S., Gluszek S., Czerwosz E., Wronka H., Firek P., Szmidt J., Suchańska M., Keczkowska J., Kaczmarska B., Kozłowski M., Diduszko R.	Nano-Ag Particles Embedded in C-Matrix: Preparation, Properties and Application in Cell Metabolism	10.3390/ma15175826	vol. 15, no. 17	pp.1–15, no.5826

[Pub34]	Materials	Wiśniewski P., Majkusiak B.	Charge-Trapping-Induced Hysteresis Effects in Highly Doped Silicon Metal–Oxide–Semiconductor Structures	10.3390/ma 15082733	vol. 15, no. 8	pp.1–9, no.2733
[Pub35]	Materials	Wlazło M., Haras M., Kołodziej G., Szawcow O., Ostapko J., Andrysiewicz W., Kharytonau D., Skotnicki T.	Piezoelectric Response and Substrate Effect of ZnO Nanowires for Mechanical Energy Harvesting in Internet-of-Things Applications	10.3390/ma 15196767	vol. 15, no. 19	pp.1–16, no.6767
[Pub36]	Materials Letters	Kowalczyk M., Kaczkan M., Majchrowski A., Malinowski M.	Comparison between glass and crystal phase of europium 3 + doped Bi2ZnOB2O6	10.1016/j.matlet. 2021.131286	vol. 308, no. B	pp.1–4, no. 131286
[Pub37]	Materials Science in Semiconductor Processing	Jóźwik I., Jagielski J., Caban P., Kamiński M., Kentsch U.	Direct visualization of highly resistive areas in GaN by means of low-voltage scanning electron microscopy	10.1016/j.mssp. 2021.106293	vol. 138	pp.1–4, no. 106293
[Pub38]	Materials Science in Semiconductor Processing	Syryanyy Y., Zając M., Guziewicz E., Woźniak W., Melikhov Y., Chernyshova M., Ratajczak R., Demchenko I.	Polarized dependence of soft X-ray absorption near edge structure of ZnO films implanted by Yb	10.1016/j.mssp. 2022.106609	vol. 144	pp.1–8, no. 106609
[Pub39]	Measurement	Butt M., Kazanskiy N., Khonina S.	On-chip symmetrically and asymmetrically transformed plasmonic Bragg grating formation loaded with a functional polymer for filtering and CO_2 gas sensing applications	10.1016/j. measurement. 2022.111694	vol. 201	pp.1–8, no. 111694
[Pub40]	Microelectronics International	Myśliwiec M., Kisiel R., Kruszewski M.	Influence of Ag particle shape on mechanical and thermal properties of TIM joints	10.1108/mi-06-2022-0108	vol. 39, nr 4	pp. 188–193
[Pub41]	Microelectronics Reliability	Ciszewski P., Sochacki M., Stęplewski W., Kościelski M., Araźna A., Janeczek K.	A comparative analysis of printed circuit drying methods for the reliability of assembly process	10.1016/j.microrel. 2022.114478	vol. 129	pp.1–8, no. 114478
[Pub42]	Micromachines	Kovalev A., Kotlyar V., Kozlova E., Butt M.	Dividing the Topological Charge of a Laguerre–Gaussian Beam by 2 Using an Off-Axis Gaussian Beam	10.3390/mi 13101709	vol. 13, no. 10	pp.1–12, no.1709
[Pub43]	Micromachines	Wiśniewski P., Nieborek M., Mazurak A., Jasiński J.	Investigation of the Temperature Effect on Electrical Characteristics of Al/SiO_2/n++-Si RRAM Devices	10.3390/mi 13101641	vol. 13, no. 10	pp.1–14, no.1641
[Pub44]	MRS Bulletin	Janik M., Głowacki M., Sawczak M., Wcisło A., Niedziałkowski P., Jurak K., Ficek M., Bogdanowicz R.	Poly-l-Lysine-functionalized fluorescent diamond particles: pH triggered fluorescence enhancement via surface charge modulation	10.1557/s43577-022-00326-1	vol. 47	pp.1–12
[Pub45]	Nanomaterials	Kazanskiy N., Butt M., Khonina S.	Optical Computing: Status and Perspectives	10.3390/nano 12132171	vol. 12, no. 13	pp.1–31, no.2171
[Pub46]	Nanomaterials	Kazanskiy N., Butt M., Khonina S.	Recent Advances in Wearable Optical Sensor Automation Powered by Battery versus Skin-like Battery-Free Devices for Personal Healthcare—A Review	10.3390/nano 12030334	vol. 12, no. 3	pp.1-29, no.334

[Pub47]	Nanophotonics	Śmietana M., Janaszek B., Lechowicz K., Sezemsky P., Koba M., Burnat D., Kieliszczyk M., Stranak V., Szczepański P.	Electro-optically modulated lossy-mode resonance	10.1515/nanoph-2021-0687	vol. 11, no. 3	pp. 593–602
[Pub48]	Nanotechnology	Bah T., Didenko S., Zhou D., Zhu T., Ikzibane H., Monfray S., Skotnicki T., Dubois E., Robillard J.	A CMOS compatible thermoelectric device made of crystalline silicon membranes with nanopores	10.1088/1361-6528/ac8d12	vol. 33, no. 50	pp.1–6, no. 505403
[Pub49]	Optica Applicata	Witoński P., Mossakowska-Wyszyńska A.	Analysis of nonlinear parity-time symmetric four-layer Bragg grating	10.37190/oa220301	vol. 52, no. 3	pp. 329–344
[Pub50]	Optical Fiber Technology	Gabler T., Janik M., Liao C., Myśliwiec A., Koba M., Jonsson-Niedziolka M., Wang Y., Śmietana M.	(INVITED)Investigation of liquids with microcavity in-line Mach-Zehnder interferometers – impact of the microcavity shape on the sensing performance	10.1016/j.yofte.2022.103059	vol. 73	pp. 1–9, no. 103059
[Pub51]	Optical Materials	Butt M., Khonina S., Kazanskiy N., Piramidowicz R.	Hybrid metasurface perfect absorbers for temperature and biosensing applications	10.1016/j.optmat.2021.111906	vol. 123	pp.1–8, no. 111906
[Pub52]	Optics and Laser Technology	Eftimov T., Arapova A., Janik M., Bock W.	Broad range bimodal microcavity in-line Mach-Zehnder interferometers	10.1016/j.optlastec.2021.107503	vol. 145	pp.1–7, no. 107503
[Pub53]	Optics and Lasers in Engineering	Dziekan Z., Pituła E., Kwietniewski N., Stonio B., Janik M., Śmiarowski T., Koba M., Parzuchowski P., Niedziółka-Jönsson J., Śmietana M.	Performance of nanoimprinted and nanocoated optical label-free biosensor – nanocoating properties perspective	10.1016/j.optlaseng.2022.107009	vol. 153	pp.1–8, no. 107009
[Pub54]	Optics and Lasers in Engineering	Krześniak A., Gabler T., Janik M., Koba M., Jonsson-Niedziolka M., Śmietana M.	A microfluidic system for analysis of electrochemical processing using a highly sensitive optical fiber microcavity	10.1016/j.optlaseng.2022.107173	vol. 158	pp.1–9, no. 107173
[Pub55]	Optics Express	Butt M., Tyszkiewicz C., Karasiński P., Zieba M., Hlushchenko D., Baraniecki T., Kaźmierczak A., Piramidowicz R., Guzik M., Bachmatiuk A.	Development of a low-cost silica-titania optical platform for integrated photonics applications	10.1364/oe.460318	vol. 30, no. 13	pp. 23678–23694
[Pub56]	Optik	Butt M., Khonina S., Kazanskiy N.	A compact design of a modified Bragg grating filter based on a metal-insulator-metal waveguide for filtering and temperature sensing applications	10.1016/j.ijleo.2021.168466	vol. 251	pp.1–7, no. 168466
[Pub57]	Physical Review B	Nabiałek A., Chumak O., Lynnyk A., Domagala J., Pacewicz A., Salski B., Krupka J., Yamamoto T., Seki T., Takanashi K., Baczewski L., Szymczak H.	Anisotropy of magnetoelastic properties in epitaxial $Co_2FexMn1-xSi$ Heusler alloy thin films	10.1103/physrevb.106.054406	vol. 106, no. 5	pp.1–11, no. 054406
[Pub58]	Plasmonics	Butt M., Khonina S., Kazanskiy N.	Simple and Improved Plasmonic Sensor Configuration Established on MIM Waveguide for Enhanced Sensing Performance	10.1007/s11468-022-01633-8	vol. 17, no. 3	pp. 1305–1314
[Pub59]	Przegląd Elektrotechniczny	Bolek K., Urbański M.	Influence of Measuring System Noise on the Fractal Dimension of the Chaotic Signal Attractor	10.15199/48.2022.12.17	vol. 98, no. 12	pp. 68–71

[Pub60]	Przegląd Elektrotechniczny	Kondracka K., Firek P., Jaworowska M., Sochacki M.	Technology of modified structures ISFET for detection of avidin	10.15199/48.2022.10.56	vol. 98, no. 10	pp. 249–252, no. 139776
[Pub61]	Przegląd Elektrotechniczny	Stonio B., Wiśniewski P., Haras M., Sochacki M.	Technologia wytwarzania sub-mikrometrowych diod tunelowych typu MIM	10.15199/48.2022.02.25	vol. 1, no. 2	pp. 116–118
[Pub62]	Przegląd Elektrotechniczny	Wiśniewski P., Majkusiak B.	Modeling of InAs/Si Electron-Hole Bilayer Tunnel Field Effect Transistor	10.15199/48.2022.02.30	vol. 1, no. 2	pp. 135–137
[Pub63]	Scientific Reports	Jarocka A., Fetliński B., Dębowski P., Pietrzak T., Jurak K., Wasiucionek M.	Facile and cost-effective technique to control europium oxidation states in glassy fluorophosphate matrices with tunable photoluminescence	10.1038/s41598-022-21981-z	vol. 12, no. 1	pp.1–10, no.18774
[Pub64]	Scientific Reports	Wilczyński K., Wróblewska A., Daniszewska A., Krupka J., Mrozowski M., Zdrojek M.	Modulation of dielectric properties in low-loss polypropylene-based composites at GHz frequencies: theory and experiment	10.1038/s41598-022-17173-4	vol. 12, no. 1	pp.1–9, no.13104
[Pub65]	Sensors	Irfan M., Khan Y., Rehman A., Butt M., Khonina S., Kazanskiy N.	Plasmonic Refractive Index and Temperature Sensor Based on Graphene and $LiNbO_3$	10.3390/s22207790	vol. 22, no. 20	pp.1–12, no.7790
[Pub66]	Sensors	Papanikolaou A., Garbat P., Kujawińska M.	Metrological Evaluation of the Demosaicking Effect on Colour Digital Image Correlation with Application in Monitoring of Paintings	10.3390/s22197359	vol. 22, no. 19	pp.1–17, no.7359
[Pub67]	Sensors and Actuators B – Chemical	Burnat D., Sezemsky P., Lechowicz K., Koba M., Janczuk-Richter M., Janik M., Stranak V., Niedziolka-Jonsson J., Bogdanowicz R., Śmietana M.	Functional fluorine-doped tin oxide coating for opto-electrochemical label-free biosensors	10.1016/j.snb.2022.132145	vol. 367	pp.1–20, no. 132145
[Pub68]	Solid-State Electronics	Mroczyński R., Ożga M., Godlewski M., Witkowski B.	Hydrothermally formed copper oxide (CuO) thin films for resistive switching memory devices	10.1016/j.sse.2022.108357	vol. 194	pp.1–6, no. 108357

7.2. Scientific and Technical Papers Published in Journals not Included in the JCR Database

NUMBER	JOURNAL	AUTHORS	TITLE	DOI	VOLUME NUMBER	PAGES, ARTICLE NUMBER
[Pub69]	Applied Research	Butt M.	Metal-insulator-metal waveguide based plasmonic sensors: Fantasy or truth-A critical review	10.1002/appl.202200099		pp.1–7, no.e202200099
[Pub70	Archives of Transport	Ratkiewicz A., Walczak J.	Difficult-to-measure integration measurement method for designing processes in a chain-like structure of conflicted cells in a supply chain	10.5604/01.3001.0016.1047	vol. 64, no. 4	pp. 27–43

[Pub71]	Biosensors	Butt M., Kazanskiy N., Khonina S.	Advances in Waveguide Bragg Grating Structures, Platforms, and Applications: An Up-to-Date Appraisal	10.3390/bios 12070497	vol. 12, no. 7	pp.1–28, no.497
[Pub72]	Engineering Proceedings	Garbat P., Dzieniszewska A., Kuś A., Józwik M., Piramidowicz R.	The Color-Polarization Filter Array (CPFA) Sensors to Recognize Skin Lesions	10.3390/engproc 2022021052	vol. 21, no. 1	pp.52–52
[Pub73]	Engineering Proceedings	Garbat P., Piramidowicz R.	Application of Polarization Sensing for Detection in Scattering Media	10.3390/engproc 2022021053	vol. 21, no. 1	pp.53–53
[Pub74]	IEEE Transactions on Electron Devices	Taube A., Kamiński M., Tarenko J., Sadowski O., Ekielski M., Szerling A., Prystawko P., Bockowski M., Grzegory I.	High Breakdown Voltage and High Current Injection Vertical GaN-on-GaN p-n Diodes With Extremely Low On-Resistance Fabricated on Ammonothermally Grown Bulk GaN Substrates	10.1109/ted.2022. 3208851	vol. 69, no. 11	pp.6255––6259
[Pub75]	Photonics	Kazanskiy N., Khonina S., Butt M.	Advancement in Silicon Integrated Photonics Technologies for Sensing Applications in Near-Infrared and Mid-Infrared Region: A Review	10.3390/photonics 9050331	vol. 9, no. 5	pp.1–27, no.331
[Pub76]	Photonics	Khan Y., Butt M., Khonina S., Kazanskiy N.	Thermal Sensor Based on Polydimethylsiloxane Polymer Deposited on Low-Index-Contrast Dielectric Photonic Crystal Structure	10.3390/photonics 9100770	vol. 9, no. 10	pp.1-10, no.770
[Pub77]	Photonics	Rehman A., Khan Y., Irfan M., Butt M., Khonina S., Kazanskiy N.	A Novel Design of Optical Switch Based on Guided Mode Resonances in Dielectric Photonic Crystal Structures	10.3390/photonics 9080580	vol. 9, no. 8	pp.1–16, no.580
[Pub78]	Photonics Letters of Poland	Butt M.	Plasmonic sensor realized on metal-insulator-metal waveguide configuration for refractive index detection	10.4302/plp.v14i1. 1122	vol. 14, no. 1	pp.1–3
[Pub79]	Photonics Letters of Poland	Butt M., Kaźmierczak A., Tyszkiewicz C., Krasiński P., Środa E., Olszewski J., Pala P., Martynkien T., Hlushchenko D., Baraniecki T., Bachmatiuk A., Jusza A., Guzik M., Piramidowicz R.	HYPHa project: a low-cost alternative for integrated photonics	10.4302/plp.v14i2. 1145	vol. 14, no. 2	pp.25–27
[Pub80]	Photonics Letters of Poland	Butt M., Piramidowicz R.	Standard slot waveguide and double hybrid plasmonic waveguide configurations for enhanced evanescent field absorption methane gas sensing	10.4302/plp.v14i1. 1121	vol. 14, no. 1	pp.10–12
[Pub81]	Przegląd Telekomunikacyjny – Wiadomości Telekomunikacyjne	Garbat P., Galiński G., Bieniek M., Żakowski M., Lasocki M.	System analizy obrazu dla potrzeb systemu AR	10.15199/59. 2022.4.7	no. 4	pp. 143–146, no.138931

[Pub82]	Sensors & Transducers	Kozłowski Ł., Shahbaz M., Butt M., Tyszkiewicz C., Karasiński P., Kaźmierczak A., Piramidowicz R.	Low-cost Integrated Photonic Platform Developed via a Sol-gel Dip-coating Method: A Brief Review		vol. 259, no. 5	pp.82–92
[Pub83]	Technologies	Khan Z., Naseer F., Khan Y., Bilal M., Butt M.	Study of Joint Symmetry in Gait Evolution for Quadrupedal Robots Using a Neural Network	10.3390/technologies10030064	vol. 10, no. 3	pp.1–12, no.64
[Pub84]	TechRxiv	Burnat D., Kwietniewski N., Bartnik K., Koba M., Kochanowska O., Kondracka K., Śmietana M.	Tailoring Refractive Index and Adlayer Sensitivity of an Optical Fiber Fabry-Perot Interferometer by a Thin Layer Deposition	10.36227/techrxiv.21102715.v1		pp.1–11
[Pub85]	TechRxiv	Janik M., Lechowicz K., Pituła E., Warszewski J., Koba M., Śmietana M.	S2EC – enhanced spectroelectrochemistry with lossy-mode resonance optical fiber sensor	10.36227/techrxiv.21316947.v1		pp.1–8

7.3. Scientific and Technical Papers Published in Conference Proceedings

NUMBER	PROCEEDINGS OF CONFERENCE / ISBN	AUTHORS	TITLE	DOI	PAGES, ARTICLE NUMBER
[Pub86]	24th International Microwave and Radar Conference MIKON ISBN 978-83-956020-3-0	Babicki K., Horestani A., Lamecki A., Mrozowski M., Baranowski M., Wróblewska A., Zdrojek M., Salski B., Krupka J.	Novel Low-Loss Substrates for 5G Applications	10.23919/mikon54314.2022.9924682	pp.1–3, no. 9924682
[Pub87]		Bajurko P., Marczewski J., Zaborowski M., Zagrajek P., Sobolewski J., Yashchyshyn Y., Skotnicki T.	Terahertz Detector Based on T-Channel JLFET with Improved Antenna Coupling Circuit	10.23919/MIKON54314.2022.9924744	pp.1–2, no. 9924744
[Pub88]	27th International Conference on Optical Fiber Sensors ISBN 978-1-957171-14-2	Burnat D., Kochanowska O., Sezemsky P., Stranak V., Koba M., Śmietana M.	Thin–Film–Modified Optical Fiber Fabry–Perot Interferometer for Refractive Index Sensing	10.1364/ofs.2022.th4.51	pp.1–4, no.Th4.51
[Pub89]		Del Villar I., Kwietniewski N., Gonzalez-Valencia E., Burnat D., Armas D., Pituła E., Matias I., Chiavaioli F., Torres P., Śmietana M.	Bloch surface wave resonances generated with dielectric stack of high refractive index contrast deposited on a D-shaped optical fiber for sensing applications	10.1364/ofs.2022.w4.58	pp.1–4, no.W4.58
[Pub90]		Lechowicz K., Warszewski J., Pituła E., Koba M., Śmietana M	Induction and monitoring of spectroelectrochemical processes with a lossy-mode resonance probe	10.1364/ofs.2022.w3.3	pp.1–4, no.W3.3
[Pub91]		Pituła E., Kouao D., Grochowska K., Sezemsky P., Simerova R., Dominguez I., Siuzdak K., Villar I., Stranak V., Śmietana M.	Ordered Titanium Dioxide Nanotubes for Lossy-mode Resonance-based Humidity Sensing	10.1364/ofs.2022.w4.62	pp.1–4, no.W4.62
[Pub92]		Gabler T., Janik M., Koba M., Sosnowska M., Kutwin M., Sawosz-Chwalibóg E., Śmietana M.	Real-time cytotoxicity monitoring using microcavity in-line Mach-Zehnder interferometer	10.1364/ofs.2022.th4.16	pp.1-4, no.Th4.16

[Pub93]	27th International Conference on Optical Fiber Sensors ISBN 978-1-957171-14-2	Sezemsky P., Koba M., Bogdanowicz R., Stranak V., Śmietana M.	Direct Monitoring of Plasma with Lossy-Mode Resonance Probe	10.1364/ofs.2022.th2.5	pp.1–4, no.Th2.5
[Pub94]		Śmietana M., Janczuk-Richter M., Sezemsky P., Stranak V., Koba M., Niedziolka-Jonsson J.	Electrical potential sensing with fluorine-doped tin oxide-coated lossy-mode resonance probe	10.1364/ofs.2022.w4.61	pp.1–4, no.W4.61
[Pub95]	29th International Conference Mixed Design of Integrated Circuits and Systems MIXDES ISBN 978-83-63578-21-3	Borkowski A., Siwiec K., Pleskacz W.	DC/DC Buck Converter Soft-Start Methods	10.23919/mixdes55591.2022.9838301	pp. 131–135
[Pub96]	29th International Conference Mixed Design of Integrated Circuits and Systems MIXDES Book of Abstracts	Kuźmicz W.	Estimating and Improving IC Manufacturing Yeld – Past, Present and Future		pp.21–21
[Pub97]		Pfitzner A.	VESTIC: A New IC Manufacturing Paradigm – Present Status and Future Plans		pp.22–22
[Pub98]	29th International Conference Mixed Design of Integrated Circuits and Systems MIXDES ISBN 978-83-63578-21-3	Wojciechowski A., Marcinek K., Pleskacz W.	Clock Signal Phase Alignment System for Daisy Chained Integrated Circuits	10.23919/mixdes55591.2022.9837958	pp.89–92
[Pub99]	45th International Spring Seminar on Electronics Technology ISBN 978-3-87480-374-8	Myśliwiec M., Kisiel R., Kruszewski M.	Pressureless Direct Bonding of Au Metallized Substrate with Si Chips by Micro-Ag Particles		pp.46–47
[Pub100]	45th International Spring Seminar on Electronics Technology ISBN 978-1-6654-6589-2	Myśliwiec M., Kisiel R., Pavłov K., Kruszewski M.	Pressureless Direct Bonding of Au Metallized Substrate with Si Chips by Micro-Ag Particles	10.1109/isse54558.2022.9812830	pp.1–7
[Pub101]	8th International Conference on Sensors and Electronic Instrumentation Advances ISBN 978-84-09-43854-9	Butt M., Kaźmierczak A., Tyszkiewicz C., Karasiński P., Piramidowicz R.	Recent Advances in the Realization of a Low-cost Integrated Photonic Platform Developed via a Sol-gel Dip-coating Method		pp.45–47, no.016
[Pub102]	9th International Symposium on Sensor Science	Garbat P., Dzieniszewska A., Kuś A., Józwik M., Piramidowicz R.	The color-polarization filter array (CPFA) sensors to recognize skin lesions		pp.55–55
[Pub103]		Garbat P., Piramidowicz R.	Application of polarization sensing for detection in scattering media		pp. 104–104, no.P38
[Pub104]		Łabaj F., Kalwas J., Górski A., Stępień D., Leszcz P., Piramidowicz R.	Design and development of a miniature Mid-IR spectrometer for environmental sensing and food safety applications		pp. 109–109, no.P34
[Pub105]		Piramidowicz R., Stopiński S., Anders K., Wiśniewski P., Słowikowski M., Pierściński K., Pierścińska D., Jureńczyk J., Ropelewski P.	MIRPIC – integrated photonics platform for sensing applications		pp.39–39
[Pub106]		Słowikowski M., Jusza A., Anders K., Zaorski W., Stopiński S., Piramidowicz R.	SMART-BED – Non-invasive system for monitoring heart and respiratory rate		pp.31–31
[Pub107]		Stopiński S., Szostak S., Anders K., Piramidowicz R.	Optical gyroscope systems based on photonic integrated circuits		pp.38–38

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[Pub108]	Ceramics in Europe 2022, ISBN978-83-942760-9-6	Kozłowska A., Węglarz H., Szysiak A., Bogucki O., Kowalko J., Leśniewska-Matys K., Trihan R., Aimable A., Rossignol F., Fetliński B., Janaszek B., Kieliszczyk M., Szczepański P., Malinowski M., Kaczkan M., Ihle M, Ziesche S., Giemza P., Szczypa M.	Multilayer ceramic as a novel functional material for lightning and sensing platform		pp. 212–212
[Pub109]		Trihan R., Aimable A., Rossignol F., Kowalko J., Węglarz H., Szysiak A., Bogucki O., Kozłowska A., Ihle M, Ziesche S., Fetliński B., Janaszek B., Kieliszczyk M., Szczepański P., Malinowski M., Kaczkan M., Giemza P., Szczypa M.	A new SPR-based sensor using transparent ceramics coated with gold-silica nanoparticles and mesoporous topcoat		pp. 255–255
[Pub110]	IEEE International Conference on Quantum Computing and Engineering QCE ISBN 978-1-6654-9113-6	Kulik P., Sowiński M., Kasprowicz G., Allock D., Ballance C., Bourdeauducq S., Britton J., Gąska M., Harty T., Jarosiński J., Jördens R., Kiepiela M., Krackow N., Nadlinger D., Poźniak K., Przywózki T., Slichter D., Świtakowski F., Weber M., Wojciechowski A., Zhang W.	Latest developments in the Sinara open hardware ecosystem	10.1109/QCE53715.2022.00123	pp. 799–802
[Pub111]	International Conference on Molecular Spectroscopy, From Molecules to Functional Materials ISBN 978-83-65955-58-6	Anders K., Jusza A., Piramidowicz R.	Invesgaon of up-conversion pumping schemes in Er+Yb:ZBLAN glasses		pp. 192–192, no.P–86 (PRE'22)
[Pub112]		Anders K., Sójka Ł., Seddon A., Benson T., Furniss D., Tang Z., Piramidowicz R., Sujecki S.	Study of Tb^{3+} doped chalcogenide fibers for applicaon in MIR light sources		pp. 191–191, no.P–85 (PRE'22)
[Pub113]		Jusza A., Butt M., Gil-Kowalczyk M., Łyszczek R., Mergo P., Piramidowicz R.	Luminescent hybrid materials for visible light sources		pp. 203–203, no.P–96 (PRE'22)
[Pub114]		Malinowski M., Kaczkan M., Turczyński S.	Mulsite luminescence of rare earth ions doped $Y4Al_2O_9$ crystals		pp.67–67, no.O–22
[Pub115]	SPIE: Fiber Lasers and Glass Photonics: Materials through Applications III, vol. 12142 ISBN 9781510651609	Bortnowski P., Jusza A., Anders K., Mergo P., Piramidowicz R.	Progress in developing optically active fibers in Poland	DOI:10.1117/12.2624514	pp.1–30, no.PC121 420W
[Pub116]		Jusza A., Grajek P., Karczewska M., Mergo P., Piramidowicz R.	Dysprosium doped glasses for application in visible light sources	10.1117/12.2624537	pp.1–25, no.PC121 420K
[Pub117]	SPIE: Micro-Structured and Specialty Optical Fibres VII, vol. 12140 ISBN 9781510651562	Anders K., Bortnowski P., Komorowski P., Jusza A., Mazurek P., Turkiewicz J., Mergo P., Markiewicz K., Nasiłowski T., Piramidowicz R.	Few-mode optical fibers for application in future telecommunication networks	10.1117/12.2624520	no.PC121 420W
[Pub118]	SPIE: Optical Sensing and Detection VII, vol. 12139 ISBN 9781510651548	Kaźmierczak A., Butt M., Zięba M., Tyszkiewicz C., Karasiński P., Piramidowicz R.	Towards the most convenient configuration of integrated photonic sensor for implementation in SiO_2:TiO_2 sol-gel derived waveguide film technology	10.1117/12.2622209	pp.1–10, no. 1213908

[Pub119]	SPIE: Optical Technologies for Telecommunications, vol. 12295 ISBN 9781510656451	Butt M., Fomchenkov S.	Optimizing the device model for enhanced sensitivity of the plasmonic sensor	10.1117/12.2631748	pp.1–7, no.122950H
[Pub120]	SPIE: Semiconductor Lasers and Laser Dynamics X, vol. 12141 ISBN 9781510651586	Paśnikowska A., Stopiński S., Bortnowski P., Anders K., Piramidowicz R.	Integrated photonic transmitter for mode division multiplexing system	10.1117/12.2624528	pp.1–1, no.PC121410T
[Pub121]	Symposium on Advanced Technologies and Materials ATAM	Duda Ł., Czajkowski M., Butt M., Rola K., Guzik M.	Luminescent submicrometric polymer and sol-gel films – preparation, properties and future perspectives for application in photonics		pp.33–33
[Pub122]		Kozłowski Ł., Kaźmierczak A., Butt M., Piramidowicz R.	Waveguide structures for refractive index sensing on a low-cost Silica–Titania optical platform		pp.80–81
[Pub123]	The Seventh International Workshop on Advanced Spectroscopy and Optical Materials	Anders K., Jusza A., Butt M., Piramidowicz R.	Low phonon glasses and polymer composites doped with erbium – a comparative study		pp.63–63, no.O13
[Pub124]		Bortnowski P., Jusza A., Anders K., Piramidowicz R.	UV and visible emission in thulium-doped ZBLAN glasses		pp.89–89, no.P06
[Pub125]		Jusza A., Karczewska M., Mergo P., Piramidowicz R.	Dysprosium doped oxide and fluoride glasses for yellow fiber lasers		pp.64–64, no.O14
[Pub126]		Piramidowicz R., Jusza A., Anders K., Butt M., Łyszczek R., Mergo P.	Luminescent polymer composites doped with rare-earth elements		pp.34–34, no.IL15
[Pub127]	VIII Congress of the Polish Vacuum Society	Firek P., Czerwosz E., Wronka H., Krawczyk S., Sochacki M., Szmidt J., Moszczyńska D.	Otrzymywanie i właściwości tranzystorów z bramką C-Pdd		pp.15–15
[Pub128]		Krawczyk S., Kozłowski M., Czerwosz E., Wronka H., Firek P., Sochacki M., Szmidt J.	Porównanie właściwości sensorycznych tranzystorów z warstwą C-Pd oraz warstw C-Pd		pp.16–16
[Pub129]	VIII International Conference on Information Technology and Nanotechnology ISBN 978-1-6654-8572-2	Ur Rehman A., Khan Y., Fomchenkov S., Butt M.	Investigation of Optical Amplification Action in Dielectric Photonic Crystals Cavity Based Structure	10.1109/itnt55410.2022.9848665	pp.1–5
[Pub130]	XIII Sympozjum Techniki Laserowej STL	Anders K., Stopiński S., Jusza A., Paśnikowska A., Piramidowicz R.	Układy laserowe w generycznej technologii fotoniki scalonej – projekty, technologie, realizacje		pp. 105–105, no.P30
[Pub131]		Bortnowski P., Jusza A., Anders K., Kaźmierczak A., Butt M., Mergo P., Piramidowicz R.	Analiza właściwości emisyjnych w zakresie UV i VIS jonów tulu w niskofononowych szkłach i kompozytach polimerowych		pp. 104–104, no.P29

[Pub132]		Janaszek B., Fetliński B., Kaczkan M., Kieliszczyk M., Szczepański P., Malinowski M., Trihan R., Aimable A., Rossignol F., Kowalko J., Węglarz H., Szysiak A., Bogucki O., Kozlowska A., Ihle M., Ziesche S., Giemza P., Szczypa M.	Nanocząsteczkowy czujnik plazmoniczny do detekcji obecności metali ciężkich oraz biocząstek	pp.91–91, no.P16
[Pub133]		Janaszek B., Tyszka-Zawadzka A., Jerominiak M., Szczepański P.	Ogranicznik mocy optycznej wykonany na bazie nieliniowego metamateriału hiperbolicznego	pp.90–90, no.P15
[Pub134]		Jusza A., Anders K., Bortnowski P., Mergo P., Piramidowicz R.	W poszukiwaniu żółtego promieniowania laserowego – domieszkowane dysprozem materiały aktywne do zastosowań w laserach na zakres widzialny	pp.53–53, no.RS-4.4
[Pub135]	XIII Sympozjum Techniki Laserowej STL	Kieliszczyk M., Janaszek B., Fetliński B.	Projektowanie planarnych elementów optycznych przy wykorzystaniu programowania genetycznego	pp. 109–109, no.P34
[Pub136]		Mossakowska-Wyszyńska A., Witoński P., Szczepański P.	Bistabilna generacja w laserze Fabry-Perot z ośrodkiem aktywnym posiadającym symetrię PT	pp.77–77, no.P2
[Pub137]		Piramidowicz R., Stopiński S., Anders K., Jusza A., Paśnikowska A., Słowikowski M., Kaźmierczak A., Butt M.	Fotoniczne układy scalone – technologie, aplikacje, trendy	pp.50–50, no.RS-4.1
[Pub138]		Stopiński S., Bieniek A., Piramidowicz R.	Zintegrowane jednoczęstotliwościowe lasery pierścieniowe do zastosowań w żyroskopach optycznych	pp.52–52, no.RS-4.3
[Pub139]		Witoński P., Mossakowska-Wyszyńska A., Szczepański P.	Właściwości wzmacniające dwuwarstwowej komórki elementarnej wykazującej parzystą symetrię PT	pp.76–76, no.P1

8. REPORTS

NUMBER	AUTHORS	TITLE	TYPE
[Rep1]	Anders K.	Development of optical interfaces for silicon-nitride-based photonic platform	**Scientific report** from the project granted by Warsaw University of Technology
[Rep2]	Anders K.	Inactivation of SARS-CoV-2 viruses using UV-C radiation from the surface of air filters	**Scientific report** from the project granted by Warsaw University of Technology
[Rep3]	Anders K., Jusza A., Butt M., Piramidowicz R.	Low phonon glasses and polymer composites doped with erbium – a comparative study	**Presentation**: 7th International Workshop on Advanced Spectroscopy and Optical Materials (IWASOM'2022)
[Rep4]	Anders K., Paśnikowska A., Bortnowski P., Stopiński S., Słowikowski M., Mazurek P., Turkiewicz J., Mergo P., Markiewicz K., Napierała M., Nasiłowski T., Piramidowicz R.	Spatial division multiplexing fiber optic systems – key components and performance parameters	**Presentation**: 16th Conference Integrated Optics – Sensors, Sensing Structures and Methods (IOS2022)
[Rep5]	Anders K., Stopiński S., Jusza A., Paśnikowska A., Piramidowicz R.	Układy laserowe w generycznej technologii fotoniki scalonej – projekty, technologie, realizacje	**Poster**: XIII Sympozjum Techniki Laserowej (STL 2022)
[Rep6]	Bolek K.	Wpływ szumów toru pomiarowego na odtwarzanie wymiaru fraktalnego sygnałów chaosu deterministycznego	**Paper Presented**: XIV Konferencja Naukowo-Techniczna Podstawowe Problemy Metrologii (PPM'22)
[Rep7]	Bortnowski P., Jusza A., Anders K., Kaźmierczak A., Butt M., Mergo P., Piramidowicz R.	Analiza właściwości emisyjnych w zakresie UV i VIS jonów tulu w niskofononowych szkłach i kompozytach polimerowych	**Poster**: XIII Sympozjum Techniki Laserowej (STL 2022)
[Rep8]	Bortnowski P., Jusza A., Anders K., Piramidowicz R.	UV and visible emission in thulium-doped ZBLAN glasses	**Poster**: 7th International Workshop on Advanced Spectroscopy and Optical Materials (IWASOM'2022)
[Rep9]	Butt M., Kaźmierczak A., Jusza A., Tyszkiewicz C., Karasiński P., Piramidowicz R.	Analiza możliwości zastosowania technologii światłowodów scalonych SiO_2:TiO_2 do konstrukcji scalonych wielokanałowych sensorów fotonicznych	**Presentation**: XXI Krajowa Konferencja Elektroniki (XXI KKE)
[Rep10]	Fetliński B.	Hyperbolic metamaterials for enhancing energy yield of photovoltaic modules	**Scientific report** from the project granted by Warsaw University of Technology
[Rep11]	Fetliński B.	Novel glassy and nanocrystalline phosphors for white LED lighting safe for human vision	**Scientific report** from the project granted by Warsaw University of Technology
[Rep12]	Filipiak M., Myśliwiec M., Słowikowski M.	Thermal reflow study in fabrication of microlens array	**Presentation**: 16th Conference Integrated Optics – Sensors, Sensing Structures and Methods (IOS2022)
[Rep13]	Firek P.	Development of an innovative technology for PVD deposition of a multilayer, nanocomposite transistor gate	**Scientific report** from the project granted by Warsaw University of Technology
[Rep14]	Firek P., Czerwosz E., Wronka H., Krawczyk S.	Otrzymywanie i właściwości tranzystorów z bramką C-Pd	**Paper Presented**: VIII Congress of the Polish Vacuum Society (PVS'22)

[Rep15]	Firek P., Krawczyk S., Wronka H., Czerwosz E., Szmidt J.	Porównanie właściwości detekcyjnych, Sensora wodoru z warstwą C-Pd, w wersji rezystancyjnej i polowej	**Presentation**: V Seminar – Prof. Aleksandra Sokołowska „Nowoczesne technologie materiałowe", 2022
[Rep16]	Firek P., Mazurak A., Ojrzeńska-Wójter D., Dzieniszewska-Naroska K.	Nauczanie w oparciu o projekty na kierunku Elektronika – okiem praktyka	**Presentation**: XXI Krajowa Konferencja Elektroniki (XXI KKE)
[Rep17]	Garbat P.	Development and implementation of an artificial intelligence system of virtual characters allowing simulation of their realistic behaviour and interactions with the player based on an autonomous analysis of the game participants' image in real time	**Scientific report** from the project granted by the National Centre for Research and Development
[Rep18]	Garbat P., Piramidowicz R.	Application of Polarization Sensing for Detection in Scattering Media	**Poster**: 9th International Symposium on Sensor Science (I3S 2022)
[Rep19]	Golas M., Lelit M., Słowikowski M., Pavłov K., Stonio B., Filipiak M., Juchniewicz M., Wiśniewski P., Beck R.	Numerical analysis of silicon nitride planar Bragg gratings	**Poster**: 16th Conference Integrated Optics – Sensors, Sensing Structures and Methods (IOS2022)
[Rep20]	Janaszek B., Fetliński B., Kaczkan M., Kieliszczyk M., Szczepański P., Malinowski M., Trihan R., Aimable A., Rossignol F., Kowalko J., Helena W., Szysiak A., Bogucki O., Kozlowska A., Ihle M., Ziesche S., Giemza P., Szczypa M.	Nanocząsteczkowy czujnik plazmoniczny do detekcji obecności metali ciężkich oraz biocząstek	**Poster**: XIII Sympozjum Techniki Laserowej (STL 2022)
[Rep21]	Janaszek B., Tyszka-Zawadzka A., Jerominiak M., Szczepański P.	Ogranicznik mocy optycznej wykonany na bazie nieliniowego metamateriału hiperbolicznego	**Poster**: XIII Sympozjum Techniki Laserowej (STL 2022)
[Rep22]	Janaszek B., Tyszka-Zawadzka A., Jerominiak M., Szczepański P.	Właściwości wzmacniające dwuwarstwowej komórki elementarnej wykazującej parzystą symetrię PT	**Poster**: XIII Sympozjum Techniki Laserowej (STL 2022)
[Rep23]	Janik M.	Influence of biological materials' charge on the functional parameters of opto-electrochemical biosensors	**Scientific report** from the project granted by Warsaw University of Technology
[Rep24]	Judek J.	Plasmons and polariton on structured Surfaces of group IVb metal notrides	**Scientific report** from the project granted by Warsaw University of Technology
[Rep25]	Jusza A., Anders K., Bortnowski P., Mergo P., Piramidowicz R.	W poszukiwaniu żółtego promieniowania laserowego – domieszkowane dysprozem materiały aktywne do zastosowań w laserach na zakres widzialny	**Presentation**: XIII Sympozjum Techniki Laserowej (STL 2022)
[Rep26]	Jusza A., Karczewska M., Mergo P., Piramidowicz R.	Dysprosium doped oxide and fluoride glasses for yellow fiber lasers	**Presentation**: 7th International Workshop on Advanced Spectroscopy and Optical Materials (IWASOM'2022)
[Rep27]	Kaczkan M.	Application of the terahertz spectroscopy to the investigation of the charge transport phenomena occurring in the electroactive materials	**Scientific report** from the project granted by Warsaw University of Technology
[Rep28]	Kaczkan M.	New Versatile Platform for Illumination and Sensing – NewILUMIS	**Scientific report** from the project granted by the National Centre for Research and Development

[Rep29]	Kaźmierczak A.	Arrays of diffractive optical elements for applications in optical interface systems of photonic integrated circuits	**Scientific report** from the project granted by Warsaw University of Technology
[Rep30]	Kaźmierczak A.	Fotonika scalona w zastosowaniach sensorycznych – historia, stan obecny, perspektywy	**Paper Presented**: XXI Krajowa Konferencja Elektroniki (XXI KKE)
[Rep31]	Kieliszczyk M., Janaszek B., Fetliński B.	Projektowanie planarnych elementów optycznych przy wykorzystaniu programowania genetycznego	**Poster**: XIII Sympozjum Techniki Laserowej (STL 2022)
[Rep32]	Kisiel R.	New generation of high thermal efficiency components packages for space	**Scientific report** from the project granted by EU Horizon project
[Rep33]	Koba M.	Fiber optic electro-optical modulator for studying electromagnetic interactions caused by high-energy laser radiation	**Scientific report** from the project granted by Warsaw University of Technology
[Rep34]	Kondracka K., Firek P., Jaworowska M., Sochacki M.	Technologia i charakteryzacja modyfikowanych struktur ISFET na potrzeby detekcji awidyny	**Poster**: XXI Krajowa Konferencja Elektroniki (XXI KKE)
[Rep35]	Kozłowska A., Węglarz H., Szysiak A., Bogucki O., Kowalko J., Leśniewska-Matys K., Trihan R., Aimable A., Rossignol F., Fetliński B., Janaszek B., Kieliszczyk M., Szczepański P., Malinowski M., Kaczkan M., Ihle M, Ziesche S., Giemza P., Szczypa M.	Multilayer ceramic as a novel functional material for lightning and sensing platform	**Presentation**: Ceramics in Europe 2022
[Rep36]	Krawczyk S., Kozłowski M., Czerwosz E., Wronka H., Firek P., Sochacki M., Szmidt J.	Porównanie właściwości sensorycznych tranzystorów z warstwą C-Pd oraz warstw C-Pd	**Presentation**: VIII Congress of the Polish Vacuum Society (PVS'22)
[Rep37]	Krupka J.	Correlations between electromagnetic and magnetoelastic properties of thin ferromagnetic films	**Scientific report** from the project granted by the National Science Centre
[Rep38]	Kuźmicz W.	Estimating and Improving IC Manufacturing Yeld – Past, Present and Future	**Presentation**: 29th International Conference Mixed Design of Integrated Circuits and Systems (MIXDES 2022)
[Rep39]	Lelit M., Słowikowski M., Golas M., Filipiak M., Juchniewicz M., Stonio B., Michalak B., Pavłov K., Myśliwiec M., Wiśniewski P., Kaźmierczak S., Anders K., Stopiński S., Beck R., Piramidowicz R.	Advances in development of SiN-based integrated photonic platform for visible spectral range	**Presentation**: 16th Conference Integrated Optics – Sensors, Sensing Structures and Methods (IOS2022)
[Rep40]	Łabaj F., Kalwas J., Górski A., Stępień D., Leszcz P., Piramidowicz R.	Design and Development of a Miniature Mid-IR Spectrometer for Environmental Sensing and Food Safety Applications	**Poster**: 9th International Symposium on Sensor Science (I3S 2022)
[Rep41]	Mazurak A.	Study on the charge transport mechanism and filament formation in Metal-Insulator-Metal (MIM) structures	**Scientific report** from the project granted by Warsaw University of Technology
[Rep42]	Mossakowska-Wyszyńska A., Witoński P., Szczepański P.	Bistabilna generacja w laserze Fabry-Perot z ośrodkiem aktywnym posiadającym symetrię PT	**Poster**: XIII Sympozjum Techniki Laserowej (STL 2022)

[Rep43]	Mroczyński R.	Graphene as an indicator of the conditions of dielectric films technology on semiconductor substrates	**Scientific report** from the project granted by Warsaw University of Technology
[Rep44]	Mroczyński R.	HIPIMS based thin film oxides for resistive random-access memory application	**Paper Presented**: 18th International Conference on Plasma Surface Engineering (PSE 2022)
[Rep45]	Mroczyński R.	Hydrothermally formed copper oxide (CuO) thin films for resistive switching memory devices	**Paper Presented**: 8th Joint International EuroSOI Workshop and International Conference on Ultimate Integration on Silicon (EuroSOI-ULIS 2022)
[Rep46]	Mroczyński R.	Materiały dielektryczne o wysokiej przenikalności elektrycznej (high-k) dla zastosowań w strukturach pamięciowych	**Paper Presented**: XXI Krajowa Konferencja Elektroniki (XXI KKE)
[Rep47]	Mroczyński R.	Research infrastructure for the fabrication and diagnostics of semiconductor structures and devices (SPUB)	**Scientific report** from the project granted by the Ministry of Science and Higher Education
[Rep48]	Niewiński M.	System for measuring the noise parameters of mid-infrared photodetectors	**Scientific report** from the project granted by Warsaw University of Technology
[Rep49]	Ożga M., Mroczyński R., Gruszecki A., Zielony E., Godlewski M., Witkowski B.	Cienkie warstwy CuO otrzymywane metodą hydrotermalną do zastosowań w strukturach pamięciowych RRAM	**Paper Presented**: XXI Krajowa Konferencja Elektroniki (XXI KKE)
[Rep50]	Pavłov K., Filipiak M., Juchniewicz M., Michalak B., Myśliwiec M., Słowikowski M., Stonio B., Wiśniewski P., Beck R.	Grey-tone mask aligner lithography optimization for micro- optics applications	**Presentation**: 16th Conference Integrated Optics – Sensors, Sensing Structures and Methods (IOS2022)
[Rep51]	Pfitzner A.	VESTIC: A New IC Manufacturing Paradigm – Present Status and Future Plans	**Presentation**: 29th International Conference Mixed Design of Integrated Circuits and Systems (MIXDES 2022)
[Rep52]	Piramidowicz R.	Diagnosis of skin cancer in the conditions of limited social mobility	**Scientific report** from the project granted by Warsaw University of Technology
[Rep53]	Piramidowicz R.	Looking for yellow lasing – dysprosium doped active materials for lasers operating in VIS spectral range	**Scientific report** from the project granted by Warsaw University of Technology
[Rep54]	Piramidowicz R.	MIRPIC – Integrated Photonics Platform for Sensing Applications	**Paper Presented**: 9th International Symposium on Sensor Science (I3S 2022)
[Rep55]	Piramidowicz R.	Photonics Integrated Circuits technologies for MIDIR	**Scientific report** from the project granted by the National Centre for Research and Development
[Rep56]	Piramidowicz R., Jusza A., Anders K., Butt M., Łyszczek R., Mergo P.	Luminescent polymer composites doped with rare-earth elements	**Presentation**: 7th International Workshop on Advanced Spectroscopy and Optical Materials (IWASOM'2022)
[Rep57]	Piramidowicz R., Stopiński S., Anders K., Jusza A., Paśnikowska A., Słowikowski M., Kaźmierczak A., Butt M.	Fotoniczne układy scalone – technologie, aplikacje, trendy	**Presentation**: XIII Sympozjum Techniki Laserowej (STL 2022)

[Rep58]	Piramidowicz R., Stopiński S., Anders K., Jusza A., Słowikowski M., Paśnikowska A., Lelit M., Połatyński A., Kaźmierczak A., Butt M.	Integrated photonics – present capabilities and future challenges	**Presentation**: 16th Conference Integrated Optics – Sensors, Sensing Structures and Methods (IOS2022)
[Rep59]	Różański P., Mroczyński R., Puźniak M., Gajewski W.,	HIPIMS reactive magnetron sputtering in resistive random-access memory application	**Paper Presented**: International Symposium on Reactive Sputter Deposition (RSD 2022)
[Rep60]	Różański P., Puźniak M., Gajewski W., Mroczyński R.	Effect of HIPIMS on thin film oxides for resistive random-access memory application	**Paper Presented**: 18th International Conference on Plasma Surface Engineering (PSE 2022)
[Rep61]	Różański P., Puźniak M., Gajewski W., Mroczyński R.	Metal oxide nanocoatings by HIPIMS for resistive random-access memory application	**Paper Presented**: 12th International Conference on HIPIMS (HIPIMS 2022)
[Rep62]	Siwiec K.	The study of the robustness of GNSS positioning against signal disturbances	**Scientific report** from the project granted by Warsaw University of Technology
[Rep63]	Słowikowski M.	SMART-BED – non-invasive system for monitoring heart and respiratory rate	**Paper Presented**: 9th International Symposium on Sensor Science (I3S 2022)
[Rep64]	Słowikowski M., Kaźmierczak A., Bieniek M., Szostak S., Stopiński S., Piramidowicz R.	Non-invasive patient's breath monitoring during MRI diagnosis with the use of integrated photonic interrogator	**Presentation**: 16th Conference Integrated Optics – Sensors, Sensing Structures and Methods (IOS2022)
[Rep65]	Sochacki M.	Development, fabrication and characterization of HBT phototransistor test structures for the UV detection with limited sensitivity to the visible spectrum range	**Scientific report** from the project granted by Warsaw University of Technology
[Rep66]	Sochacki M.	Nowa era elektryczności	**Presentation**: Inauguration of the academic year 2022/2023 at Faculty of Electronics and Information Technology WUT
[Rep67]	Stonio B., Kwietniewski N., Sochacki M.	Technologia wytwarzania tlenku krzemu jako dielektryka polowego w obszarze terminacji JTE w wysokonapięciowych diodach p-i-n	**Poster**: XXI Krajowa Konferencja Elektroniki (XXI KKE)
[Rep68]	Stopiński S.	Photonic integrated circuits for new generation of optical gyroscope systems	**Scientific report** from the project granted by Warsaw University of Technology
[Rep69]	Stopiński S.	Optical gyroscope systems based on photonic integrated circuits	**Paper Presented**: 9th International Symposium on Sensor Science (I3S 2022)
[Rep70]	Stopiński S., Bieniek A., Piramidowicz R.	Zintegrowane jednoczęstotliwościowe lasery pierścieniowe do zastosowań w żyroskopach optycznych	**Presentation**: XIII Sympozjum Techniki Laserowej (STL 2022)
[Rep71]	Sutkowski M.	Analysis of the posture of female soccer players, participating in the Polish Women's Extraleague	**Scientific report** from the project granted by Warsaw University of Technology
[Rep72]	Szczepański P.	Shaping optical properties of planar metamaterials for photonic structures of novel functionalities	**Scientific report** from the project granted by Warsaw University of Technology
[Rep73]	Szmidt J.	Development of a modular quantum computer infrastructure for special and military IT applications	**Scientific report** from the project granted by the National Centre for Research and Development

[Rep74]	Śmietana M.	Biopolymer materials with chemically and genetically programmed heavy metal selectivity for new generation ultra-sensitive biosensors	**Scientific report** from the project granted by the National Centre for Research and Development
[Rep75]	Śmietana M.	Heterogenous diamond biosensing nanoarchitectures: opto-electro-chemical interactions with antibody complexes	**Scientific report** from the project granted by the National Science Centre
[Rep76]	Śmietana M.	Life inside an optical fiber – new opportunities for investigations and monitoring of cell cultures in micro-scale	**Scientific report** from the project granted by Warsaw University of Technology
[Rep77]	Śmietana M.	Optical analysis of electrochemical reaction products in picoliter volumes	**Scientific report** from the project granted by the National Science Centre
[Rep78]	Śmietana M.	Optical fiber biosensing systems for fast and early identification of inflammatory factors	**Scientific report** from the project granted by the National Science Centre
[Rep79]	Śmietana M.	Opto-electrochemical effects in thin conductive oxides for sensing applications	**Scientific report** from the project granted by Warsaw University of Technology
[Rep80]	Śmietana M.	S^2EC – integration of optical and electrochemical techniques towards biochemical sensing with high sensitivity and selectivity	**Scientific report** from the project granted by Warsaw University of Technology
[Rep81]	Śmietana M.	Translucent titanium dioxide nanostructures deposited on substrates with complex geometry for photoconversion and sensorics	**Scientific report** from the project granted by the National Science Centre
[Rep82]	Taube A., Sochacki M., Kwietniewski N., Werbowy A., Szmidt J., Gierałtowska S., Wachnicki Ł., Godlewski M.	Własności elektryczne izotypowych i anizotypowych heterozłączy ZnO/4H-SiC	**Presentation**: V Seminar – Prof. Aleksandra Sokołowska „Nowoczesne technologie materiałowe", 2022
[Rep83]	Trihan R., Aimable A., Rossignol F., Kowalko J., Węglarz H., Szysiak A., Bogucki O., Kozłowska A., Ihle M, Ziesche S., Fetliński B., Janaszek B., Kieliszczyk M., Szczepański P., Malinowski M., Kaczkan M., Giemza P., Szczypa M.	A new SPR-based sensor using transparent ceramics coated with gold-silica nanoparticles and mesoporous topcoat	**Presentation**: Ceramics in Europe 2022
[Rep84]	Tyszkiewicz C., Karasiński P., Kaźmierczak A., Butt M.	Badanie zależności między czułością homogeniczną światłowodów żebrowych a rozkładem energii prowadzonych w nich pól modów HE00 i EH00	**Presentation**: XXI Krajowa Konferencja Elektroniki (XXI KKE)
[Rep85]	Wiśniewski P., Beck R.	Stochastyczne efekty w nowych typach pamięci półprzewodnikowych na potrzeby bezpieczeństwa układów elektronicznych	**Presentation**: V Konferencja Naukowa PRZESTĘPCZOŚĆ TELEINFORMATYCZNA XXI WIEKU (PT 2022)
[Rep86]	Wiśniewski P., Jasiński J., Mazurak A., Stonio B., Beck R.	Silicon-oxide based MOS structures for Resistive RAM Devices	**Poster**: European Materials Research Society 2022 Fall Meeting (E-MRS 2022 Fall Meeting)
[Rep87]	Witoński P., Mossakowska-Wyszyńska A., Szczepański P.	Właściwości wzmacniające dwuwarstwowej komórki elementarnej wykazującej parzystą symetrię PT	**Poster**: XIII Sympozjum Techniki Laserowej (STL 2022)

9. CONFERENCES, SEMINARS AND MEETINGS

NUMBER	CONFERENCE, SEMINARS AND MEETINGS
[Con1]	7th International Workshop on Advanced Spectroscopy and Optical Materials (IWASOM'2022), 2022, July 10–15, Gdańsk, Poland
[Con2]	8th International Conference on Sensors and Electronic Instrumentation Advances (SEIA' 2022), September 21–23, Corfu, Greece
[Con3]	8th Joint International EuroSOI Workshop and International Conference on Ultimate Integration on Silicon (EuroSOI-ULIS 2022), 2022. May 18-20, Udine, Italy
[Con4]	9th International Symposium on Sensor Science (I3S 2022), 2022, June 20–22, Warszawa, Poland
[Con5]	12th International Conference on HIPIMS (HIPIMS 2022), 2022, June15–16, Sheffield, United Kingdom
[Con6]	16th Conference Integrated Optics – Sensors, Sensing Structures and Methods (IOS2022), 2022, February 28 – March 04, Szczyrk, Poland
[Con7]	18th International Conference on Plasma Surface Engineering (PSE 2022), 2022, September 12–15, Erfurt, Germany
[Con8]	24th International Microwave and Radar Conference (MIKON 2022), 2022, September 12–14, Gdańsk, Poland
[Con9]	27th International Conference on Optical Fiber Sensors (OFS 2022), 2022, August 29 – September 02, Alexandria, Virginia, USA
[Con10]	29th International Conference Mixed Design of Integrated Circuits and Systems (MIXDES 2022), 2022, June 23–24, Wrocław, Poland
[Con11]	45th International Spring Seminar on Electronics Technology "Electronics Technology Innovations towards Green Electronics" (ISSE 2022), 2022, May 11–15, Online, Austria
[Con12]	Conference Ceramics in Europe 2022, July 10–14, Kraków, Poland
[Con13]	Conference SPIE Photonics Europe 2022: Fiber Lasers and Glass Photonics: Materials through Applications III, Micro-Structured and Specialty Optical Fibres VII, Optical Sensing and Detection VII, Semiconductor Lasers and Laser Dynamics X (SPIE PE 2022), 2022, April 03–07, Strasbourg, France
[Con14]	European Materials Research Society 2022 Fall Meeting (E-MRS 2022 Fall Meeting), 2022, September 19–22, Warszawa, Poland
[Con15]	IEEE International Conference on Quantum Computing and Engineering 2022 (QCE 22), 2022, September 18–23, Online, USA
[Con16]	International Symposium on Reactive Sputter Deposition (RSD 2022), 2022, December 7–9, Gandawa, Belgium
[Con17]	Symposium on Advanced Technologies and Materials (ATAM 2022), 2022, September 06–09, Wrocław, Poland
[Con18]	V Konferencja Naukowa Przestępczość Teleinformatyczna XXI wieku (PT 2022), June 13–15, Gdynia, Poland

CONFERENCES, SEMINARS AND MEETINGS

[Con19]	Seminar – Prof. Aleksandra Sokołowska „Nowoczesne technologie materiałowe", 2022, May 18–20, Jastrzębia Góra, Poland
[Con20]	VIII Congress of the Polish Vacuum Society (PVS'22), 2022, July 06–07, Kraków, Poland
[Con21]	XIII Sympozjum Techniki Laserowej (STL 2022), 2022, September 19–23, Karpacz, Poland
[Con22]	XIV Konferencja Naukowo-Techniczna Podstawowe Problemy Metrologii (PPM'22), 2022, June 06, Gliwice, Poland
[Con23]	XVIth International Conference on Molecular Spectroscopy, From Molecules to Functional Materials (ICMS 2022), 2022, September 11–14, Szczawnica, Poland
[Con24]	XXI Krajowa Konferencja Elektroniki (XXI KKE), 2022, June 05–09, Darłowo, Poland

10. AWARDS

[Award1] Bączyk Marcin, Firek Piotr, Nałęcz Marek, Piramidowicz Ryszard, Radtke Maciej, Szostak Sławomir, Wieczorek Piotr, Zaręba Agnieszka, **WUT Rector's Collective Award for Organizing Achievements (2nd stage)**, (Nagroda zespołowa stopnia II JM Rektora PW za osiągnięcia organizacyjne w latach 2020–2021), 2022

[Award2] Borkowski Adam, Siwiec Krzysztof, Pleskacz Witold, **Best Paper Award on 29th International Conference MIXDES 2022**, (Nagroda dla Najlepszej Pracy na 29 Międzynarodowej Konferencji MIXDES 2022), 2022

[Award3] Bortnowski Paweł, **Best Poser Award on International Workshop on Advanced Spectroscopy and Optical Materials IWASOM 2022**, (Nagroda dla Najlepszej Prezentacji plakatowej na konferencji International Workshop on Advanced Spectroscopy and Optical Materials IWASOM 2022), 2022

[Award4] Janaszek Bartosz, Kieliszczyk Marcin, Tyszka-Zawadzka Anna, Szczepański Paweł, **WUT Rector's Collective Award for Scientific Achievements (1st stage)**, (Nagroda zespołowa stopnia I JM Rektora PW za osiągnięcia naukowe w latach 2020–2021), September 27, 2022

[Award5] Kasprowicz Dominik, **Medal of National Education Commission** (Medal Komisji Edukacji Narodowej), 2022

[Award6] Krupka Jerzy, **WUT Rector's Individual Award for Scientific Achievements (1st stage)**, (Nagroda indywidualna stopnia I JM Rektora PW za całokształt działalności naukowej), September 27, 2022

[Award7] Kuźmicz Wiesław, **Knight's Cross of the Order of the Polonia Restituta**, (Krzyż Kawalerski Orderu Odrodzenia Polski), October 4, 2022

[Award8] Mazurak Andrzej, Jasiński Jakub, Walczak Jakub, Zaręba Agnieszka, Krogulski Krzysztof, **WUT Rector's Collective Award for Organizing Achievements (2nd stage)**, (Nagroda zespołowa stopnia II JM Rektora PW za osiągnięcia organizacyjne w latach 2020–2021), 2022

[Award9] Piramidowicz Ryszard, Butt Muhammad Ali, Jusza Anna, Kaźmierczak Andrzej, Stopiński Stanisław, Anders Krzysztof, Paśnikowska Aleksandra, Słowikowski Mateusz, Lelit Marcin, **WUT Rector's Collective Award for Scientific Achievements (1st stage)**, (Nagroda zespołowa stopnia I JM Rektora PW za osiągnięcia naukowe w latach 2020––2021), September 27, 2022

[Award10] Sutkowski Marek, **9th place on 48th Annual Nikon Small World Photo Microscopy Competition**, (9-te miejsce w 48 Konkursie Nikon Small World Photo Microscopy), 2022

[Award11] Sutkowski Marek, **Honorable Mention in abstract, Amateur category in Chromatic Awards 2022**, (Wyróżnienie w Konkursie Chromatic Awards 2022), 2022

[Award12] Sutkowski Marek, **Honorable Mention in Monochrome Awards – International Black & White Photography Contest 2022**, (Wyróżnienie w Konkursie Monochrome Awards - International Black & White Photography Contest 2022), 2022

AWARDS

[Award13] Szmidt Jan, Kaszewski Arkadiusz, Kwietniewski Norbert, Wojtasiak Wojciech, Gryglewski Daniel, Gierczyński Michał, Jackiewicz Krzysztof, Straś Andrzej, Grzesiak Lech, Bałkowiec Tomasz, Kamiński Maciej, Stonio Bartłomiej, Martychowiec Agnieszka, **WUT Rector's Collective Award for Scientific Achievements (1st stage),** (Nagroda zespołowa stopnia I JM Rektora PW za osiągnięcia naukowe w latach 2020–2021), September 27, 2022

[Award14] Werbowy Aleksander, **President's of the Republic of Poland Silver Medal for Long-Term Service**, (Medal Srebrny za Długoletnią Służbę), 2022

[Award15] Wojciechowski Andrzej, **Best Student's Paper Award on 29th International Conference MIXDES 2022**, (Nagroda za najlepszą pracę studencką na 29 Międzynarodowej Konferencji MIXDES 2022)

[Award16] Wojtasik Adam, **Medal of National Education Commission** (Medal Komisji Edukacji Narodowej), 2022