

Institute of Microelectronics and Optoelectronics

annual report 2019

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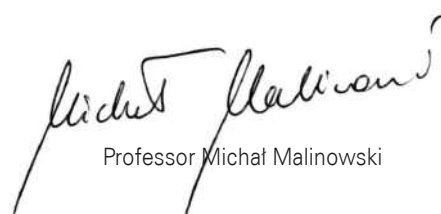
From the Director

This Annual Report summarizes the activities of the Institute of Microelectronics and Optoelectronics (IMiO) in the year 2019, 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, 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 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 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, fibre optic 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 the 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 present research activities of the Institute are concentrated in the area of microelectronics, nanoelectronics and photonics. These include in particular: VLSI systems, microelectronic and nanoelectronic semiconductor devices, hybrid circuits (e.g., microwave, optoelectronic), sensors, microsystems, lasers, active photonic materials, fiber optics and integrated photonics, electronic imaging and image processing. It is worth to emphasize that research activities of the Institute include modelling, CAD, manufacturing and versatile characterization. In the field of teaching, the Institute meets the challenges posed by the development of modern technology and information society. The educational offer (at all levels – B.Sc., M.Sc. and Ph.D.) reflects the main fields of the advanced electronics and photonics and, simultaneously, the main research expertise of the Institute. The Institute’s involvement in distance learning studies of Electronics and Telecommunications is also worth mentioning, especially postgraduate studies in the domain of tools and techniques of virtual education that began in 2004. Several student laboratories in the area of 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.

Moreover, I would like to thank all the colleagues working at IMiO for their constant commitment and effort to make the Institute an outstanding place to be.



Professor Michał Malinowski

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1. GENERAL INFORMATION

1.1. Board of Directors



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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 main competences covering the major 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;
- microwaves, microwave photonics and microwave measurement techniques;
- new materials for high-temperature, high-power and high-frequency electronics;
- new materials for modern photonics.

The research activity is supported by a number of projects financed by 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.

Parallel to scientific activity also the didactic offer of the Institute has been recently enriched, which resulted in establishing a completely new specialization – “Integrated Electronics and Photonics,” elaborated 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.

GENERAL INFORMATION

1.3. Microelectronics and Nanoelectronics Devices Division

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

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Robert Mroczyski, Ph.D., D.Sc.	Professor
Jakub Jasiński, Ph.D.	Assistant Professor
Andrzej Mazurak, Ph.D.	Assistant Professor
Sławomir Szostak, Ph.D.	Assistant Professor
Jakub Walczak, Ph.D.	Senior Lecturer
Agnieszka Zaręba, Ph.D.	Senior Lecturer

Junior academic staff

Monika Masłyk, M.Sc.	Ph.D. Student
Miroslaw Puźniak, M.Sc.	Ph.D. Student
Piotr Wiśniewski, M.Sc.	Ph.D. Student

Technical and administrative staff

Witold Ciemiewski
Kazimierz Dalbiak
Krzysztof Krogulski

To name a few examples of its research topics:

- Diagnostics and characterisation of properties of single and double insulating layers (gate stack including ultra thin oxide layers) by means of electrical measurements analysis;
- Wear-out and degradation processes in MOS structures (breakdown of dielectrics layers, hot carriers effects, radiation damage effects);
- Transport mechanism and quantum effects in MOS structures (transistor, tunnel diode) with ultra thin oxide;
- New materials (semiconductors and dielectrics) for microelectronics applications (e.g.: silicon carbide, gallium nitride, silicon-germanium, germanium);
- Theoretical studies on MOS-SOI (silicon-on-insulator) and Si:Ge (silicon-germanium) MOS structure physics (modelling of devices behaviour and modelling for characterisation and diagnostics);
- Nanoelectronic phenomena and devices (e.g. tunnel and resonance tunnel diodes and transistors, Coulomb blockade diode, single-electron transistors, memories);
- PECVD deposition of ultra thin dielectric layers for MOSFET gate dielectric (SiO_2 , Si_3N_4 , SiO_xN_y);
- Ultra shallow implantation from r.f. plasma;
- Very low temperature processing of test structures;
- Fabrication of ultrathin amorphous silicon layers by PECVD;
- Fabrication of double barrier (single and multilayer) structures and devices;
- MEMS/MOEMS processing;
- Silicon photonic devices fabrication.

1.4. 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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Zbigniew Jaworski, Ph.D.	Assistant Professor
Arkadiusz Łuczyk, Ph.D.	Assistant Professor
Krzysztof Siwiec, Ph.D.	Assistant Professor
Andrzej Wielgus, Ph.D.	Assistant Professor
Marek Niewiński, Ph.D.	Senior Lecturer
Adam Wojtasik, Ph.D.	Senior Lecturer

Junior academic staff

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Igor Butryn, M.Sc.	Ph.D. Student, Science Assistant
Bartosz Dec, M.Sc.	Assistant
Dominik Kasprówicz, Ph.D.	Assistant
Daniel Pietroń, M.Sc.	Ph.D. Student, Science Assistant
Szymon Reszewicz, M.Sc.	Ph.D. Student, Science Assistant
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Tomasz Mrozek, M.Sc.	Assistant
Paweł Narczyk, M.Sc.	Assistant

Science research and technical staff

Jerzy Gempel, M.Sc.

Technical and administrative staff

Adam Borkowski, M.Sc.
Stanisław Jeszka, M.Sc.
Krzysztof Zielant, 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 innovative AD converters, data processing in physical experiments and medical equipment, RF front ends for wireless data transmission etc.,
- modeling and control of leakage currents in nanometer digital circuits,
- investigations and development of new VESTIC microelectronic technology.

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GE | Building of Electronics – ul. Nowowiejska 15/19
GG | WUT Main Building – Pl. Politechniki 1

GENERAL INFORMATION

1.5. 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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Jerzy Kalenik, Ph.D.	Assistant Professor
Konrad Kielbasiński, Ph.D.	Assistant Professor
Krzysztof Król, Ph.D.	Assistant Professor
Aleksander Werbowy, Ph.D.	Assistant Professor

Junior academic staff

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Magdalena Dominik, M.Sc.	Ph.D. Student
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Kinga Kondracka, M.Sc.	Ph.D. Student, Constructor
Agnieszka Martychowiec, M.Sc.	Ph.D. Student, Constructor
Anna Katarzyna Myśliwiec, M.Sc.	Ph.D. Student
Bartłomiej Stonio, M.Sc.	Ph.D. Student
Anastasiia Veklych, M.Sc.	Ph.D. Student
Krzysztof Wilczyński, M.Sc.	Ph.D. Student

Science research staff

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Mariusz Sochacki, Ph.D., D.Sc.	Assistant Professor

Science research and technical staff

Norbert Kwietniewski, M.Sc.

Technical and administrative staff

Monika Janik, Ph.D.
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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

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.

GENERAL INFORMATION

1.6. Optoelectronics Division

The activity of the Optoelectronics Division is concentrated on education as well as on various areas of optoelectronic research in the field of laser physics, new optical waveguide materials and structures, laser spectroscopy, laser construction and laser applications in medicine, air pollution monitoring, the technology of electronic imaging devices, digital image processing, propagative electronics and microwave photonics.

Photovoltaics laboratory, as a part of the Division, serves as a focal point for conducting and stimulating research and demonstration activities; educating students; organizing technical meetings, workshops, symposia and conferences; disseminating information and addressing environmental issues.

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Anna Tysza-Zawadzka, Ph.D.	Assistant Professor
Piotr Witoński, Ph.D.	Assistant Professor
Krzysztof Madziar, Ph.D.	Senior Lecturer
Marek Sutkowski, Ph.D.	Senior Lecturer
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Piotr Warda, Ph.D.	Senior Lecturer

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Paweł Bortnowski, M.Sc.	Ph.D. Student
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Małgorzata Kuklińska, M.Sc.	Ph.D. Student
Aleksandra Paśnikowska, M.Sc.	Ph.D. Student
Mateusz Słowikowski, M.Sc.	Ph.D. Student

Science research staff

Andrzej Kaźmierczak, Ph.D. Assistant Professor

Science research and technical staff

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Technical and administrative staff

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The academic staff of the Division gives lectures in photonics, laser physics, laser technology, laser applications, laser spectroscopy, integrated optoelectronics and optical computing, digital image processing, propagative electronics and microwave photonics, all of which are accompanied by appropriate laboratory class activities.

The main research activity of the Division comprises:

- solid state laser construction and their applications in materials processing;
- spectroscopic research of new laser materials, investigation of the excitation processes in rare earth doped dielectric materials, research of blue up-conversion laser structures, waveguide lasers;
- theoretical research of laser generation in planar, fibre and hollow waveguide gas lasers, analysis of light generation in DFB (distributed feedback) structures, photonic crystals structures and in lasers with non-linear optical elements, investigation of the statistical properties of the light generated in various laser structures;

- nano-optical structures and photonic band-gap materials;
- optimisation of the construction of ion gas lasers, investigation of the processes in discharge tube ceramic ion laser and laser operation in various cavity geometry, investigation of light generation in ion gas lasers for medical applications;
- spectroscopic and theoretical research of light generation in silicon photonic lasers;
- theoretical principles of image modelling, processing and analysis;
- application of image processing methods for diagnostic control and measurement systems in industry, medicine, research and commerce;
- image acquisition in polarization imaging systems and optical image processing;
- 3D Vision methods and algorithms;
- electro optic effects in liquid crystals and their applications to LCD and photo refractive phenomena in liquid crystals;
- an analysis of the oscillation conditions, frequency stabilisation and synthesis in microwave bands;
- measurement techniques of microwave circuits and devices parameters with emphasis on automation and computerisation of measurement methods;
- modelling and computer aided design of microwave devices and circuits;
- controlling of microwave circuits parameters by means of optical signals;
- investigations and modelling of optical-microwave frequency conversion processes;
- modelling of optically controlled microwave devices, as photodiodes, photo-varactors, phototransistors;
- modelling of optoelectronic and microwave devices for data transmission networks.



Optoelectronics Division

1.7. Statistical Data

SPECIFICATION	2018	2019	DIFFERENCE
Academic staff	83	80	-3
Tenured professors	8	8	0
Professors	7	7	0
Docent	1	1	0
Assistant professors	18	23	+5
Senior lecturers	8	8	0
Assistants	5	5	0
Ph.D. students	36	28	-8
Science research staff	11	19	+8
Technical and Administrative staff	24	22	-2
Teaching activities	69	79	+10
Basic courses	37	37	0
Advanced courses	16	22	+6
Special courses	16	20	+4
Degrees awarded	40	48	+8
D.Sc. degrees	0	0	0
Ph.D. degrees	4	1	-3
M.Sc. degrees	11	16	+5
B.Sc. degrees	25	31	+6
Research projects	28	27	-1
Granted by the University	8	8	0
Granted by State Institutions	14	14	0
Granted by International Institutions	6	5	-1
Publications	123	106	-17
Sci.-tech. books	0	0	0
Sci.-tech. papers in journals	46	48	+2
Sci.-tech. papers in conference proceedings	77	58	-19
Patents	16	8	-8
Reports	65	66	+1
Conferences	35	22	-13
Awards	5	14	+9



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, Professor, full time, Head of Microelectronics and Nanoelectronics Devices Division ('04–), 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 of 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).
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Electronic Materials and Microsystem
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2.2. Junior Research Staff

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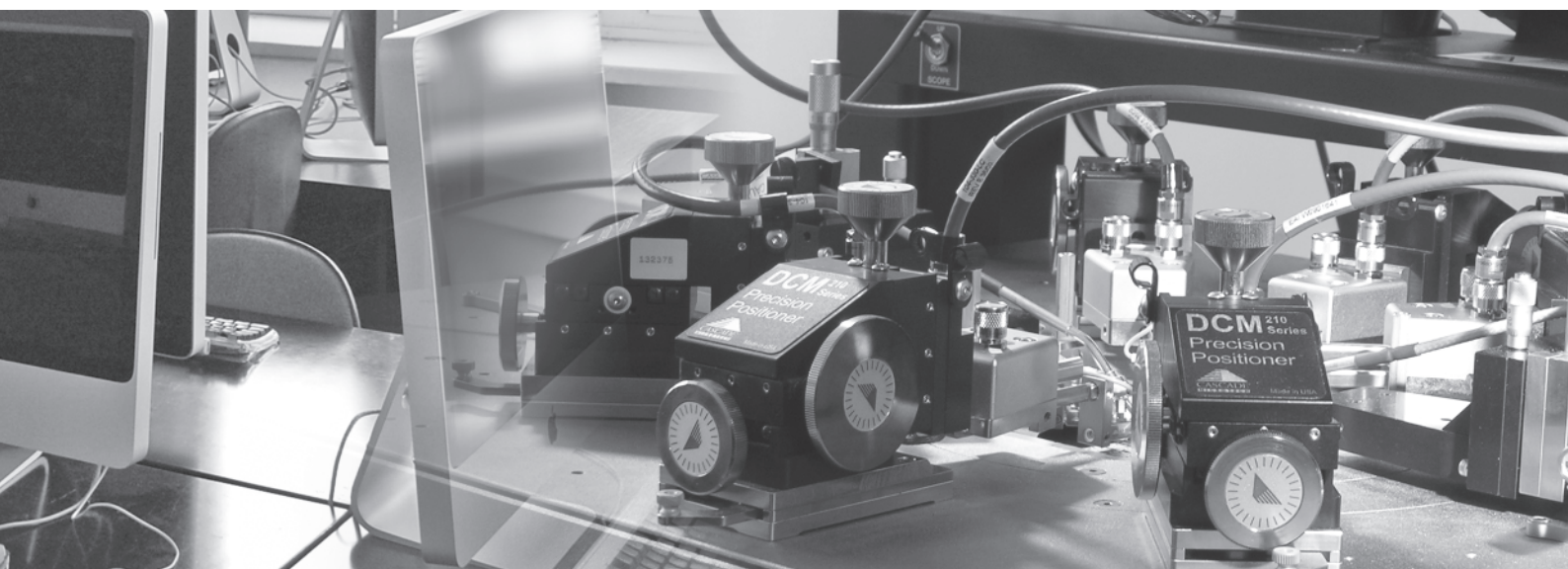
2.3. Science Research Staff

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 GG | WUT Main Building – Pl. Politechniki 1



VLSI Engineering and Design Automation Division

3. TEACHING ACTIVITIES

3.1. Basic Courses

- [Edu1] **Algorithms and Data Structures** (Algorytmy i struktury danych), **AISDE**, Adam Wojtasik
- [Edu2] **Analog Circuit Design for VLSI Systems** (Projektowanie układów analogowych dla systemów VLSI) **PUAV**, Krzysztof Siwiec
- [Edu3] **Application of Matlab in Calculation Methods** (Matlab w zastosowanych metodach obliczeniowych) **MZMO**, Krystian Król
- [Edu4] **Computer-Aided Design of Printed-Board Circuits** (Projektowanie obwodów drukowanych), **PADS**, Jerzy Kalenik
- [Edu5] **Digital Circuits** (Układy cyfrowe), **UCYF**, Elżbieta Piwowska
- [Edu6] **Electronic Elements and Circuits** (Elementy i układy elektroniczne), **ELIU**, Andrzej Pfizner, Agnieszka Zaręba
- [Edu7] **Electronic Elements and Circuits – Laboratory** (Elementy i układy elektroniczne – laboratorium), **ELIUL**, Andrzej Pfizner, Agnieszka Zaręba
- [Edu8] **Electronics 1** (Elektronika 1), **ELE1**, Lidia Łukasiak, Sławomir Szostak
- [Edu9] **Electronics 2** (Elektronika 2), **ELE2**, Jakub Jasiński
- [Edu10] **Equipment – Programming Synthesis of Digital Systems** (Synteza sprzętowo – programowa systemów cyfrowych), **SSP**, Elżbieta Piwowska
- [Edu11] **Fields and waves**, (Pola i fale), **POFA**, Jerzy Piotrowski
- [Edu12] **Fundamentals of Circuit and System Technology** (Podstawy technologii układów i systemów), **PTUIS**, Robert Mroczyński, Romuald Beck
- [Edu13] **Fundamentals of Electronic Devices and Circuits** (Podstawy elementów i układów elektronicznych) **PELEL**, Sławomir Szostak, Lidia Łukasiak
- [Edu14] **Fundamentals of Lasers** (Lasery – kurs podstawowy), **LKP**, Paweł Szczepański
- [Edu15] **Fundamentals of Microprocessor Techniques** (Podstawy techniki mikroprocesorowej), **TMIK**, Lidia Łukasiak
- [Edu16] **Fundamentals of Microwave Engineering** (Podstawy techniki w.cz.), **TWCZ**, Jerzy Piotrowski
- [Edu17] **Fundamentals of Photonics** (Podstawy fotoniki), **FOT**, Michał Malinowski
- [Edu18] **Fundamentals of Solid State Electronics** (Elektronika ciała stałego), **ELCS**, Jan Szmidt, Agnieszka Zaręba
- [Edu19] **Image Processing – Models and Systems** (Modele i systemy przetwarzania obrazów) **MSPO**, Piotr Garbat
- [Edu20] **Introduction to Microelectronics** (Podstawy mikroelektroniki), **PMK**, Andrzej Pfizner
- [Edu21] **Introduction to Microsystems** (Wstęp do mikrosystemów), **WMS**, Andrzej Mazurak, Robert Mroczyński
- [Edu22] **Introduction to Numerical Methods** (Wstęp do metod numerycznych), **WNUM**, Krystian Król
- [Edu23] **Introduction to Programming** (Podstawy programowania), **PRM**, Marek Niewiński
- [Edu24] **Introduction to the UNIX System** (Użytkowanie systemu UNIX), **USUX**, Andrzej Wielgus
- [Edu25] **Lighthouse Telecommunication** (Telekomunikacja optyczna), **TEOP**, Agnieszka Szymańska
- [Edu26] **Logic Circuits** (Układy logiczne) **ULOG**, Andrzej Wielgus
- [Edu27] **Meeting 1 – Fundamentals of Information Technology** (Zjazd 1 – Podstawy technologii informacyjnej), **ZJ1Z**, Krzysztof Madziar
- [Edu28] **Meeting 4 – Advanced Course Laboratory** (Zjazd 4 – Zaawansowane laboratorium kierunkowe), **ZJ4Z**, Agnieszka Szymańska
- [Edu29] **Methods of Image Acquisition and Processing for Photography** (Techniki rejestracji i obróbki obrazów w fotografii), **TROOF**, Marek Sutkowski

TEACHING ACTIVITIES

- [Edu30] **Object Programming** (Programowanie obiektowe), **PROE**, Marek Niewiński
- [Edu31] **Operating Systems** (Systemy operacyjne), **SOE**, Andrzej Wielgus
- [Edu32] **Optical Waveguide Lasers and Amplifiers** (Wzmacniacze i lasery światłowodowe) **WLS**, Ryszard Piramidowicz, Krzysztof Anders
- [Edu33] **Optoelectronic Devices and Systems** (Elementy i systemy optoelektroniczne), **ESO**, Marcin Kaczkan
- [Edu34] **Physical Fundamentals of Information Processing** (Fizyczne podstawy przetwarzania informacji), **FPPI**, Jan Szmidt, Agnieszka Zaręba
- [Edu35] **Programming for mobile Apple iOS and MacOS X** (Programowanie dla systemów: mobilnego iOS oraz MacOS X), **APIOS**, Adam Wojtasik
- [Edu36] **Programming microcontrollers in C language** (Programowanie mikrokontrolerów w języku C), **PMIK**, Sławomir Szostak
- [Edu37] **Semiconductor Devices** (Przyrządy półprzewodnikowe), **PP**, Lidia Łukasiak, Agnieszka Zaręba

3.2. Advanced Courses

- [Edu38] **3D Vision Systems** (Systemy wizji 3D) **SWIZ**, Piotr Garbat
- [Edu39] **Advanced Semiconductor Structures** (Zaawansowane struktury półprzewodnikowe) **ZSP**, Lidia Łukasiak, Tomasz Skotnicki
- [Edu40] **Advanced Technologies for Silicon Microelectronics and Photonics** (Zaawansowane technologie mikroelektroniki i fotoniki krzemowej) **ZTM**, Robert Mroczyński, Romuald Beck
- [Edu41] **Analog Integrated Circuit Design for VLSI Systems** (Projektowanie bloków analogowych dla systemów VLSI) **PSSA**, Tomasz Borejko
- [Edu42] **Characterization of Materials for Microelectronics** (Charakteryzacja materiałów dla mikroelektroniki) **CHA**, Aleksander Werbowy, Piotr Firek
- [Edu43] **Computational Methods in Microelectronics and Photonics** (Metody obliczeniowe w mikroelektronice i fotonice), **MOBI**, Andrzej Pfitzner, Dominik Kasproicz, Agnieszka Mossakowska-Wyszyńska
- [Edu44] **Digital Image Processing** (Cyfrowe przetwarzanie obrazów), **CPOO**, Piotr Garbat
- [Edu45] **Fiber-Optic Communication** (Komunikacja światłowodowa), **KOS**, Ryszard Piramidowicz
- [Edu46] **Fundamentals of Nanoelectronics and Nanophotonics** (Podstawy nanoelektroniki i nanofotoniki), **NANO**, Bogdan Majkusiak, Paweł Szczepański
- [Edu47] **Fundamentals of Photovoltaics** (Podstawy fotowoltaiki) **PFOT**, Michał Malinowski
- [Edu48] **Introduction to Digital VLSI System Design** (Projektowanie scalonych systemów cyfrowych), **PSSC**, Zbigniew Jaworski
- [Edu49] **Laboratory of Fundamentals of Nanoelectronics and Nanophotonics** (Pracownia podstaw nanoelektroniki i nanofotoniki), **PNAN**, Bogdan Majkusiak, Paweł Szczepański
- [Edu50] **Lasers** (Lasery) **LAS**, Paweł Szczepański
- [Edu51] **Microsystems Engineering** (Inżynieria mikrosystemów) **MIK**, Piotr Firek
- [Edu52] **Monte Carlo Methods** (Metody Monte Carlo) **MMC**, Dominik Kasproicz, Marek Niewiński
- [Edu53] **Nanotechnologies** (Nanotechnologie), **NAN**, Jan Szmidt, Aleksander Werbowy
- [Edu54] **Optoelectronic Techniques for Imaging Devices** (Optoelektroniczne techniki zobrazowania informacji) **OTZI**, Marek Sutkowski
- [Edu55] **Photonic Integrated Circuits for Optical Logic** (Zintegrowane optoelektroniczne układy logiczne) **ZOUL**, Michał Malinowski, Agnieszka Mossakowska-Wyszyńska

- [Edu56] **Photovoltaic Systems** (Systemy fotowoltaiczne), **SFOT**, Mateusz Śmietana
- [Edu57] **Semiconductor Photonic Devices** (Fotoniczne przyrządy półprzewodnikowe) **FPP**, Marcin Kaczkan
- [Edu58] **Spectroscopic Methods** (Techniki spektroskopowe) **TSP**, Michał Malinowski
- [Edu59] **VLSI System Design** (Projektowanie systemów scalonych w technice VLSI), **PSSV**, Zbigniew Jaworski

3.3. Courses in English

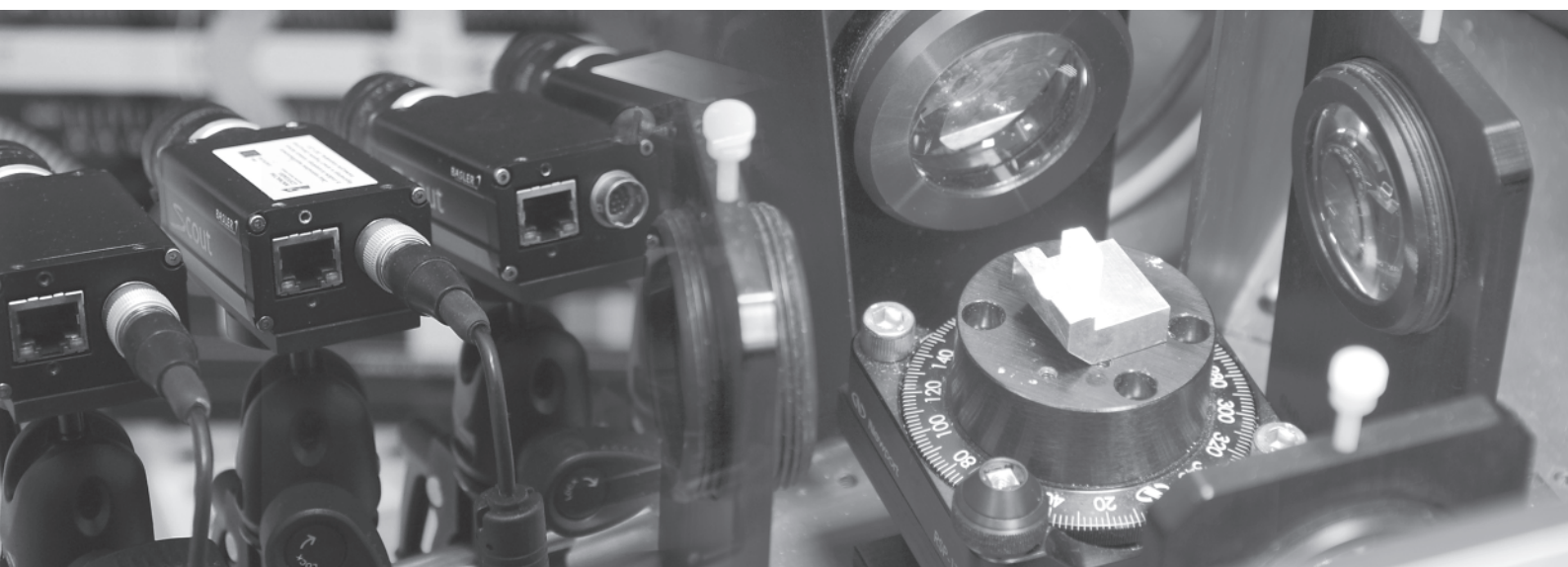
- [Edu60] **Electronics 1, EELE1**, Bogdan Majkusiak, Jakub Walczak, Andrzej Mazurak

3.4. Courses for other Faculties

- [Edu61] **Electromagnetic Compatibility, Faculty of Management** (Kompatybilność elektromagnetyczna, Wydział Zarządzania), **KOMEL**, Jerzy Piotrowski
- [Edu62] **Electronic Circuits and the Introduction to Microelectronics, Faculty of Management** (Układy elektroniczne i wstęp do mikroelektroniki, Wydział Zarządzania), **UEMIK**, Sławomir Szostak
- [Edu63] **Electronic Devices, Faculty of Management** (Elementy elektroniczne, Wydział Zarządzania), **ELEME**, Lidia Łukasiak
- [Edu64] **Electronics 1, Faculty of Mechatronics** (Elektronika 1, Wydział Mechatroniki), **ELE1**, Sławomir Szostak
- [Edu65] **Electronics 2, Faculty of Mechatronics** (Elektronika 2, Wydział Mechatroniki), **ELE2**, Jakub Jasiński
- [Edu66] **Energy Conditioning and Storage Laboratory, Faculty of Physics** (Laboratorium przetwarzania i magazynowania energii, Wydział Fizyki) **LPME**, Michał Malinowski
- [Edu67] **Introduction to Microprocessor Systems, Faculty of Management** (Wstęp do systemów mikroprocesorowych, Wydział Zarządzania), **WSYMI**, Jakub Jasiński
- [Edu68] **Laboratory of Nanotechnology, Faculty of Physics** (Laboratorium nanotechnologii, Wydział Fizyki), **NAN**, Robert Mroczyński
- [Edu69] **Laboratory of Photonics, Faculty of Physics** (Laboratorium fotoniki, Wydział Fizyki), **FOT**, Ryszard Piramidowicz
- [Edu70] **Laboratory of Physics 2, Faculty of Physics** (Laboratorium Fizyki 2, Wydział Fizyki), **FIZ2**, Janusz Parka
- [Edu71] **Logic Circuits, Faculty of Management** (Układy logiczne, Wydział Zarządzania), **UKLO**, Piotr Firek
- [Edu72] **Laser Technology, Faculty of Physics** (Technika Laserów, Wydział Fizyki), **TL**, Ryszard Piramidowicz
- [Edu73] **Photonic Devices, Faculty of Management** (Elementy fotoniczne, Wydział Zarządzania), **ELFOT**, Ryszard Piramidowicz

3.5. Courses in English for other Faculties

- [Edu74] **Fiber Optic Communication Systems, Faculty of Physics, FOCS**, Ryszard Piramidowicz
- [Edu75] **Laser Technique, Faculty of Physics, LT**, Ryszard Piramidowicz
- [Edu76] **Optical Fiber Technology, Faculty of Mechatronics, OFT**, Ryszard Piramidowicz
- [Edu77] **Photographic Techniques in Image Acquisition, Faculty of Mechatronics, PTIA**, Marek Sutkowski
- [Edu78] **Photonic Integrated Circuits, Faculty of Physics, PIC**, Ryszard Piramidowicz
- [Edu79] **Semiconductor Optoelectronics, Faculty of Physics, SOP**, Paweł Szczepański



Optoelectronics Division

4. RESEARCH PROJECTS

Project definitions and descriptions – prepared by Project Leaders.

4.1. Projects Granted by the University

- [Pro1] The Development of Design, Processing and Testing Methods of the Electronic Devices and Materials for Microelectronics and Optoelectronics** (Rozwój metod wytwarzania i badania materiałów oraz modelowania i charakteryzacji przyrządów w dziedzinie mikroelektroniki i optoelektroniki), project leaders: Paweł Szczepański and Michał Malinowski, May 2018–May 2019, **sub-projects:**
- [Pro1.1] Development of the technology and characterization of materials for novel microelectronic, optoelectronic and photonic devices** (Rozwój technologii i charakteryzacji materiałów dla nowoczesnych przyrządów mikroelektroniki, optoelektroniki oraz fotoniki), project leader: Robert Mroczński, co-workers: R.B. Beck, W. Ciemiewski, K. Dalbiak, J. Jasiński, L. Łukasiak, B. Majkusiak, A. Mazurak, S. Szostak, J. Walczak
- This work is devoted to the development and optimization of technology of selected semiconductor, dielectric and conductive materials for application in novel microelectronic, optoelectronic and photonic devices. It is planned to perform investigations of particular active materials (charge transport) in the form of silicon nanocrystals (or other type of semiconductor), high-k dielectrics and conductive layers (e.g. Titanium Nitride – TiN). In order to characterization of developed technologies, test structures based on investigated materials will be fabricated. The obtained electrical and structural properties of examined devices and structures will be analyzed allowing the ultimate verification of the developed technologies and the feasibility of the application of investigated materials in novel semiconductor structures.
- [Pro1.2] Investigation of active materials, passive and active photonic structures and integrated circuits , optowaves systems and image processing** (Badanie materiałów aktywnych, pasywnych i aktywnych struktur fotonicznych oraz układów scalonych, systemów optofalowych i przetwarzania obrazu), project leaders: Paweł Szczepański, co-workers: Agnieszka Mossakowska-Wyszyńska, Stanisław Jonak, Marcin Kaczkan, Ryszard Piramidowicz, Anna Tyszk-Zawadzka, Stanisław Stopinski, Anna Jusza, Krzysztof Anders, Piotr Garbat, Krzysztof Madziar, Marek Sutkowski, Piotr Witoński, Jerzy Piotrowski, Agnieszka Szymańska, Piotr Warda, Michał Malinowski.
- Researches include five following topics. The first one comprises the development of design and characterization methods of integrated photonic circuits. Especially passive and active systems developed on indium phosphide, silicon and polymer platforms are investigated along with their integration with electronic integrated circuits. The second topic includes analysis of spectroscopic properties of active materials and their potential applications for lasing, efficiency improvement of photovoltaic cells, and new class of luminophores. Moreover, the modelling of passive and active periodic structures, including metamaterials and photonic structures having PT-symmetry is developed. Particularly, the novel bulk and waveguide photonic tunable devices based on these structures, are analyzed. The next topic covers investigation of optowave systems for signal transmission. The influence of the system components on light polarization and signal transmission is considered. Finally, the methods of the image processing and image acquisition are developed.
- [Pro1.3] Materials, technologies, structures and devices for microelectronics and optoelectronics** (Materiały, technologie, struktury i przyrządy dla mikroelektroniki i optoelektroniki), project leader: Jan Szmidt, co-workers: Jerzy Krupka, Mateusz Śmietana, Marcin Koba, Mariusz Sochacki, Piotr Firek, Aleksander Werbowy, Magdalena Dominik, Maciej Kamiński, Kinga Kondracka, Norbert Kwietniewski, Aleksandra Paculska, Andrzej Taube, Michał Waśkiewicz, Natalia Kyc, Anna Myśliwiec, Zbigniew Rudkowski

RESEARCH PROJECTS

Within the framework of the project several tasks are carried out. These include: analysis of factors causing photodegradation of typical diesel fuels for contemporary diesel engines, development of the fast method of diesel fuel stability evaluation, optimization of the properties of selected oxide thin films for fiber-optic based sensors, fabrication and current-voltage measurements of ion-sensitive field effect transistors with graphene layer in the gate area, constructing measurement setups for semiconductor photodetectors and power devices characterization.

- [Pro1.4] **Studies on the VeSFET device applications as sensor structure** (Badania tranzystora VeSFET pod kątem zastosowań czujnikowych), project leader: Andrzej Pfitzner; co-workers: Witold Pleskacz, Marek Cieplucha and other members of the VLSI Engineering and Design Automation Division.

Preliminary feasibility study of sensor structures based on VESTIC (Vertical Slit Transistor based Integrated Circuit) architecture is focused on Vertical Slit Field-Effect Transistor (VeSFET). Unique geometry of the VeSFET device makes it possible to build sensor arrays and 3D integration. The evaluation of the electrical characteristics of this transistor from external factors based on numerical simulations is the main goal of the project. VeSFET structure seems to be a promising alternative to the present devices due to the full electrical symmetry of the twin gates. The area of one of them can be designed to accumulate electric charge depending on the chemical environment or radiation.

- [Pro2] **Demonstrator of optoelectronic and microelectronic sensors for sailing applications** (Demonstrator czujników optoelektronicznych i mikroelektronicznych o zastosowań w żeglarsztwie) project leader: Krzysztof Anders, May 2018–March 2019.

The main result of the project is the development of a fully functional demonstrator of a multi-functional sensor system powered by innovative photovoltaic panels, allowing the registration and analysis of measurement data such as yawning and rolling and acceleration associated with it, mast and sail deformation, distance from obstacles and other units, and additionally measuring the PM2.5 and PM10 dust content in the air. The development of such a system aims, among others, at support of sailing school lessons, the ability to monitor the construction of a yacht/sailing ship in order to avoid defects, the possibility of yacht monitoring by charter companies, the possibility of determining optimal sail settings in order to achieve the highest possible speed etc.

- [Pro3] **Development of all digital phase locked loop bandwidth shaping method in FMCW radar transceiver** (Opracowanie metody kształtowania pasma cufrowej pętli synchronizacji fazy w układzie nadawczo- odbiorczym radaru FMCW) project leader: Igor Butryn, June 2019–December 2019.

Radars using the Frequency Modulated Continuous Wave (FMCW) as a transmitted signal are widely used in many applications. They are exploited in automotive industry for parking space detection, anti-crash systems and for foreign object detection in airport runway, to name a few. There are several challenges in designing a transceiver front-end for FMCW radars. The most important are those associated with the generation of high bandwidth chirp signal. The generation of highly linear frequency ramp is critical to achieve robust operation of FMCW radars. The FMCW radar front-end transmits a frequency ramp, also known as chirp signal, and receives the returned echo that is delayed in time proportionally to the distance between the object and the antenna. There are several ways to generate chirp signal and many architectures of the frequency synthesizer for FMCW radars are presented in the literature, such as Voltage Controlled Oscillator (VCO), Direct Digital Synthesizer (DDS), Charge Pump Phase Locked Loop (PLL) and All Digital Phase Locked Loop (ADPLL). An ADPLL with a digital filter occupies much less area on chip. ADPLL has a flexible loop configuration, hence variable chirp rate can be obtained. Moreover, very good linearity of the frequency ramp can be achieved. The use of ADPLL makes it possible to change the chirp sweep time during radar operation in accordance to the unmanned aerial vehicles (UAV) altitude and therefore the less frequency variation of de-chirped signal, hence the requirement imposed on the sample rate of the analog-to-digital converter is relaxed. Extensive use of digital techniques allows calibration of the loop bandwidth that results in highest ramp linearity. All digital phase locked loop bandwidth shaping is possible by change of digital filter coefficient. For this purpose, a loop model in VerilogA was created to simulated chirp signal generation. Digital filter coefficients were computed using a script written in Python.

- [Pro4] Hardware accelerator supporting watermarking of audio files** (Sprzętowy akcelerator wspomagający znakowanie wodne plików dźwiękowych) project leader: Marek Niewiński, co-workers: Filip Piórski, Jakub Kajzer, Wiktor Szczerek, May 2019–December 2019.

The main aim of the project was to implement a selected algorithm for digital watermarking audio files on FPGA platform. The WAV audio files were used as processed data. In first step, basing on analysis of the literature, a few algorithms were implemented in MATLAB environment, to test which one introduce the smallest amount of distortions. As a result, the algorithm – which use a steganography technique of modifying the lsb bit in audio samples – was selected. As a hardware platform – the NetFPGA 1G-CML, with Kintex-7 chip was used. Due to same technical problem with communication over PCI-E bus, finally 1Gb Ethernet ports were utilized to transfer audio files to/from FPGA module. The audio “blind” tests shows the accurateness of the proposed solution.

- [Pro5] Method development of automatic on-chip calibration (inside an integrated circuit) of a low-noise amplifier parameters in order to obtain a low sensitivity to variation of fabrication parameters** (Opracowanie metody automatycznej kalibracji typu on-chip (wewnątrz układu scalonego) parametrów wzmacniacza niskoszumnego w celu uzyskania niskiej wrażliwości na rozrzuty parametrów procesu technologicznego) project leader: Daniel Pietroń, June 2019–December 2019.

The aim of this work was to design a low-noise amplifier with an auto-calibration system, which help to reduce the influence of technological process variation on the parameters of the low-noise amplifier. Calibration of the low-noise amplifier will be based on frequency changes. For this purpose, a new low noise amplifier circuit has been proposed. It can operate in two modes: low noise amplifier mode or oscillator mode. Calibration will be based on the oscillation frequency in oscillator mode. After that, the calibrated circuit will get back to low noise amplifier mode.

Correction of the amplifier/oscillator parameters will be carried out by means of a bank of switched capacitors, which together with the inductive element form a resonant circuit. Switching the capacitors in the output resonant circuit will change the oscillation frequency in oscillator mode and center frequency of the band in low noise amplifier mode. The capacitor bank requires an additional auto-calibration system that will control the tuning process (connect and disconnect of capacitors), depending on the oscillation frequency in the oscillator mode. It is required in order to compensate for the effect of changing the technological process parameters (which results in variations in the oscillation frequency) in relation to the nominal values. For this purpose, a digital circuit has been designed. The main task of the digital circuit is to control the low noise amplifier's switched capacitor bank in order to tune the resonant frequency in oscillator mode and center frequency of the amplified band in amplifier mode. The digital circuit was written in the Verilog hardware description language and then synthesized at different levels: logic gates, electrical schematic, and integrated circuit topography.

Additionally two more circuits were designed. Oscillation amplifier for amplifying the oscillations of low noise amplifier working in oscillation mode and set the dc voltage component of amplified signal. The oscillation amplifier amplifies the signal such that the sinusoidal signal produces a square wave signal with a peak-to-peak amplitude of 1.5 V. It can be said that there is conversion from an analogue signal to a digital signal. Second circuit is a frequency divider by 8, made of three TSPC (True Single Phase Clocked) flip-flops.

The operation of the new solution low-noise amplifier with the automatic calibration circuit was verified at the simulation level.

- [Pro6] Miniaturized optical time domain reflectometer system** (Miniaturowy moduł reflektometru optycznego OTDR) project leader: Stanisław Stopiński, May 2018–March 2019.

The project is focused on development of a novel, miniaturized optical time domain reflectometer system, compatible with portable devices such as smartphones or tablets. The device will be realized as an application specific photonic integrated circuit (ASPIC) in an indium phosphide generic integration technology. A proof-of-the-concept optical chip will be designed, manufactured and tested with respect of applicability in real measuring systems.

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[Pro7] New visible light sources – investigation of luminescent properties of glass materials doped with dysprosium or samarium ions

New visible light sources – investigation of luminescent properties of glass materials doped with dysprosium or samarium ions (Nowe źródła światła ma zakres widzialny – badanie właściwości luminescencyjnych materiałów szklanych domieszkowanych jonami dysprozu lub samaru) project leader: Anna Jusza, May 2018–March 2019

The main aim of this project is to investigate luminescent properties of dysprosium or samarium doped glasses. This kind of materials could offer potential emission and lasing in unique yellow spectral range – not available for convenient semiconductor light sources. Scope of the work covered manufacturing and versatile investigation of luminescent properties of glass materials activated with Dy^{3+} or Sm^{3+} ions. The study covered measurements and analysis of absorption, excitation and emission spectra together with fluorescent dynamic profiles of excited states for all samples.

[Pro8] Photonic integrated circuit for interrogation of fiber Bragg gratings (Fotoniczny układ scalony do interogacji światłowodowych siatek Bragga) project leader: Stanisław Stopiński, June 2019–December 2019

The main goal of the project is focused on development of an integrated interrogator unit of fiber Bragg gratings (FBG), used as sensors of strain and temperature in optical sensing systems. In the framework of the project an application specific photonic integrated circuit (ASPIC) will be designed, manufactured and characterized with respect to its application as a central readout unit of fiber-optic sensor networks based on multiple FBGs. To realize the ASPIC an indium phosphide (InP) generic integration technology platform will be used. The design of the optical chip will utilize basic and customized building blocks. Manufacturing will be done in the framework of a multi-project wafer run.

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

[Pro9] Research infrastructure for the fabrication and diagnostics of semiconductor structures and devices (SPUB)

(Zespół urządzeń do wytwarzania przyrządów i struktur półprzewodnikowych i ich charakteryzacji i diagnostyki wraz z niezbędną infrastrukturą, SPUB) Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Robert Mroczyński, June 2019–December 2021

The project is devoted to supporting the maintenance of the **Laboratory of advanced semiconductor technologies and diagnostics of materials, structures, and devices** that is unique domestically. The Laboratory offers access to the most advanced nanoelectronic and microsystem technologies, as well as novel interdisciplinary technologies of integrated nanoelectronics and photonics to all research teams and partners domestically and internationally. This allows for a clear indication of the potential of Polish science through the implementation of fundamental research (widely published in journals with high impact factor) and participation in national and international research projects. Importantly, access to the Laboratory is not limited only to research teams – the available research infrastructure of the Laboratory of IMiO WUT also educate highly qualified engineering staff, crucial for the development of an innovative economy, based more and more on advanced material engineering, nanoelectronics, and photonics. The continuation of this type of support allows for further expansion of the research interest and tasks carried out with the use of available research tools. Moreover, the maintenance of such advanced equipment in the appropriate condition necessary to perform unique research and development studies will be also ensured.

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

[Pro10] DIAMSEC – ultrasensitive sensing platform for rapid detection of epidemiological and pandemic threats

(DIAMSEC – ultraczuła platforma sensoryczna do szybkiej detekcji zagrożeń epidemiologicznych i pandemicznych), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Mateusz Śmietana, co-workers: Marcin Koba, Emil Piłuła, December 2017–November 2020

The aim of the project is to develop and prepare for implementation an innovative sensing platform for rapid detection of pandemic and epidemic conditions. The project proposes a development of a technology for synthesis and modification of sensing structures based on thin films of diamond, titanium oxide, ITO and graphene towards medium-scale production of ultrasensitive tests for detection of viruses and pathogenic bacteria. DIAMSEC platform can be used directly by a patient, as well as to assist in diagnosis-making process for people in emergency rooms, small clinics, and doctors' offices, in ambulances to the scene of the accident in order to rapid diagnostics of patients. It can also be used to conduct screening tests towards detection of sources and avoid spreading of infectious diseases. Thanks to the universal approach it can be also used in veterinary medicine. Use of the platform DIAMSEC comparing to the currently used methods lead to a shorter measurement time, a reduction in amount required analyte, higher sensitivity and lower cost of a single test.

[Pro11] Innovative, hardware-software component, based on a dedicated integrated circuit and software to perform various cryptographic application, with the particular attention paid to electronic identification systems with the high level of confidence (Innowacyjny komponent sprzętowo-programowy, wykorzystujący specjalizowany układ scalony oraz oprogramowanie, realizujący różne funkcje kryptograficzne, ze szczególnym uwzględnieniem zastosowań w systemach identyfikacji elektronicznej z wysokim poziomem pewności IDSoC), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Witold Pleskacz, co-workers: A. Łuczyk, L. Łukasik, P. Szczepański, S. Reszewicz, A. Borkowski, M. Derlecki, J. Bęczkowski, September 2017–August 2020

The aim of the project is to develop and manufacture an innovative single-chip secure processor – IDSoC. The developed system on chip will be composed of a proprietary application processor with an increased fault tolerance and security level. The processor will include a non-volatile memory area dedicated to storing both embedded software and sensitive user data, such as biometric data. Thanks to the appropriate error detection and correction systems as well as hardware encryption, the non-volatile memory will ensure data integrity and confidentiality. In addition, the integrated IDSoC system will be equipped with a set of peripherals for hardware cryptographic support. During the project, it is planned to develop a true random number generator (TRNG) and to carry out research on the possibility of the physical unclonable function (PUF) utilization for the purpose of identification and authentication. It is also anticipated to develop a set of sensors for the monitoring of the integrated circuit's environmental conditions (e.g. temperature, supply voltage, clock frequency). The mechanisms of the external interference detection in the system's physical structure will also be employed, which will significantly protect the system features against unauthorized access attempts and will prevent from the acquisition of sensitive data. The IDSoC system, to be developed during the project, might be utilized in the applications in which the storage and processing of sensitive data is required, e.g. in electronic identification systems (electronic identity card, e-passport). The inherent part of the IDSoC system will be its dedicated firmware, developed in the course of the project. The firmware will support and enable all the system's functions, most notably the electronic identification with high level of confidence and other advanced cryptographic procedures.

[Pro12] Methods and means of protection and defense against high power microwave pulses (Metody i sposoby ochrony i obrony przed impulsami HPM), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Mariusz Sochacki, co-workers: Jan Szmidt, Piotr Firek, December 2014–December 2020

The protection and defense system against high power microwave pulses will be equipped with limiting diodes. The protection semiconductor devices will be designed, manufactured and characterized in the Institute of Microelectronics and Optoelectronics. Wide bandgap semiconductors can be used in such kind of application, primarily the silicon carbide (SiC) wafers. The diodes will be characterized by means of current-voltage and capacitance-voltage measurements. Finally, the microwave properties of the devices will be studied, which is important especially in the context of their application in microwave transceiver circuits.

[Pro13] Miniature, dual-frequency, system-on-a-chip for precise satellite navigation GPS/Galileo integrated with application processor dedicated to IoT devices with low power consumption (Miniaturowy, dwuczęstotliwościowy, jednoukładowy system scalony do precyzyjnej nawigacji satelitarnej GPS/Galileo zintegrowany z procesorem aplikacyjnym dedykowany do urządzeń IoT o niskim poborze mocy NaviSoC), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Witold Pleskacz, co-workers: P.Narczyk, K. Marcinek, T. Mrozek, I. Butryn, D. Pietroń, Ł. Wiechowski, November 2017–October 2020

The development concept of specialized microcontroller for precise satellite navigation meets the growing needs of many sectors of the world economy, where according to estimates 6–7% of European GDP depends on satellite navigation applications. The aim of the project is to develop, produce, test and demonstrate the dual-frequency, system-on-a-chip for precise GPS/Galileo satellite navigation. The system will be integrated with application processor and will allow for a significant increase in the accuracy of mobile devices. The consortium was established to realize this project. It consists of one scientific entity (Warsaw University of Technology) and the two entrepreneurs (ChipCraft Sp. z o.o. and Inowatronika – Tomasz Radomski).

Within the project NCBiR NR02-0096-10/2011 “Dual-mode blocks of the integrated circuit GALILEO and GPS signal receiver in nanometer CMOS technology for precise positioning of mobile objects” realized in 2011–2014, applicant has developed, produced and characterized integrated circuits forming the so-called chipset – three circuits of complete analogue path of the satellite navigation receiver, which can receive two frequency bands from both constellations Galileo and GPS. Due to its size and the lack of the full integration on the one silicon die the technology did not extend beyond the area of laboratory demonstrations.

The miniaturization of the chipset will be achieved by development of NaviSoC system-on-a-chip by the ChipCraft company in cooperation with the Warsaw University of Technology and with the Inowatronika company. Experience of Warsaw University of Technology from the previous project mentioned above will be utilized. The developed technology will be examined and demonstrated in operational conditions, i.e. in IoT class devices (Internet-of-Things) produced in the course of this project thanks to the cooperation and exploiting experience of Inowatronika company.

[Pro14] Nanophotonics with metal – group-IV-semiconductor nanocomposites: From single nanoobjects to functional ensembles (NaMSeN) (NaMSeN – Nanofotonika bazująca na nanokompozytach metali i półprzewodników z grupy IV – od pojedynczych nanoobiektów do zespołów funkcjonalnych), V4-Japan Advanced Materials Joint Call of National Centre for Research and Development, Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Romuald Beck, February 2016–January 2019

The NaMSeN project aims to advance the field of group-IV semiconductor nano-structures in the new stage closer to photonic applications by overcoming intrinsic limitations of these materials (namely the low absorption cross section and emission rate due to the dominating indirect transitions) via formation of metal-semiconductor nanostructural composites and alloys (SiGe, heavy doping Si:B,P etc.) The enhancement of optical properties should be achieved mainly by exciton – plasmon coupling, Purcell effect and crystal lattice modification by strain. The project includes development of relevant technologies, theoretical models and characterization methods. The nano-composites will be studied on different scales from single nano-objects, microscopic ensembles up to test devices.

The project is matching the Joint Call theme of materials for electronics and energy harvesting by addressing applications to chemical and bio-sensing as well as light emitting devices. Bio-compatibility and degradability of nano-composites will be tested in living cells using single nano-particle luminescence imaging.

Top research group from all Visegrad countries and Japan are selected to form this project consortium with high potential for sustainable and fruitful collaboration.

[Pro15] Nanostructured photonic crystal fibers for innovative few mode propagation (Nanostrukturalne światłowodów fotoniczne do kilkumodowej propagacji nowej generacji” w ramach programu „Nowoczesne technologie materiałowe” TECHMATSTRATEG), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Ryszard Piramidowicz, June 2018–May 2021

The aim of the project is to develop innovative few-modes materials, thanks to which it will be possible to use the last undeveloped area of multiplexing – spatial multiplexing. The project will develop nanostructured anisotropic photonic fibers with defined polarization properties, shaped dispersion and distribution of the mode field or strongly nonlinear properties allowing for few-mode propagation of the new generation.

[Pro16] Technologies of semiconductor materials for high power and high frequency electronics (Technologie materiałów półprzewodnikowych dla elektroniki dużych mocy i wysokich częstotliwości WidePOWER), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Jan Szmidt, co-workers: Piotr Firek, Krystian Król, Aleksander Werbowy, Michał Waśkiewicz, Kinga Kondracka, Jakub Szarafiński, Andrzej Taube, Norbert Kwietniewski, Mariusz Sochacki, Kazimierz Dalbiak, Witold Ciemiewski, December 2017–November 2020

The overall aim of this project is to develop technology of silicon carbide (SiC) homoepitaxy and gallium nitride (GaN) heteroepitaxy towards production grade device epitaxial structures. Silicon carbide and AlGaN/GaN/SiC wafers for fabrication of 1.7kV/3.3kV devices and vertical HEMTs are expected as basic product for the implementation. Quality of the wafers will be verified by the fabrication of 1.7kV PiN diode and VHEMTs that will be ready for the implementation in advanced power electronics. The processing of SiC PiN diode will be upgraded up to 3.3kV devices to investigate main barriers of implementation in the case of high voltage bipolar SiC devices. Comprehensively characterized and certified epitaxial structures will be the subject of market analysis on the day of completion of the project in order to assess the competitiveness and scale of production giving real rate of investment return. The findings from the demonstration pilots of power converters and aviation band amplifiers will be widely published among companies and further stakeholders. The key performance measurement of these applications is that companies outside the consortium have specific knowledge to make better informed decisions about future R&D strategies and investments for the uptake of advanced power electronics. It will support the commercialization of wafers and devices efficiently.

[Pro17] Tunable hyperbolic metamaterials for photonic devices of novel generation (Przestrzajalne metamateriały hiperboliczne na potrzeby nowej generacji przyrządów fotonicznych HYPERMAT), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Michał Malinowski, co-workers: Robert Mroczyński, Ryszard Piramidowicz, Anna Jusza, Krzysztof Anders, Anna Tysza-Zawadzka, Bartosz Janaszek, Marcin Kieliszczak, Bartosz Fetliński, December 2017–November 2020

The main objective of this project is to develop an innovative technology of tunable multilayer hyperbolic metamaterials (THMMs) operating in NIR and MIR frequency ranges. Such structures exhibit extraordinary features unprecedented in commercially available state-of-the-art photonic solutions, resulting from unusual dispersion characteristics which can be controlled by an external electric field. THMMs can be used as efficient, adaptive antireflective coatings (AR) or as tunable edge-filters in photonic components commercially offered by our large industrial partner, i.e., PCO S.A. The development of the technology of tunable hyperbolic metamaterials, demonstration of the proof of concept, and transfer of the technology to PCO S.A. could become the foundation for the technological platform of a novel class of photonic components, which would significantly enrich PCO S.A.’s commercial offer and become a strong impulse for the development of innovative national photonics industry, offering products globally. We expect that project results will contribute to the development of science related to nanotechnology and photonics. An intensive cooperation between Consortium partners will emerge to advance scientific leadership of the Polish scientific units as the leaders in the modeling, technology and characterization of photonic devices including nanostructures based on THMMs.

4.4. Projects Granted by the National Science Centre

[Pro18] Active Tunable Hyperbolic Metamaterials (Aktywne przestrajalne metamateriały hiperboliczne), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Bartosz Janaszek, co-worker: Marcin Kieliszczuk, July 2017–July 2020

The main objective of this project is to investigate Active Tunable Hyperbolic Metamaterial's properties. Full characterization of such structures requires not only performing a series of numerical simulations, but also derivation of theoretical models of light interaction with the considered structure. Theoretical analysis will cover classical as well as semi-classical approach allowing for obtaining crucial optical parameters, such as reflection, transmission and Photonic Density of States (PDOS). In particular, PDOS forms an especially useful framework for obtaining an effective gain of an active structure. Further investigations will include supporting calculations based on standard effective medium theory (EMT), nonlocal-effect-corrected EM, as well as transfer-matrix method (TMM). The crucial point of the analysis comprises complex numerical simulation based on Finite Difference Time Domain (FDTD) method. Such an approach allows for observation and investigation of wave propagation in any pre-defined medium, including periodical nanostructures, e.g. Active Tunable Hyperbolic Metamaterials.

[Pro19] Conductive photonic structures for multiparametric bio-chemical diagnostics (SONATA BIS Przewodzące struktury fotoniczne do wieloparametrycznej diagnostyki biochemicznej), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Mateusz Śmietana, May 2015–May 2019

The main objective of this project is to design, fabricate and characterize a platform of a new class of optical-fiber-based bio-sensor employing transparent and electrochemically active thin overlays. The obtained sensors will be additionally functionalized with organic bio-film and capable for simultaneous label-free optical and electrochemical measurement, or optical measurement of biochemical interactions taking place at sensor's surface for stimulated (controlled) electrochemical potential. Combination of these two optical and electrochemical systems within one sensing structure will allow for selective detection and multi-parameter analysis of bio-analytes reaching surface of the overlay.

[Pro20] Correlations between electromagnetic and magnetoelastic properties of thin ferromagnetic films (Korelacje pomiędzy własnościami elektromagnetycznymi i magnetoelastycznymi 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.

[Pro21] 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 interferometer (μ IMZI) 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.

4.5. Projects Granted by the Polish National Agency for Academic Exchange

[Pro22] Optical fibre based biosensor of Lyme borreliosis spirochetes (Biosensor światłowodowy krętków boreliozy z Lyme), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, project leader: Mateusz Śmietana, January 2019–December 2020

RESEARCH PROJECTS

Our motivation is to study and to develop an optical fiber sensor based on lossy-mode resonance phenomenon for detection of Lyme borreliosis. This motivation is strongly supported by already existing cooperation between both project applying laboratories/universities. While the team of University of South Bohemia is experienced with deposition of thin films and bioscience, the team at Warsaw University of Technology is performing long-term running and successful research of sensors, detection techniques and diagnostics of detector materials.

4.6. Projects Granted by the International Institutions

[Pro23] Convergence of Electronics and Photonics Technologies for Enabling Terahertz Applications CELTA (CELTA – Konwergencja elektroniki i technik fonicznych na rzecz rozwoju zastosowań techniki terahercowej), EU Horizon 2020 project, (Projekt realizowany w ramach Horyzont 2020: MSCA-ITN-2015-ETN – Marie Skłodowska-Curie Innovative Training Networks (ITN-ETN)), project leader: Krzysztof Madziar, March 2016–February 2020

CELTA aims to produce the next generation of researchers who will enable Europe to take a leading role in the multidisciplinary area of utilising Terahertz technology for applications involving components and complete systems for sensing, instrumentation, imaging, spectroscopy, and communications. All these technologies are keys to tackling challenges and creating solutions in a large number of focus areas relevant for the societal challenges identified in the Horizon 2020 programme. To achieve this objective, CELTA is comprised of 11 leading research institutions and has assembled a comprehensive research training programme for all the 15 early-stage researchers (ESRs). CELTA integrates multidisciplinary scientific expertise, complementary skills, and experience working in academia and industry to empower ESRs to work in interdisciplinary teams, integrate their activities, share expertise, and promote a vision of a converged co-design and common engineering language between electronics and photonics for Terahertz technologies.

[Pro24] Green Power Electronics (Zielona energoelektronika), EU INTERREG BALTIC SEA REGION project, (Projekt realizowany w ramach umowy partnerskiej zawartej z University of Southern Denmark z siedzibą w Sønderborgu w Danii), project leader: Mariusz Sochacki, co-workers: Krystian Król, Norbert Kwietniewski, Katarzyna Kubicka, March 2016–March 2019

The project Green Power Electronics will enhance the capacity of Baltic Sea Region companies to take up advanced power electronics into their R&D strategies and investment planning. Advanced power electronics is based on new materials and is a disruptive technology enabling the energy supply chain to increase energy efficiency. The novel technology is expected to enter the markets within the next 3–7 years. Challenges regarding the reliability under harsh conditions, economic viability of the transition towards advanced power electronics as well as general agreement on the technology and quality standards need to be overcome.

During the project period we carry out three pilots between companies and research institutions within the sectors renewable energies, i.e. wind energy, e-mobility and smart houses. Through these pilots we demonstrate the technical maturity, reliability and economic feasibility of advanced power electronics.

We market the technical and economic opportunities of advanced power electronics to companies in the Baltic Sea Region. SMEs will develop their individual technology roadmaps to take up this novel technology.

[Pro25] High-precision techniques of millimeter and sub-THz band characterization of materials for microelectronics TEAM TECH (Wysokoprecyzyjne techniki charakteryzacji materiałów w zakresie fal milimetrowych oraz subterahercowych do zastosowań mikroelektronicznych), EU Structural Funds project, (Fundusze strukturalne UE: Program Operacyjny Inteligentny Rozwój (PO IR)), project leader: Jerzy Krupka, November 2016–October 2019

The main objective of this project will be to develop novel sensors and sensing methodologies useful to non-destructive contactless electric and magnetic characterization of materials at millimeter and sub-THz spectra. The implementa-

tion of this goal will be two-pronged. On one hand, the said resonant structures will be exploited to benefit from their inherent narrow-band properties, which are particularly useful at measuring low-loss materials. On the other hand, the research will also concern broadband measurement techniques based on multimode resonant structures. The auxiliary goal is adopting the technological approaches typical for the microelectronics industry and applies them for precise fabrication of novel resonant cavities operating in the millimeter and the sub-THz bands. Another such goal is development of a new low-loss yet high dielectric constant material for dielectric posts inserted into sensing cavities.

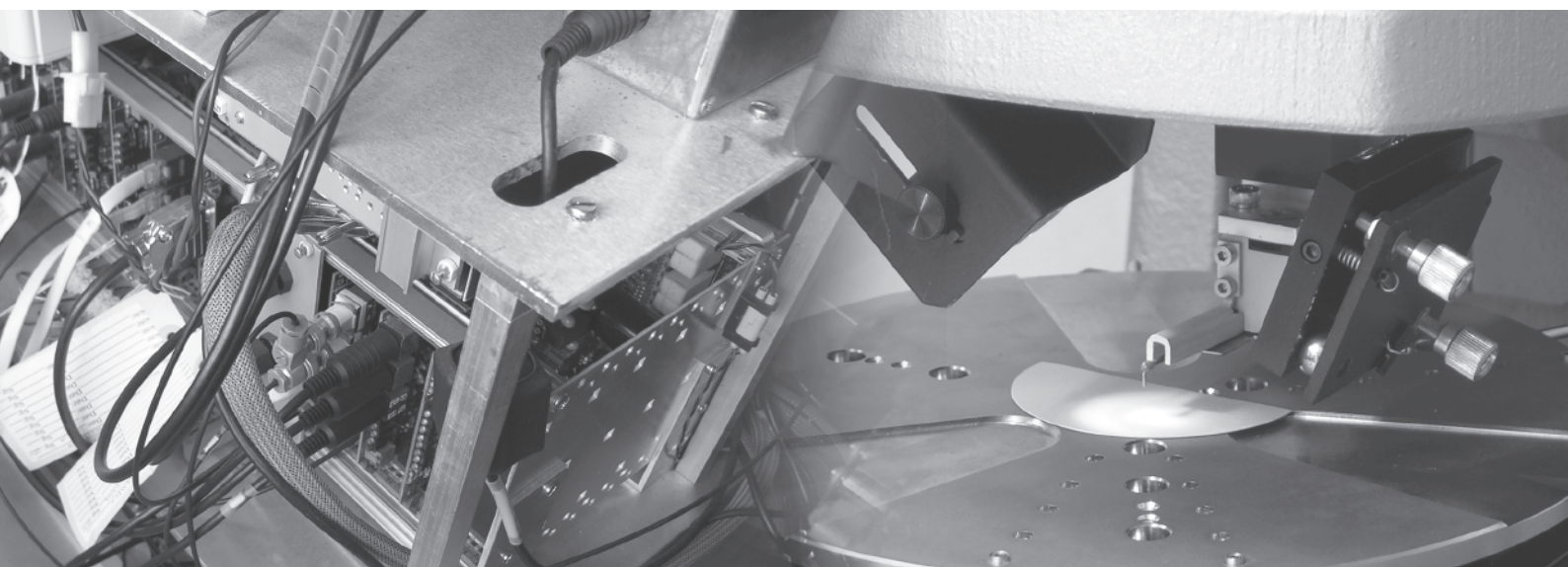
[Pro26] Integrated Electronics and Photonics – development (with the participation of industry representatives) of an M.Sc. program in the area of Electronics including novel educational techniques and taught in English within the framework of the project “NERW PW Science–Education–Development–Cooperation” financed from Axis III Higher Education for the Economy and Development of the Operational Programme Science Education Development 2014–2020

(„Zadanie 13 – Integrated Electronics and Photonics – opracowanie z udziałem przedstawicieli z otoczenia przemysłowego programu kształcenia wykorzystującego nowe formy dydaktyczne na studiach II stopnia na kierunku Elektronika prowadzonych w języku angielskim” w ramach projektu „NERW PW Nauka–Edukacja–Rozwój–Współpraca” finansowanego w ramach Osi III Szkolnictwo wyższe dla gospodarki i rozwoju Operacyjnego Wiedza Edukacja Rozwój 2014–2020), project leader: Sławomir Szostak, March 2018–November 2021

[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 >600 W/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).



Electronic Materials and Microsystem
Technology 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 Association: 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.

Members of the Board: Przemysław Jesinowicz, Magdalena Paszczuk, Yevhen Herashchenko

Total number of Members: 15

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.

In 2019 Students Scientific Association took part in the following events:

- XXIII Festival of Science organized by Polish Academy of Science in Jabłonna, September 21st–22nd, 2019. As in previous years, the members of ONYKS organized „Soldering school”, which had strongly attracted attention of many viewers.
- XVI Science Clubs and Student Organizations Expo KONIK

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

Association Tutor: Marek Niewiński, Ph. D.

Members of the Board: Filip Piórski, Jakub Kajzer, Wiktor Szczerek

Total number of Members: 3

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.

Project started in 2019 by association's members:

Hardware accelerator supporting watermarking of audio files.

The main aim of the project was to implement a selected algorithm for digital watermarking audio files on FPGA platform. The WAV audio files were used as processed data. In first step,

basing on analysis of the literature, a few algorithms were implemented in MATLAB environment, to test which one introduce the smallest amount of distortions. As a result, the algorithm – which use a steganography technique of modifying the lsb bit in audio samples – was selected. As a hardware platform – the NetFPGA 1G-CML, with Kintex-7 chip was used. Due to same technical problem with communication over PCI-E bus, finally 1Gb Ethernet ports were utilized to transfer audio files to/from FPGA module. The audio “blind” tests shows the accurateness of the proposed solution.

5.2. Cooperation with schools

IMiO PW is one of the initiators and the main organizer of the STEM educational project. (Science, Technology, Engineering, Mathematics). STEM's main activity is an interdisciplinary, nationwide competition for high school students. The winners and awarded finalists of the competition are admitted to Warsaw University of Technology in selected fields of study.

This project has been organized since 2018 by Warsaw University of Technology together with educational partners, i.e. the Center for Information Education and Computer Applications in Warsaw and the Tadeusz Czacki XXVII Secondary School in Warsaw. The Faculty of Electronics and Information Technology is the main organizer and coordinator on behalf of Warsaw University of Technology is.

The program is addressed to the youth of upper secondary schools and teachers and aims to improve the quality of education and promote education in the areas defined by the acronym STEM (Science, Technology, Engineering, Mathematics), i.e. natural sciences, technology, engineering and mathematics. STEM helps the young participants of the program develop their skills and abilities to initiate change, modernize and open to new solutions, which creates a real chance that they will tie their future with the areas mentioned above.

One of the most important tools of STEM is an interdisciplinary competition that requires an extended curriculum in physics, mathematics and computer science in secondary schools. The participants have the opportunity to test their knowledge in theoretical and practical tasks. Moreover, they participate in lectures and workshops organized by the Warsaw University of Technology, thus gaining access to the best education at the highest level.

932 students from 57 schools across Poland took part in the first stage of the first three-stage STEM competition, 254 qualified for the second stage and 55 for the third stage. 7 winners and 17 distinguished finalists were selected. Nine (winners and finalists) were accepted as students of the Warsaw University of Technology. About 70 people were involved in organizational activities, most of them from the academic community (academic teachers, doctoral students, students). In the second competition, out of 1,148 candidates entering the first stage, 251 qualified for the second stage. The third stage of the competition is scheduled for March 18, 2020

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

- [PhD1] Bartosz Fetliński, **Methods of solar spectrum conversion in rare earth ions activated hosts for photovoltaic applications** (Metody konwersji widma promieniowania słonecznego w ośrodkach aktywowanych jonami ziem rzadkich dla zastosowań fotowoltaicznych), supervisor: Michał Malinowski, 17 June 2019

6.2. M.Sc. Degrees

- [MSc1] Adam Borkowski, **Implementation of DC/DC converter to supply system-on-chip in CMOS 110 nm technology** (Implementacja przetwornicy napięcia typu DC/DC do zasilania scalonych systemów elektronicznych w technologii CMOS 110 nm), advisor: Tomasz Borejko, 22 March 2019
- [MSc2] Bartosz Dec, **Feasibility studies of EARAM non-volatile memory in VeSTIC technology based on Charge Trapping effect** (Studium wykonalności pamięci EARAM w technologii VeSTIC opartej na zjawisku pułapkowania ładunku), advisor: Andrzej Pfitzner, 15 March 2019
- [MSc3] Jakub Kaczmarek, **Detection of processing related radiation damage effects by means of electrical characterization** (Badanie efektów uszkodzeń radiacyjnych – skutków procesów trawienia plazmowego), advisor: Romuald Beck, 22 March 2019
- [MSc4] Andrzej Kwieciński, **Project and implementation of a RISC-V processor core for multicore architectures** (Projekt i implementacja rdzenia procesora RISC-V dla architektur wielordzeniowych), advisor: Arkadiusz Łuczyk, 22 March 2019
- [MSc5] Marta Łazarewicz, **Investigation and analysis of Yb³⁺ doped YAM crystals** (Badanie i analiza kryształów YAM domieszkowanych Yb³⁺), advisor: Marcin Kaczkan, 25 October 2019
- [MSc6] Piotr Mardowski, **Simulation optimization of dispersion parameters of hyperbolic metamaterial structures in the IR range** (Symulacyjna optymalizacja parametrów rozproszenia hiperbolicznych struktur metamateriałowych w zakresie IR), advisor: Paweł Szczepański, 28 February 2019
- [MSc7] Bartosz Michalak, **Effect of thermal annealing on sensing properties of optical fiber structures with indium tin oxide nano-overlays** (Wpływ wygrzewania struktur światłowodowych z nanowarstwami tlenku cyny indu na ich właściwości sensoryczne), advisor: Mateusz Śmietana, 11 October 2019
- [MSc8] Agata Olszewska, **Remote camera-based method for heart rate monitoring** (Badanie bezkontaktowych, wizyjnych metod pomiaru pulsu), advisor: Piotr Garbat, 22 March 2019
- [MSc9] Łukasz Ostrowski, **Hardware implementation and comparison of SPA and DPA resistant elliptic curve cryptography encryption algorithms** (Sprzętowa realizacja i porównanie zabezpieczonych przed atakami typu SPA i DPA algorytmów szyfrujących z wykorzystaniem krzywych eliptycznych), advisor: Witold Pleskacz, 11 October 2019
- [MSc10] Jakub Szarafiński, **Technology and characterization of MISFET structures with the AlO_xN_y layer as a gate dielectric** (Technologia i charakterystyka struktur MISFET z warstwą AlO_xN_y jako dielektryk bramkowy), advisor: Piotr Firek, 15 March 2019
- [MSc11] Yadviga Tcherniavskaya, **Analysis and Improvement of LVDS ICs for Space Applications** (Analiza i poprawa układów scalonych LVDS dla zastosowań kosmicznych), advisor: Tomasz Borejko, 28 June 2019

DEGREES AWARDED

- [MSc12] Magdalena Trendak, **Optimization of indium tin oxide layer properties for application in optical fiber biosensors based on lossy mode resonance phenomenon** (Optymalizacja właściwości warstwy tlenku cyny indu na potrzeby biocujników światłowodowych opartych na zjawisku rezonansu modów tłumionych), advisor: Mateusz Śmietana, 11 October 2019
- [MSc13] Piotr Wiśniewski, **Modeling and characterization of multi-junction solar cell for space applications** (Badanie i charakteryzacja wielozłączowego ogniwa fotowoltaicznego do zastosowań kosmicznych), advisor: Marcin Kaczkan, 25 October 2019
- [MSc14] Andrzej Wojciechowski, **Configurable MBIST processor for integrated microprocessor circuit's embedded memories testing** (Konfigurowalny procesor MBIST do testowania pamięci wbudowanych scalonego systemu mikroprocesorowego), advisor: Witold Pleskacz, 22 March 2019
- [MSc15] Urszula Zdulska, **Pr+Yb:ZBLAN fiber laser in hybrid design** (Laser światłowodowy Pr+Yb:ZBLAN o konstrukcji hybrydowej), advisor: Ryszard Piramidowicz, 22 March 2019
- [MSc16] Krzysztof Zielant, **Sample-and-Hold circuit designed in 22nm FD-SOI technology** (Układ Sample-and-Hold wykonany w technologii FD-SOI 22nm), advisor: Zbigniew Jaworski, 25 October 2019

6.3. B.Sc. Degrees

- [BSc1] Aleksander Bajkowski, **Project of control and measurement central for smart buildings** (Projekt centrali sterująco pomiarowej do inteligentnego budynku), advisor: Sławomir Szostak, 14 February 2019
- [BSc2] Emil Baldyga, **Hardware realization comparison of chosen integer division algorithms** (Porównanie sprzętowych realizacji wybranych algorytmów dzielenia liczb całkowitych), advisor: Andrzej Wielgus, 14 February 2019
- [BSc3] Mateusz Bieniek, **Microprocessor integrated optoelectronic interrogator driver** (Mikroprocesorowy sterownik scalonego interogatora optoelektronicznego), advisor: Sławomir Szostak, 14 February 2019
- [BSc4] Sebastian Cieślak, **Design and implementation of processor sub-blocks with RISC-V architecture** (Projekt i implementacja podbloków procesora o architekturze RISC-V), advisor: Tomasz Borejko, 8 February 2019
- [BSc5] Włodzimierz Dumański, **Four wave mixing in wave multiplication systems** (Mieszanie czterofalowe w systemach zwielokrotnienia falowego), advisor: Agnieszka Szymańska, 11 October 2019
- [BSc6] Aleksandra Dzieniszewska, **Denoising of multimodal images using deep learning** (Filtracja obrazów wielomodalnych z wykorzystaniem sieci głębokiego uczenia), advisor: Piotr Garbat, 14 February 2019
- [BSc7] Tomasz Gabler, **Analysis of micro-cavities made in optical fiber as a sensor that allows for testing liquids in their of nanoliter volumes** (Analiza mikrootworów wykonanych we włóknach światłowodowych jako czujnika pozwalającego na badania nanolitrowych objętości cieczy), advisor: Mateusz Śmietana, 28 June 2019
- [BSc8] Jeremiasz Hauck, **Implementation of time-to-digital converter (TDC) for an all digital phase lock loop (ADPLL)** (Implementacja przetwornika czasowo-cyfrowego (TDC) dla układu całkowicie cyfrowej pętli synchronizacji fazowej (ADPLL)), advisor: Krzysztof Siwiec, 28 June 2019

- [BSc9] Daniel Iwanicki, **Technology of ultra-thin conductive films for the application of structures based on hiperbolic matematerials** (Technologia ultracienkich warstw przewodzących na potrzeby wytwarzania struktur bazujących na materiałach hiperbolicznych), advisor: Robert Mroczyński, 14 February 2019
- [BSc10] Arkadiusz Kalinowski, **Preparation of automated setup for measurements of nonlinear properties of microwave devices** (Przygotowanie stanowiska do zautomatyzowanych pomiarów nieliniowych własności przyrządów mikrofalowych), advisor: Krzysztof Madziar, 8 February 2019
- [BSc11] Maciej Karcz, **Integrated photonic transmitter driver for the WDM-PON system** (Sterownik zintegrowanego nadajnika fotonicznego do systemu WDM-PON), advisor: Sławomir Szostak, 25 September 2019
- [BSc12] Krzysztof Krupiński, **Digital Image processing algorithms for Positron emission tomography J-PET** (Implementacja algorytmów przetwarzania obrazów dla tomografu pozytonowego J-PET), advisor: Arkadiusz Łuczyk, 25 September 2019
- [BSc13] Katarzyna Lechowicz, **Investigation of optical fiber sensors coated with Indium Tin Oxide thin films for biosensing applications** (Badania czujników światłowodowych pokrytych cienkimi warstwami tlenku indu cyny w zastosowaniach biosensorycznych), advisor: Mateusz Śmietana, 28 June 2019
- [BSc14] Rafał Nowakowski, **Analysis of the possibilities of using the SystemC TLM 2.0 standard in the desing of digital systems** (Analiza możliwości wykorzystania standardu SystemC TLM 2.0 w projektowaniu systemów cyfrowych), advisor: Elżbieta Piwowarska, 25 September 2019
- [BSc15] Adrian Oleksiak, **Environments to design and verification RISC-V processors** (Środowisko do projektowania i weryfikacji procesorów o architekturze RISC-V), advisor: Tomasz Borejko, 8 February 2019
- [BSc16] Paweł Oprzyński, **Hardware implementation of pseudorandom number generator for multithreading applications** (Sprzętowa implementacja generatora liczb pseudolosowych na potrzeby aplikacji wielowątkowych), advisor: Marek Niewiński, 14 February 2019
- [BSc17] Paweł Pieńczuk, **Implementation of power amplifier in operational amplifier architecture, working in AB class and CMOS 55 nm technology** (Implementacja wzmacniacza mocy o architekturze wzmacniacza operacyjnego pracującego w klasie AB w technologii CMOS 55 nm), advisor: Witold Pleskacz, 8 February 2019
- [BSc18] Rafał Piotrowski, **Integration of selected TFT displays with the Cypress PSoC platform** (Integracja wybranych wyświetlaczy TFT z platformą Cypress PSoC), advisor: Marek Niewiński, 20 September 2019
- [BSc19] Grzegorz Potyrański, **Implementation of an integrated transimpedance amplifier for infrared detectors in 130 nm CMOS technology** (Implementacja scalonego wzmacniacza transimpedancyjnego dla detektorów podczerwieni w technologii o wymiarze charakterystycznym 130 nm), advisor: Witold Pleskacz, 8 February 2019
- [BSc20] Piotr Pruszcak, **Simulator of fuzzy systems based on FAM matrix** (Symulator systemów rozmytych opisanych macierzami FAM), advisor: Andrzej Wielgus, 28 February 2019
- [BSc21] Piotr Romaniuk, **Integration of the PSoC platform with the selected GPS/GSM module** (Integracja platformy PSoC z wybranym modulem GPS/GSM), advisor: Marek Niewiński, 20 September 2019
- [BSc22] Jan Sarnecki, **Shape reconstruction using structured light** (Rekonstrukcja kształtu za pomocą światła strukturyzowanego), advisor: Piotr Garbat, 25 September 2019

DEGREES AWARDED

- [BSc23] Monika Sieczka, **Construction of a polarizing illuminator for a microscope** (Wykonanie oświetlacza polaryzacyjnego do mikroskopu), advisor: Marek Sutkowski, 11 October 2019
- [BSc24] Maciej Trębiński, **Project of structure of analog to digital converter with Delta-Sigma modulator with high resolution and low power consumption** (Projekt struktury przetwornika analogowo-cyfrowego z modulatorem Delta-Sigma o wysokiej rozdzielczości i niskim poborze mocy), advisor: Krzysztof Siwiec, 14 February 2019
- [BSc25] Tomasz Waksmundzki, **Optical sensor-based air pollution measuring station** (Stacja pomiarowa z optycznym czujnikiem zanieczyszczenia powietrza), advisor: Krzysztof Anders, 20 September 2019
- [BSc26] Zofia Walczewska, **Measuring stand for measurement of fibers using optical reflectometry methods** (Stanowisko pomiarowe do badań światłowodów metodą reflektometrii optycznej), advisor: Stanisław Stopiński, 20 September 2019
- [BSc27] Eryk Warchulski, **Optimization of technology of ultra-thin layers with meta-heuristics methods** (Optymalizacja technologii ultracienkich warstw przy wykorzystaniu metod meta-heurystycznych), advisor: Robert Mroczyński, 14 February 2019
- [BSc28] Łukasz Wierzbicki, **Application for marker detection** (Aplikacja wykrywająca znaczniki), advisor: Marek Sutkowski, 28 June 2019
- [BSc29] Wiktor Zaorski, **Measurement setup for characterization of optical gyroscopes** (Stanowisko pomiarowe do badań żyroskopów optycznych), advisor: Stanisław Stopiński, 14 February 2019
- [BSc30] Weronika Zatorska, **Adaptive methods of sharpening and denoising images. Deconvolution with the use of CUDA library** (Adaptacyjne metody wyostrażania i odszumiania obrazów. Dekonwolucja z wykorzystaniem biblioteki CUDA), advisor: Piotr Garbat, 14 February 2019
- [BSc31] Kacper Zezuliński, **Optical monochromator controller** (Sterownik monochromatora optycznego), advisor: Krzysztof Anders, 8 February 2019

7. PUBLICATIONS

7.1. Scientific and Technical Papers published in Journals Included in the ISI¹ Database

NUMBER	JOURNAL	AUTHORS	TITLE	DOI	VOLUME	PAGES
[Pub1]	Journal of Nanomaterials	Beck R., Ber K.	Comprehensive Study of Kinetics of Processes Competing during PECVD Ultrathin Silicon Layer High-Temperature Annealing	10.1155/2019/9628984	vol. 2019	1–12
[Pub2]	Physica Status Solidi A-Applications and Materials Science	Belosludtsev A., Yakimov Y., Mroczynski R., Stanionytė S., Skapas M., Buinovskis D., Kyžas N..	Effect of annealing on optical, mechanical, electrical properties and structure of scandium oxide films	10.1002/pssa.201900122	no. June 2019	1–8
[Pub3]	Circuit World	Borecki J., Araźna A., Janeczek K., Kalenik J., Kalenik M., Stęplewski W., Tarakowski R.	Piezoresistive effect in embedded thick-film resistors	10.1108/CW-11-2018-0086	no. 45/1, 2019	31–36
[Pub4]	Sensors	Borecki M., Prus P., Korwin-Pawłowski M.	Capillary Sensor with Disposable Optrode for Diesel Fuel Quality Testing	10.3390/s19091980	vol. 19, no. 9, 2019	1–18
[Pub5]	Journal of Electronic Testing-Theory and Applications	Cieplucha M.	Metric-Driven Verification Methodology with Regression Management	10.1007/s10836-019-05777-0	vol. 35, no. 1, 2019	101–110
[Pub6]	Elektronika – konstrukcje, technologie, zastosowania	Czerwosz E., Biernacki K., Wronka H., Kozłowski M., Diduszko R., Firek P., Fetliński B.	HETEROZŁACZA p-CuO/n-Si DLA ZASTOSOWAŃ FOTOWOLTAICZNYCH	10.15199/13.2019.12.7	vol. 60, no. 12, 2019	36–39
[Pub7]	Microelectronics International	Firek P., Stonio B.	Influence of AlN etching process on MISFET structures	10.1108/MI-12-2018-0081	vol. 36, no. 3, 2019	109–113
[Pub8]	Optics Communications	Gao Y., Sima C., Cheng J., Cai B., Yuan K., Lian Z., Śmietana M., Lu P., Liu D.	Highly-birefringent and ultra-wideband low-loss photonic crystal fiber with rhombic and elliptical holes	10.1016/j.optcom.2019.06.004	vol. 450, 2019	172–175
[Pub9]	IEEE Transactions on Components Packaging and Manufacturing Technology	Górecki P., Myśliwiec M., Górecki K., Kisiel R.	Influence of packaging processes and temperature on characteristics of Schottky diodes made of SiC	10.1109/TCPMT.2019.2894970	vol. 9, no. 4, 2019	633–641
[Pub10]	IEEE Transactions on Electron Devices	Górecki P., Górecki K., Kisiel R., Myśliwiec M.	Thermal Parameters of Monocrystalline GaN Schottky Diodes	10.1109/TED.2019.2907066	vol. 66, no. 5, 2019	2132–2138

¹ Institute for Scientific Information (Philadelphia, USA)

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[Pub11]	Applied Sciences	Hoang V., Stepniewski G., Czarnecka K., Kasztelan R., Long V., Xuan K., Shao L., Śmietana M., Buczyński R.	Optical Properties of Buffers and Cell Culture Media for Optofluidic and Sensing Applications	10.3390/app9061145	vol. 9 no. 6 2019	1–11
[Pub12]	Optical Materials Express	Hoang V., Kasztelan R., Filipkowski A., Stepniewski G., Pysz D., Klimczak M., Ertman S., Long V., Woliński T., Trippenbach M., Xuan K., Śmietana M., Buczyński R.	Supercontinuum generation in an all-normal dispersion large core photonic crystal fiber infiltrated with carbon tetrachloride	10.1364/OME.9.002264	vol. 9 no. 5 2019	2264–2278
[Pub13]	Journal of Applied Physics	Hosain M., Le Floch J., Bourhill J., Krupka J., Tobar M.	Ferroelectric phase transition and crystal asymmetry monitoring of SrTiO ₃ using quasi TEM _{1,1} and quasi TM _{m,1,1} modes	10.1063/1.5092520	vol. 126 no. 10 2019	
[Pub14]	IEEE Photonics Journal	Hu J., Shao L., Gu G., Zhang X., Liu Y., Song X., Song Z., Feng J., Buczyński R., Śmietana M., Wang T., Lang T.	Dual Mach–Zehnder Interferometer Based on Side-Hole Fiber for High-Sensitivity Refractive Index Sensing	10.1109/JPHOT.2019.2948087	vol. 11 no. 6 2019	1–13
[Pub15]	Sensors and Actuators B – Chemical	Janczuk-Richter M., Piestrzyńska M., Burnat D., Sezemsky P., Stranak V., Bock W., Bogdanowicz R., Niedziółka-Jönsson J., Śmietana M.	Optical investigations of electrochemical processes using a long-period fiber grating functionalized by indium tin oxide	10.1016/j.snb.2018.10.001	vol. 279 no. 15 January 2019	223–229
[Pub16]	Journal of Lightwave Technology	Janczuk-Richter M., Dominik M., Koba M., Mikulic P., Bock W., Maćkowski S., Jonsson-Niedziółka M., Jonsson-Niedziółka J., Śmietana M.	Water-induced fused silica glass surface alterations monitored using long-period fiber gratings	10.1109/JLT.2019.2909947	vol. 37 no. 18 2019	4542–4548
[Pub17]	Journal of Lightwave Technology	Janik M., Eftimov T., Koba M., Śmietana M., Bock W.	Tailoring Properties of Microcavity In-line Mach-Zehnder Interferometer by the Microcavity Enlargement using Femtosecond Laser	10.1109/JLT.2019.2907661	vol. 37 no. 18 2019	4501–4506
[Pub18]	Optical Materials	Jusza A., Lipińska L., Baran M., Olszyna A., Jastrzębska A., Gil M., Mergo P., Piramidowicz R.	Praseodymium doped nanocrystals and nanocomposites for application in white light sources	10.1016/j.optmat.2019.109247	vol. 95 no. September 2019	1–8
[Pub19]	Optical Materials	Jusza A., Lipińska L., Baran M., Polis P., Olszyna A., Piramidowicz R.	Short wavelength emission properties of Tm ³⁺ and Tm ³⁺ +Yb ³⁺ doped LaAlO ₃ nanocrystals and polymer composites	10.1016/j.optmat.2019.109365	vol. 97 no. November 2019	1–7
[Pub20]	IEEE Transactions on Microwave Theory and Techniques	Karpisz T., Salski B., Kopyt P., Krupka J.	Measurement of Dielectrics from 20 to 50 GHz with a Fabry-Perot Open Resonator	10.1109/TMTT.2019.2905549	vol. 67 no. 5 2019	1901–1908
[Pub21]	IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems	Kasprowicz D.	Table-Based Model of a Dual-Gate Transistor for Statistical Circuit Simulation	10.1109/TCAD.2018.2852756	vol. 38 no. 8 2019	1493–1500

[Pub22]	Photonics Letters of Poland	Kaźmierczak A., Słowikowski M., Pavlov K., Filipiak M., Piramidowicz R.	Polymer micro-lenses as a long-coupling-distance interfacing layer in the low-cost optical coupling solution between optical fibers and photonic integrated waveguide circuits	10.4302/plp.v11i4.964	vol. 11 no. 4 2019	121–123
[Pub23]	Przegląd Elektrotechniczny	Kisiel R., Sochacki M., Taube A., Guzewicz M.	Montaż struktur AlGaIn/GaN na Si do podłoży DBC w oparciu o technologię SLID oraz zgrzewania dyfuzyjnego mikroproszkiem Ag	10.15199/48.2019.11.02	no. 11 2019	5–7
[Pub24]	Optical Materials	Kowalczyk M., Kaczkan M., Majchrowski A., Malinowski M.	Short-wavelength luminescence of Eu ³⁺ -doped KGd(WO ₄) ₂ crystals	10.1016/j.optmat.2019.109507	vol. 98 no. December 2019	1–7
[Pub25]	Journal of Luminescence	Kowalczyk M., Kaczkan M., Majchrowski A., Malinowski M.	Spectroscopic characterization of orthorhombic δ -BiB ₃ O ₆ phase nonlinear single crystal doped with Pr ³⁺ ions	10.1016/j.jlumin.2018.11.030	vol. 207 no. March 2019	251–257
[Pub26]	Journal of Magnetism and Magnetic Materials	Krupka J., Pacewicz A., Salski B., Kopyt P., Bourhill J., Goryachev M., Tobar M.	Electrodynamic improvements to the theory of magnetostatic modes in ferrimagnetic spheres and their applications to saturation magnetization measurements	10.1016/j.jmmm.2019.165331	vol. 487 no. 1 October 2019	1–9
[Pub27]	Materials Science in Semiconductor Processing	Kruszewski P., Prystawko P., Grabowski M., Sochacki T., Sidor A., Bockowski M., Jasiński J., Łukasiak L., Kisiel R., Leszczyński M.	Electrical properties of vertical GaN Schottky diodes on Ammono-GaN substrate	10.1016/j.mssp.2019.02.037	vol. 96 no. 15 June 2019	132–136
[Pub28]	Journal of Luminescence	Malinowski M., Kaczkan M.	Absorption intensity analysis and emission properties KEu(PO ₃) ₄ and KEu _x Y _{1-x} (PO ₃) ₄ crystals	10.1016/j.jlumin.2019.03.032	vol. 211 no. July 2019	138–143
[Pub29]	Przegląd Elektrotechniczny	Martychowiec A., Kwitniewski N., Sochacki M.	Przegląd metod czyszczenia powierzchni podłoży SiC	10.15199/48.2019.10.35	vol. 95 no. 10 2019	154–157
[Pub30]	Solid-State Electronics	Mazurak A., Mroczynski R.	Comparison of Memory Effect with Voltage or Current Charging Pulse Bias in MIS Structures Based on Codoped Si-NCs Embedded in SiO ₂ or HfO _x	10.1016/j.sse.2019.03.050	vol. 21 March 2019 no. in press	1–10
[Pub31]	JOURNAL OF VACUUM SCIENCE & TECHNOLOGY B	Mazurak A., Jasiński J., Majkusiak B.	Determination of border/bulk traps parameters based on (C - G - V) admittance measurements	10.1116/1.5060674	vol. 37 no. 3 2019	1–9
[Pub32]	Microelectronic Engineering	Mazurak A., Jasiński J., Majkusiak B.	Effect of traps-to-gate tunnel communication on C-V characteristics of MIS capacitors	10.1016/j.mee.2019.111011	vol. 215 no. 15 July 2019	1–5
[Pub33]	Sensors and Actuators B - Chemical	Niedziałkowski P., Białobrzaska W., Burnat D., Sezemsky P., Stranak V., Wulff H., Ossowski T., Bogdanowicz R., Koba M., Śmietana M.	Electrochemical performance of indium-tin-oxide-coated lossy-mode resonance optical fiber sensor	10.1016/j.snb.2019.127043	vol. 301 no. 12 December 2019	1–10

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[Pub34]	Materials	Nowak D., Clapa M., Kula P., Sochacki M., Stonio B., Galazka M., Pelka M., Kuten D., Niedzielski P.	Influence of the interactions at the graphene-substrate boundary on graphene sensitivity to UV irradiation	10.3390/ma122333949	vol. 12 no. 23 2019	1–9
[Pub35]	Sensors and Actuators A Physical	Ozcariz A., Dominik M., Śmietana M., Zamarreño C., Del Villar I., Arregui F.	Lossy mode resonance optical sensors based on indium-gallium-zinc oxide thin film	10.1016/j.sna.2019.03.010	vol. 290 no. 1 May 2019	20–27
[Pub36]	Scientific Report	Pacewicz A., Krupka J., Salski B., Pavlo A., Kopyt P.	Rigorous broadband study of the intrinsic ferromagnetic linewidth of monocrystalline garnet spheres	10.1038/s41598-019-45699-7	vol. 9 2019	1–9
[Pub37]	Materials Research Express	Pawłowski R., Kielbasiński K., Sobik P., Pawłowski B., Wita H., Konefał R., Auguścik M., Pajor-Swierzy A., Szałapak J., Krzemiński J., Jakubowska M.	Obtaining of silver nanopowders by the thermal decomposition of fatty silver salts with various chain length	10.1088/2053-1591/ab086b	vol. 6 no. 6 2019	1–9
[Pub38]	Biosensors & Bioelectronics	Piestrzyńska M., Dominik M., Kosiel K., Janczuk-Richter M., Szot-Karpińska K., Brzozowska E., Shao L., Niedziolka-Jonsson J., Bock W., Śmietana M.	Ultrasensitive tantalum oxide nano-coated long-period gratings for detection of various biological targets	10.1016/j.bios.2019.03.006	vol. 133 no. 15 May 2019	8–15
[Pub39]	Optical Materials	Piramidowicz R., Jusza A., Lipińska L., Gil M., Mergo P.	RE ³⁺ :LaAlO ₃ doped luminescent polymer composites	10.1016/j.optmat.2018.06.018	vol. 87 no. January 2019	35–41
[Pub40]	Semiconductor Science and Technology	Sai P., But D., Yahniuk I., Grabowski M., Sakowicz M., Kruszewski P., Prystawko P., Khachapuridze A., Nowakowski-Szkudlarek K., Przybytek J., Wiśniewski P., Stonio B., Słowikowski M., Rumyantsev S., Knap W., Cywiński G.	AlGaIn/GaN field effect transistor with two lateral Schottky barrier gates towards resonant detection in sub-mm range	10.1088/1361-6641/aaf4a7	vol. 34 no. 2 2019	1–6
[Pub41]	Optical Materials Express	Sobaszek M., Burnat D., Sezemsky P., Stranak V., Bogdanowicz R., Koba M., Siuzdak K., Śmietana M.	Enhancing electrochemical properties of an ITO-coated lossy-mode resonance optical fiber sensor by electrodeposition of PEDOT:PSS	10.1364/OME.9.003069	vol. 9 no. 7 2019	3069–3078
[Pub42]	Przegląd Elektrotechniczny	Sochacki M., Gienza P.	Analiza aspektów termicznych oraz niezawodnościowych na przykładzie opraw ze źródłami LED do oświetlenia miejsca pracy	10.15199/48.2019.02.16	vol. 95 no. 2 2019	75–77
[Pub43]	Przegląd Elektrotechniczny	Stonio B., Kwietniewski N., Firek P., Słowikowski M., Pavlov K., Sochacki M., Szmidt J.	Wpływ materiału maskującego na jakość odwzorowania w procesie suchego trawienia węgla krzemu 4H-SiC w plazmie chlorowej	10.15199/48.2019.10.36	vol. 95 no. 10 2019	160–163
[Pub44]	Przegląd Elektrotechniczny	Stonio B., Kwietniewski N., Firek P., Słowikowski M., Pavlov K., Caban P., Sochacki M., Szmidt J.	Wpływ reaktywnego trawienia jonowego wspomaganego plazmą BCl ₃ na jakość powierzchni węgla krzemu 4H-SiC	10.15199/48.2019.09.38	no. 9 2019	175–177

[Pub45]	Journal of Luminescence	Sujecki S., Sojka Ł., Bereś-Pawlik E., Anders K., Piramidowicz R., Zhuoqi T., Furniss D., Barney E., Benson T., Seddon A.	Experimental and numerical investigation to rationalize both near-infrared and mid-infrared spontaneous emission in Pr ³⁺ doped selenide-chalcogenide fiber	10.1016/j.jlumin.2019.01.023	vol. 209 no. May 2019	14–20
[Pub46]	Electroanalysis	Śmietana M., Niedziałkowski P., Białobrzaska W., Burnat D., Sezemsky P., Koba M., Stranak V., Siuzdak K., Ossowski T., Bogdanowicz R.	Study on Combined Optical and Electrochemical Analysis Using Indium-tin-oxide-coated Optical Fiber Sensor	10.1002/elan.201800638	vol. 31 no. 2 2019	398–404
[Pub47]	Acta Materialia	Wang Y., Hrubak R., Turczyński S., Pawlak D., Malinowski M., Włodarczyk D., Kosyl K., Paszkowicz W., Przybylinska H., Wittlin A., Kamińska A., Zhydashkevskyy Y., Brik M., Li L., Ma C., Suchocki A.	Spectroscopic properties and martensitic phase transition of Y ₄ Al ₂ O ₉ :Ce single crystals under high pressure	10.1016/j.actamat.2018.11.057	vol. 165 no. 15 February 2019	346–361
[Pub48]	Scientific Reports	Żuk B., Sutkowski M., Paśko S., Grudniewski T.	Posture correctness of young female soccer players	10.1038/s41598-019-47619-1	vol. 9 no. 1 2019	1–7

7.2. Scientific and Technical Papers Published in Conference Proceedings

NUMBER	PROCEEDINGS OF CONFERENCE / ISBN/DOI	AUTHORS	TITLE	PAGES
[Pub49]	Book of Abstracts INTERPHOTONICS 2019 Kocaeli University	Anders K., Komorowski P., Bortnowski P., Gusowski M., Jusza A., Mergo P., Karczewski O., Piramidowicz R.	Few Mode Optical Fibers - Concept, Technology and Applications	1–1
[Pub50]	Technical Digest of Conferences ELTE IMAPS 2019 International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Borecki J., Kalenik J., Steplewski W., Araźna A., Janeczek K.	Piezoresistive effect in surface and embedded thick-film resistors	133–134
[Pub51]	Proceedings of SPIE: Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2019 ISBN 9781510630659 DOI:10.1117/12.2536616	Borecki M., Olejnik A., Rychlik A., Korwin-Pawlowski M., Szmidt J.	A passive sensing device for a cloud on the skyline detection	1–7
[Pub52]	Proceedings of 26 th International Conference Mixed Design of Integrated Circuits and Systems MIXDES 2019 ISBN 978-83-63578-15-2 DOI:10.23919/MIXDES.2019.8787139	Borkowski A., Borejko T., Pleskacz W.	DC/DC Buck Converter with Build-in Tuned Sawtooth Wave Generator Using CMOS Technology	196–199
[Pub53]	Seventh European Workshop on Optical Fibre Sensors ISBN 9781510631236 DOI:10.1117/12.2541354	Burnat D., Janczuk-Richter M., Niedziałkowski P., Białobrzaska W., Sezemsky P., Koba M., Stranak V., Bogdanowicz R., Ossowski T., Niedziółka-Jönsson J., Śmietana M.	Optical fiber lossy-mode resonance sensors with doped tin oxides for optical working electrode monitoring in electrochemical systems	1–4

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[Pub54]	Proceedings 17th International Conference on Microwave and High Frequency Heating, 2019 Universitat Politècnica de València ISBN 9788490487198 DOI:10.4995/AMPERE2019.2019.9953	Celuch M., Rudnicki J., Krupka J., Gwarek W.	Application of dielectric resonators to surface impedance measurements of microwave susceptors	
[Pub55]	Proceedings of 26th International Conference Mixed Design of Integrated Circuits and Systems MIXDES 2019 Lodz University of Technology ISBN 978-83-63578-15-2 DOI:10.23919/MIXDES.2019.8787018	Cieślak S., Oleksiak A., Marcinek K., Pleskacz W.	Retargeting the MIPS-II CPU Core to the RISC-V Architecture	261–264
[Pub56]	Proceedings of the 2019 IEEE 22th International Symposium on Design and Diagnostics of Electronic Circuits and Systems ISBN 978-1-7281-0073-9 DOI:10.1109/DDECS.2019.8724643	Derlecki M., Siwiec K., Narczyk P., Pleskacz W.	Design of a True Random Number Generator Based on Low Power Oscillator with Increased Jitter	1–4
[Pub57]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Fetliński B., Kaczkan M., Malinowski M.	Optical properties of Al thin films and multi-layered structures	31–32
[Pub58]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Firek P., Krawczyk S., Czerwos E., Szmidt J.	Hydrogen sensor based on field effect transistor with C-Pd layer	119–120
[Pub59]	Proceedings of SPIE: Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2019 ISBN 9781510630659 DOI:10.1117/12.2536649	Firek P., Waśkiewicz M., Zdunek K., Szmidt J., Chodun R., Nowakowska-Langier K.	Influence of annealing on electronic properties of thin AlN films deposited by magnetron sputtering method on silicon substrates	1–8
[Pub60]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Firek P., Szarański J., Głuszko G., Szmidt J.	Tranzystor polowy z wykorzystaniem AlO_xN_y w roli dielektryka bramkowego	21–22
[Pub61]	Proceedings of SPIE: Photonics Applications in Astronomy, Communications, Industry, and High-Energy Physics Experiments 2019 ISBN 9781510630659 DOI:10.1117/12.2536799	Gęca M., Borecki M.	Spectrometric data analysis of a capillary sensor of fuel photo-stability working with high power light emitting diode at 365 nm	1–8
[Pub62]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Iwanicki D., Warchulski E., Ożga M., Świniarski M., Gertych A., Pasternak I., Zdrojek M., Godlewski M., Arabas J., Mrocznyński R.	Optimization of ultra-thin magnetron sputtered aluminum films	25–26
[Pub63]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Janaszek B., Kieliszczak M., Tyska-Zawadzka A., Szczepański P.	Effect of spatial dispersion in hyperbolic media,	99–100

[Pub64]	Conference Proceeding of BIT's 9 th Annual World Congress of Nano Science and Technology-2019	Janaszek B., Kieliszczyk M., Szczepański P.	Exploring nonlocal response of hyperbolic metamaterials	71–71
[Pub65]	E-MRS Fall Meeting 2019	Janaszek B., Kieliszczyk M., Szczepański P.	Nonlocal hyperbolic metamaterials	69–69
[Pub66]	Proceedings of 26 th International Conference Mixed Design of Integrated Circuits and Systems MIXDES 2019 Lodz University of Technology ISBN 978-83-63578-15-2 DOI:10.23919/MIXDES.2019.8787023	Jaworski Z.	Highly Linear 4-bit Flash ADC Implemented in 22 nm FD-SOI Process	221–226
[Pub67]	Book of Abstracts INTERPHOTONICS 2019 Kocaeli University	Jusza A., Anders K., Komorowski P., Mergo P., Piramidowicz R.	Progress in RE ³⁺ -doped active materials for visible light sources	63–63
[Pub68]	Proceedings on the Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference, CLEO / EUROPE – EQEC 2019 ISBN 978-1-7281-0469-0 DOI:10.1109/CLEOE-EQEC.2019.8871946	Jusza A., Komorowski P., Olas J., Anders K., Piramidowicz R.	UV Luminescence in Ho:ZBLAN Glasses	1–1
[Pub69]	Proc. 2019 IEEE MTT-S International Microwave Symposium, 2019 ISBN 978-1-7281-1309-8 DOI:10.1109/MWSYM.2019.8700981	Karpisz T., Salski B., Kopyt P., Krupka J.	W-Band Measurements of Low-Loss Dielectrics with a Fabry-Perot Open Resonator	1503–1506
[Pub70]	Proceedings of 26 th International Conference Mixed Design of Integrated Circuits and Systems MIXDES 2019 Lodz University of Technology ISBN 978-83-63578-15-2 DOI:10.23919/MIXDES.2019.8787195	Kasprowicz D.	Semiconductor Device Parameter Extraction Based on I–V Measurements and Simulation	321–326
[Pub71]	Proceedings on the Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference, CLEO / EUROPE – EQEC 2019 ISBN 978-1-7281-0469-0 DOI:10.1109/CLEOE-EQEC.2019.8873399	Kaźmierczak A., Słowikowski M., Osuch T., Stopiński S., Piramidowicz R.	Analysis of Operation of Photonic Integrated Interrogators for Fiber Optic Sensor Networks	1–1
[Pub72]	Conference Proceeding of BIT's 9 th Annual World Congress of Nano Science and Technology-2019	Kieliszczyk M., Janaszek B., Szczepański P.	Semi-analytical method for simultaneous extraction of subwavelength thin-film complex refractive index and thickness based on photometric measurement	73–73
[Pub73]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4 DOI:10.1108/CW-12-2019-0186	Kisiel R., Guziewicz M., Taube A., Sochacki M.	Development of Assembly Techniques for Connection of AlGaIn/GaN/Si Chips to DBC substrate	127–128
[Pub74]	Seventh European Workshop on Optical Fibre Sensors ISBN 9781510631236 DOI:10.1117/12.2540849	Koba M., Burnat D., Szot-Karpińska K., Sezemsky P., Stranak V., Bogdanowicz R., Niedziółka-Jönsson J., Śmietana M.	Combined optical and electrochemical analysis of protein binding with ITO-coated lossy-mode resonance sensor	1–4

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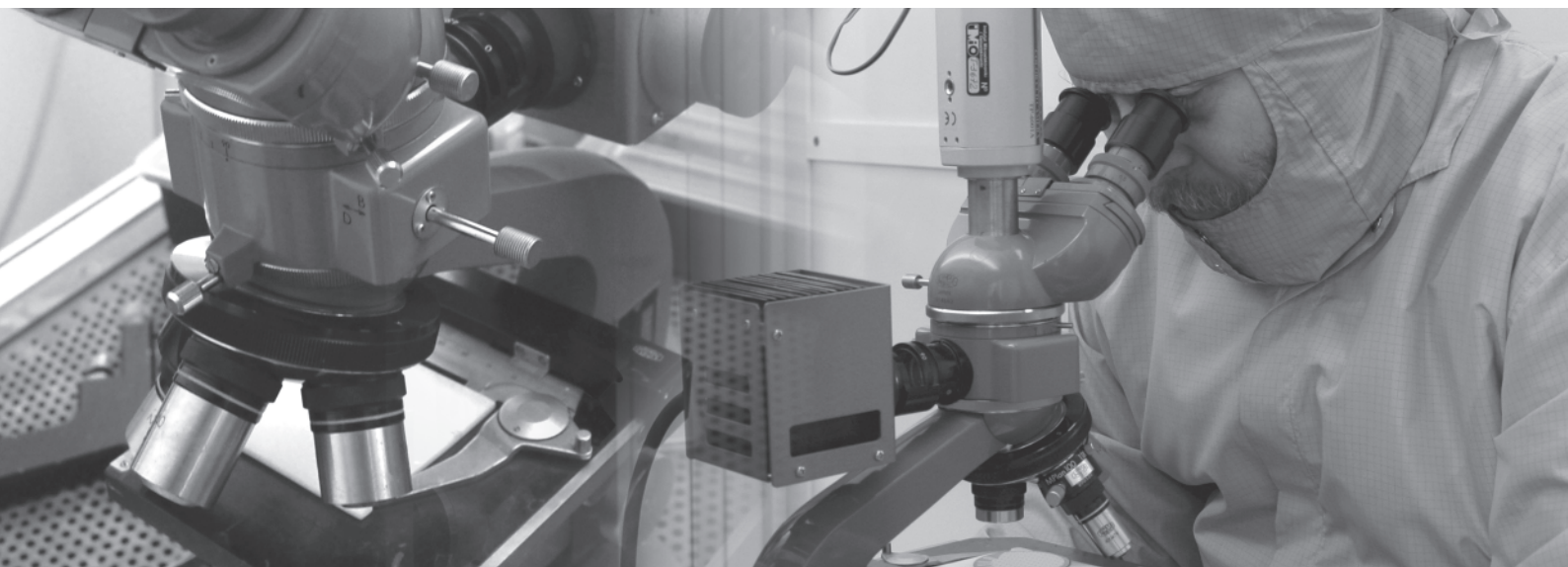
[Pub75]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Kondracka K., Firek P., Kiepus A., Wańkiewicz M., Lewicki S., Zdanowski R., Szmidt J.	Identyfikacja żywotności komórek przy pomocy struktur typu ISFET	51–52
[Pub76]	Proceedings of SPIE: Photonics Applications in Astronomy, Communications, Industry and High-Energy Physics Experiments 2019 ISBN 9781510630659 DOI:10.1117/12.2536746	Kondracka K., Firek P., Caban P., Przewłoka A., Szmidt J.	Technology and characterization of ISFET structures with graphene membrane	1–7
[Pub77]	Quantum Sensing and Nano Electronics and Photonics XVI DOI:10.1117/12.2510580	Kosiel K., Pągowska K., Kozubal M., Guziewicz M., Gołaszewska-Malec K., Lawniczak-Jablonska K., Jakiela R., Rejmak P., Libera J., Kalisz M., Koba M., Szymański M., Dominik M., Niedziółka-Jonsson J., Bock W., Śmietana M.	Atomic layer deposited metallic oxides for optical fiber sensors (Conference Presentation)	1–44
[Pub78]	Proc. Annual Conference on Magnetism and Magnetic Materials	Krupka J., Pacewicz A., Salski B., Kopyt P.	Electrodynamics Theory of Ferromagnetic Resonance and its Applications in Precise Measurements of Ferromagnetic Linewidth, Permeability Tensor and Saturation Magnetization	
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[Pub80]	Proceedings of the 11 th Annual WUT-KNU Joint Research Workshop, 2019, ISBN 978-83-7814-931-6	Łukasiak L., Jasiński J., Kruszewski P., Prystawko P.	Analysis of I-V Characteristics of Forward-biased GaN Schottky Diodes at Reduced Temperatures	137–146
[Pub81]	Proceedings of the 2019 IEEE 14 th Nanotechnology Materials and Devices Conference (NMDC) ISBN 978-1-7281-2637-1 DOI:10.1109/NMDC47361.2019.9083991	Mazurak A., Mroczński R.	Memory effect in MIS structures with embedded all-inorganic colloidal silicon carbide (SiC) nanocrystals	1–4
[Pub82]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Mazurak A., Mroczński R.	Wytwarzanie i charakteryzacja testowych przyrządów MIS zawierających nanokryształy Si i SiC	47–48
[Pub83]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Mossakowska-Wyszyńska A., Witoński P.	Analiza Generacji Promieniowania w Laserze z Nieliniowym Z zwierciadłem Wykazującym Parzystą Symetrię	95–96
[Pub84]	Conference Proceedings „Polskie Porozumienie na Rzecz Rozwoju Sztucznej Inteligencji” Wrocław University of Science and Technology ISBN 78-83-943803-2-8	Mroczński R., Arabas J., Warchulski E.	Optimization of ultra-thin magnetron sputtered aluminum films with the use of AI models	376–379

[Pub85]	Proceedings of 42 nd International Spring Seminar on Electronics Technology ISSE 2019 ISBN 978-1-7281-1874-1 DOI:10.1109/ISSE.2019.8810261	Myśliwiec M., Kisiel R.	Development of SLID Bonding Technology for GaN Assembly Based on Ag Microflakes	1–5
[Pub86]	Proceedings of SPIE: Photonics Applications in Astronomy, Communications, Industry and High-Energy Physics Experiments 2019 ISBN 9781510630659 DOI:10.1117/12.2536753	Olejniak A., Borecki M., Rychlik A.	A sensing device for color immediate detection of medium-distant objects on the horizon	1–9
[Pub87]	Proceedings of 26 th International Conference Mixed Design of Integrated Circuits and Systems MIXDES 2019 Lodz University of Technology ISBN 978-83-63578-15-2 DOI:10.23919/MIXDES.2019.8787108	Oleksiak A., Cieslak S., Marcinek K., Pleskacz W.	Design and Verification Environment for RISC-V Processor Cores	206–209
[Pub88]	Proceedings of 26 th International Conference Mixed Design of Integrated Circuits and Systems MIXDES 2019 Lodz University of Technology ISBN 978-83-63578-15-2 DOI:10.23919/MIXDES.2019.8787129	Ostrowski Ł., Marcinek K., Pleskacz W.	Implementation and Comparison of SPA and DPA Countermeasures for Elliptic Curve Point Multiplication	227–230
[Pub89]	Proc. Annual Conference on Magnetism and Magnetic Materials, 2019	Pacewicz A., Krupka J., Pavlo A., Salski B., Kopyt P.	Inexpensive Setup for Accurate Characterization of the Ferromagnetic Linewidth of Garnet Spheres	1–5
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[Pub92]	Book of Abstracts INTERPHOTONICS 2019 Kocaeli University	Piramidowicz R., Stopiński S., Kaźmierczak A., Słowikowski M., Paśnikowska A., Jusza A., Anders K., Pleskacz W.	Integrated Photonics – Technological Platforms and Applications	62–62
[Pub93]	Programme and Abstracts of 14 th Conference Integrated Optics – Sensors, Sensing Structures and Methods IOS'2019	Piramidowicz R., Stopiński S., Kaźmierczak A., Paśnikowska A., Słowikowski M., Jusza A., Anders K., Pleskacz W., Szczepański P.	Integrated photonics – technologies and applications	48–49
[Pub94]	Proceedings on the Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference, CLEO / EUROPE – EQEC 2019 ISBN 978-1-7281-0469-0 DOI:10.1109/CLEOE-EQEC.2019.8872953	Piramidowicz R., Jusza A., Anders K., Lipińska L., Mergo P.	Rare-earths activated polymer composite fibers – technology and characterization	1–1

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[Pub96]	Proceedings of 2019 IEEE International Test Conference (ITC) ISBN 978-1-7281-4824-3 DOI:10.1109/ITC44170.2019.9000137	Stamenkovic Z., Bosio A., Cserey G., Novak O., Pleskacz W., Sekanina L., Steininger A., Stojanovic G., Stopjakova V.	International Symposium on Design and Diagnostics of Electronic Circuits and Systems	1–4
[Pub97]	Proceedings of SPIE: Photonics Applications in Astronomy, Communications, Industry and High-Energy Physics Experiments 2019 ISBN 9781510630659 DOI:10.1117/12.2536814	Stonio B., Firek P., Taube A., Szmidi J.	Preparation of MoS ₂ films for sensor applications	1–8
[Pub98]	Conference proceedings of 22 nd European Conference on Integrated Optics ECIO 2019 European Conference on Integrated Optics	Stopiński S., Anders K., Szostak S., Piramidowicz R.	Development of a Portable Optical Time Domain Reflectometer System in Photonic Integration Technology	1–3
[Pub99]	Programme and Abstracts of 14 th Conference Integrated Optics – Sensors, Sensing Structures and Methods IOS'2019	Stopiński S., Siennicki M., Piramidowicz R.	Integrated ring lasers for optical gyroscope systems	61–62
[Pub100]	Proceedings on the Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference, CLEO / EUROPE – EQEC 2019 ISBN 978-1-7281-0469-0 DOI:10.1109/CLEOE-EQEC.2019.8872144	Stopiński S., Anders K., Szostak S., Piramidowicz R.	Optical Time Domain Reflectometer Based on Application Specific Photonic Integrated Circuit	1–1
[Pub101]	Proceedings and Abstracts Book of Asian Advanced Materials Congress, 2019 ISBN 978-91-88252-22-7	Szczepański P., Janaszek B., Kieliszczak M., Tyska-Zawadzka A.	Controlling dispersion in tunable hyperbolic metamaterials	38–38
[Pub102]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Tyska-Zawadzka A., Kieliszczak M., Janaszek B., Szczepański P.	Coupled-mode formulation by reciprocity in directional coupler based on hyperbolic metamaterials	97–98
[Pub103]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Vashistha A., Mroczński R.	Optimization of optical properties of titanium nitride (TiN) thin-films	202–203
[Pub104]	Proceedings of 26 th International Conference Mixed Design of Integrated Circuits and Systems MIXDES 2019 Lodz University of Technology ISBN 978-83-63578-15-2 DOI:10.23919/MIXDES.2019.8787081	Wielgus A., Pruszcak P.	Software Tool for FAM-based Modeling and Simulation of Fuzzy Systems	370–374

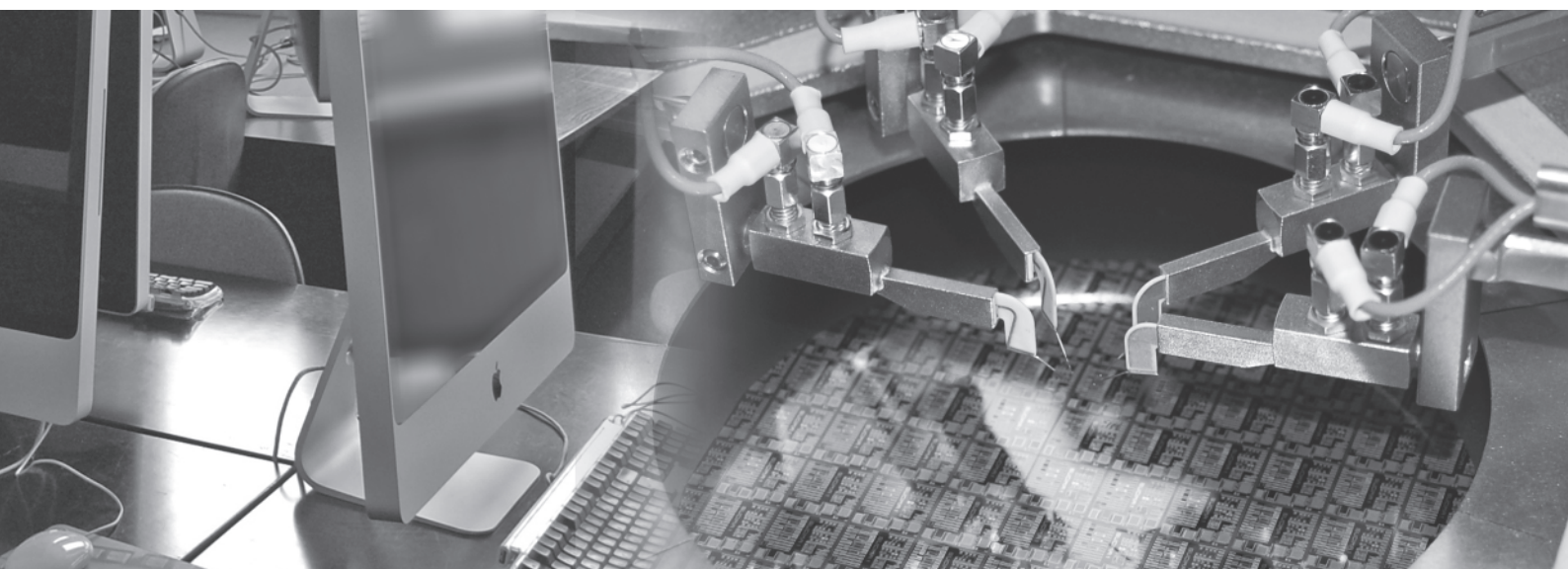
[Pub105]	Technical Digest of Conferences ELTE IMAPS 2019, International Microelectronics and Packaging Society Poland Chapter ISBN 978-83-932464-3-4	Wiśniewski P., Majkusiak B.	Modeling and analysis of Electron- Hole Bilayer TFET current-voltage characteristics	112–113
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Microelectronics and Nanoelectronics Devices Division

8. PATENTS

[Pat1]	Borkowski A., Borejko T., Siwiec K., Pleskacz W.: DC/DC buck converter to supply navigation processor, Topography of integrated circuits (Przetwornica napięcia typu DC/DC do procesora nawigacyjnego), Application number: S-0050, Patent/rights number: T-49, Application date: 08 January 2019, Patent (decision) date: 12 March 2019
[Pat2]	Butryn I., Siwiec K., Pleskacz W.: All digital phase locked loop on L1/E1 band for the satellite navigation receiver (Układ cyfrowej pętli synchronizacji fazy na pasmo L1/E1 do odbiornika sygnału satelitarnego), Topography of integrated circuits, Application number: S-0053, Patent/rights number: T-52, Application date: 08 January 2019, Patent (decision) date: 12 March 2019
[Pat3]	Butryn I., Siwiec K., Pleskacz W.: All digital phase locked loop on L5/E5 band for the satellite navigation receiver (Układ cyfrowej pętli synchronizacji fazy na pasmo L5/E5 do odbiornika sygnału satelitarnego), Topography of integrated circuits, Application number: S-0054, Patent/rights number: T-53, Application date: 08 January 2019, Patent (decision) date: 12 March 2019
[Pat4]	Pietroń D., Borejko T., Siwiec K., Pleskacz W.: Dual band low noise amplifier for L1/E1 and L5/E5 band for the satellite navigation receiver (Dwupasmowy wzmacniacz niskoszumny na pasma L1/E1 i L5/E5 do odbiornika sygnału satelitarnego), Topography of integrated circuits, Application number: S-0051, Patent/rights number: T-50, Application date: 08 January 2019, Patent (decision) date: 12 March 2019
[Pat5]	Pietroń D., Borejko T., Siwiec K., Pleskacz W.: Radio frequency and frequency conversion paths for L1/E1 band for the satellite navigation receiver (Tor wielkiej częstotliwości i przemiany częstotliwości na pasmo L1/E1 do odbiornika sygnału satelitarnego), Topography of integrated circuits, Application number: S-0056, Patent/rights number: T-55, Application date: 08 January 2019, Patent (decision) date: 12 March 2019
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[Pat7]	Sutkowski M.: Method of generating a document with safety element and a secured document (Sposób generowania dokumentu z zabezpieczeniem oraz zabezpieczony dokument), Invention, Application number: P.428691, Application date: 28 January 2019
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VLSI Engineering and Design Automation Division

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NUMBER	AUTHORS	TITLE	TYPE
[Rep1]	Anders K.	Demonstrator of optoelectronic and microelectronic sensors for sailing applications	scientific report from the project granted by the University
[Rep2]	Beck R.B.	Nanophotonics with metal – group-IV-semiconductor nanocomposites: From single nanoobjects to functional ensembles (NaMSeN)	scientific report from the project granted by the National Centre for Research and Development
[Rep3]	Borecki J., Kalenik J., Stepkowski W., Arażna A., Janeczek K.	Piezoresistive effect in surface and embedded thick-film resistors	poster: 43 rd International Microelectronics and Packaging Conference 2019
[Rep4]	Borkowski A., Borejko T., Pleskacz W.	DC/DC Buck Converter with Build-in Tuned Sawtooth Wave Generator Using CMOS Technology	poster: 26 th International Conference Mixed Design of Integrated Circuits and Systems 2019
[Rep5]	Butryn I.	Development of all digital phase locked loop bandwidth shaping method in FMCW radar transceiver	scientific report from the project granted by the University
[Rep6]	Cieślak S., Oleksiak A., Marcinek K., Pleskacz W.	Retargeting the MIPS-II CPU Core to the RISC-V Architecture	poster: 26 th International Conference Mixed Design of Integrated Circuits and Systems 2019
[Rep7]	Fetliński B., Kaczkan M., Malinowski M.	Optical properties of Al thin films and multi-layered structures	paper presented: 13 th Electron Technology Conference 2019
[Rep8]	Firek P., Krawczyk S., Wronka H., Czerwosz E., Szmidi J.	Hydrogen sensor based on field effect transistor with C-Pd layer	poster: 43 rd International Microelectronics and Packaging Conference 2019
[Rep9]	Firek P., Szarański J., Głuszko G., Szmidi J.	Tranzystor polowy z wykorzystaniem AlO_xN_y w roli dielektryka bramkowego	paper presented: 13 th Electron Technology Conference 2019
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[Rep12]	Iwanicki D., Warchulski E., Oźga M., Świniarski M., Gertych A., Pasternak I., Zdrojek M., Godlewski M., Arabas J., Mroczński R.	Optimization of ultra-thin magnetron sputtered aluminum films	paper presented: 13 th Electron Technology Conference 2019
[Rep13]	Janaszek B.	Active Tunable Hyperbolic Metamaterials	scientific report from the project granted by the National Science Centre
[Rep14]	Janaszek B., Kieliszczak M., Szczepański P.	Exploring nonlocal response of hyperbolic metamaterials	paper presented: BIT's 9 th Annual World Congress of Nanosciences and Technology 2019

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[Rep15]	Janaszek B., Kieliszczak M., Szczepański P.	Nonlocal hyperbolic metamaterials	paper presented: European Materials Research Society 2019 Fall Meeting 2019
[Rep16]	Janaszek B., Kieliszczak M., Tyszka-Zawadzka A., Szczepański P.	Effect of spatial dispersion in hyperbolic media	poster: 13 th Electron Technology Conference 2019
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[Rep18]	Jusza A., Komorowski P., Olas J., Anders K., Piramidowicz R.	UV Luminescence in Ho: ZBLAN Glasses	poster: Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference 2019
[Rep19]	Kaźmierczak A., Słowikowski M., Osuch T., Stopiński S., Piramidowicz R.	Analysis of Operation of Photonic Integrated Interrogators for Fiber Optic Sensor Networks	poster: Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference 2019
[Rep20]	Kieliszczak M., Janaszek B., Szczepański P.	Semi-analytical method for simultaneous extraction of subwavelength thin-film complex refractive index and thickness based on photometric measurement	paper presented: BIT's 9 th Annual World Congress of Nanosciences and Technology 2019
[Rep21]	Kisiel R.	New generation of high thermal efficiency components packages for space	scientific report from the project granted by the EU Horizon project – HEATPACK
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[Rep24]	Kopyt P., Salski B., Karpisz T., Krupka J.	Resonator-based measurements of humidity of soils	poster: European Geoscience Union General Assembly 2019
[Rep25]	Krupka J.	High-precision techniques of millimeter and sub-Thz band characterization of materials for microelectronics TEAM TECH	scientific report from the project granted by the EU Structural Funds
[Rep26]	Krupka J.	Correlations between electromagnetic and magnetoelastic properties of thin ferromagnetic films	scientific report from the project granted by the National Science Centre
[Rep27]	Łukasiak L., Jasiński J., Kruszewski P., Prystawko P.	Analysis of I-V Characteristics of Forward-biased GaN Schottky Diodes at Reduced Temperatures	presentation: The 11 th Annual WUT-KNU Joint Research Workshop 2019
[Rep28]	Madziar K.	Convergence of Electronics and Photonics Technologies for Enabling Terahertz Applications CELTA	scientific report from the project granted by the EU Horizon 2020
[Rep29]	Malinowski M.	Tunable hyperbolic metamaterials for photonic devices of novel generation HYPERMAT	scientific report from the project granted by the National Centre for Research and Development

[Rep30]	Mazurak A., Mroczyński R.	Colloidal all-inorganic nanocrystals in MIS structures and devices	poster: European Materials Research Society 2019 Spring Meeting 2019
[Rep31]	Mazurak A., Mroczyński R.	Wytwarzanie i charakteryzacja testowych przyrządów MIS zawierających nanokryształy Si i SiC	paper presented: 13 th Electron Technology Conference 2019
[Rep32]	Mossakowska-Wyszyńska A., Witoński P.	Analiza generacji promieniowania w laserze z nieliniowym zwierciadłem wykazującym parzystą symetrię	poster: 13 th Electron Technology Conference 2019
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[Rep34]	Mroczyński R.	Development of the technology and characterization of materials for novel microelectronic, optoelectronic and photonic devices	scientific report from the project granted by the University
[Rep35]	Mroczyński R.	Research infrastructure for the fabrication and diagnostics of semiconductor structures and devices (SPUB)	scientific report from the project granted by the University
[Rep36]	Niewiński M.	Hardware accelerator supporting watermarking of audio files	scientific report from the project granted by the University
[Rep37]	Oleksiak A., Cieślak S., Marcinek K., Pleskacz W.	Design and Verification Environment for RISC-V Processor Cores	poster: 26 th International Conference Mixed Design of Integrated Circuits and Systems 2019
[Rep38]	Ostrowski Ł., Marcinek K., Pleskacz W.	Functional verification of the digital integrated circuits – probabilistic model of the regression testing procedure	poster: 26 th International Conference Mixed Design of Integrated Circuits and Systems 2019
[Rep39]	Pańnikowska A., Stopiński S., Piramidowicz R.	Integrated InP-based Multichannel Transmitters for WDM-PON System	poster: Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference 2019
[Rep40]	Pavlov K., Słowikowski M., Wiśniewski P., Stonio B., Filipiak M., Myśliwiec M., Michalak B., Beck R.	Manufacturing technology for high precision passive photonic elements	paper presented: 13 th Electron Technology Conference 2019
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[Rep42]	Pietron D.	Method development of automatic on-chip calibration (inside an integrated circuit) of a low-noise amplifier parameters in order to obtain a low sensitivity to variation of fabrication parameters	scientific report from the project granted by the University
[Rep43]	Piramidowicz R.	Nanostructured photonic crystal fibers for innovative few mode propagation TECHMATSTRATEG	scientific report from the project granted by the National Centre for Research and Development

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[Rep44]	Piramidowicz R., Jusza A., Anders K., Lipińska L., Mergo P.	Rare-earths activated polymer composite fibers – technology and characterization	presentation: Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference 2019
[Rep45]	Pleskacz W.	Innovative, hardware-software component, based on a dedicated integrated circuit and software to perform various cryptographic application, with the particular attention paid to electronic identification systems with the high level of confidence	scientific report from the project granted by the National Centre for Research and Development
[Rep46]	Pleskacz W.	Miniature, dual-frequency, system-on-a-chip for precise satellite navigation GPS/Galileo integrated with application processor dedicated to IoT devices with low power consumption	scientific report from the project granted by the National Centre for Research and Development
[Rep47]	Puźniak M., Gajewski W., Żelechowski M., Mroczyński R.	Technology and optimization of hafnium oxynitride (HfO_xN_y) thin-films formed by pulsed-DC reactive magnetron sputtering	presentation: Microtechnology and thermal problems in electronics 2019
[Rep48]	Sochacki M.	Green Power Electronics	scientific report from the project granted by the EU INTERREG BALTIC SEA REGION
[Rep49]	Stopiński S.	Miniaturized optical time domain reflectometer system	scientific report from the project granted by the University
[Rep50]	Stopiński S.	Photonic integrated circuit for interrogation of fiber Bragg gratings	scientific report from the project granted by the University
[Rep51]	Stopiński S., Anders K., Szostak S., Piramidowicz R.	Optical Time Domain Reflectometer Based on Application Specific Photonic Integrated Circuit	poster: Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference 2019
[Rep52]	Sutkowski M., Garbat P., Piecek W.	Optically Excited Markers for Image Analysis	poster: 15 th European Conference on Liquid Crystals 2019
[Rep53]	Szczepański P.	Investigation of active materials, passive and active photonic structures and integrated circuits , optowaves systems and image processing	scientific report from the project granted by the University
[Rep54]	Szczepański P., Janaszek B., Kieliszczak M., Tyska-Zawadzka A.	Controlling dispersion in tunable hyperbolic metamaterials	paper presented: 30 th Asian Advanced Materials Congress 2019
[Rep55]	Szmidt J.	Materials, technologies, structures and devices for microelectronics and optoelectronics	scientific report from the project granted by the University
[Rep56]	Szmidt J.	Methods and means of protection and defense against high power microwave pulses	scientific report from the project granted by the National Centre for Research and Development
[Rep57]	Szmidt J.	Technologies of semiconductor materials for high power and high frequency electronics – WidePOWER	scientific report from the project granted by the National Centre for Research and Development

[Rep58]	Szostak S.	Integrated Electronics and Photonics – development (with the participation of industry representatives) of an M.Sc. program in the area of Electronics including novel educational techniques and taught in English within the framework of the project “NERW PW Science-Education-Development-Cooperation”	scientific report from the project granted by Axis III Higher Education for the Economy and Development of the Operational Programme Science Education Development 2014–2020
[Rep59]	Śmietana M.	DIAMSEC – ultrasensitive sensing platform for rapid detection of epidemiological and pandemic threats	scientific report from the project granted by the National Centre for Research and Development
[Rep60]	Śmietana M.	Conductive photonic structures for multiparametric bio-chemical diagnostics SONATA BIS	scientific report from the project granted by the National Science Centre
[Rep61]	Śmietana M.	Optical analysis of electrochemical reaction products in picoliter volumes	scientific report from the project granted by the National Science Centre
[Rep62]	Śmietana M.	Optical fibre based biosensor of Lyme borreliosis spirochetes	scientific report from the project granted by the Polish National Agency for Academic Exchange
[Rep63]	Tysza-Zawadzka A., Kieliszczak M., Janaszek B., Szczepański P.	Coupled-mode formulation by reciprocity in directional coupler based on hyperbolic metamaterials	poster: 13 th Electron Technology Conference 2019
[Rep64]	Vashistha A., Mroczński R.	Optimization of optical properties of titanium nitride (TiN) thin-films	poster: 13 th Electron Technology Conference 2019
[Rep65]	Wiśniewski P., Majkusiak B.	Modeling and analysis of Electron-Hole Bilayer TFET current-voltage characteristics	poster: 13 th Electron Technology Conference 2019
[Rep66]	Wojciechowski A., Marcinek K., Pleskacz W.	Configurable MBIST Processor for Embedded Memories Testing	presentation: 26 th International Conference Mixed Design of Integrated Circuits and Systems 2019



Optoelectronics Division

10. CONFERENCES, SEMINARS AND MEETINGS

10.1. Conferences

NUMBER	CONFERENCE	PARTICIPANTS
[Con1]	2 nd International Conference on Photonics Research (INTERPHOTONICS 2019), 04.11.2019 – 09.11.2019, Kemer, Turkey	Anders K., Bortnowski P., Gusowski M., Jusza A., Komorowski P., Pańnikowska A., Piramidowicz R., Pleskacz W., Słowikowski M., Stopiński S.
[Con2]	13 th Electron Technology Conference (ELTE IMAPS 2019), 04.09.2019 – 06.09.2019, Wrocław, Poland	Beck R., Borecki J., Fetliński B., Firek P., Janaszek B., Kaczkan M., Kalenik J., Kieliszczak M., Kisiel R., Majkusiak B., Malinowski M., Mazurak A., Mossakowska-Wyszyńska A., Mroczynski R., Myśliwiec M., Słowikowski M., Sochacki M., Stonio B., Szczepański P., Szmidt J., Tysza-Zawadzka A., Wiśniewski P., Witoński P.
[Con3]	14 th Conference Integrated Optics – Sensors, Sensing Structures and Methods (IOS 2019), 25.02.2019 – 01.03.2019, Szczyrk, Poland	Anders K., Jusza A., Pańnikowska A., Piramidowicz R., Pleskacz W., Słowikowski M., Stopiński S., Szczepański P.
[Con4]	17 th International Conference on Microwave and High Frequency Heating (AMPERE 2019), 09.09.2019 – 12.09.2019, Valencia, Spain	Krupka J.
[Con5]	22 nd European Conference on Integrated Optics (ECIO 2019), 24.04.2019 – 26.04.2019, Ghent, Belgium	Anders K., Piramidowicz R., Stopiński S., Szostak S.
[Con6]	26 th International Conference Mixed Design of Integrated Circuits and Systems (MIXDES 2019), 27.06.2019 – 29.06.2019, Rzeszów, Poland	Borkowski A., Borejko T., Jaworski Z., Kasprowicz D., Kuźmich W., Marcinek K., Pleskacz W., Wielgus A., Wojciechowski A.
[Con7]	30 th Asian Advanced Materials Congress (30 th AMC 2019), 31.10.2019 – 04.11.2019, Singapore, Singapore	Janaszek B., Kieliszczak M., Szczepański P.
[Con8]	Annual Conference on Magnetism and Magnetic Materials (MMM 2019), 04.11.2019 – 08.11.2019, Las Vegas, USA	Krupka J.
[Con9]	BIT's 9 th Annual World Congress of Nanosciences and Technology 2019 (Nano-S&T 2019), 20.10.2019 – 22.10.2019, Suzhou, China	Janaszek B., Kieliszczak M., Szczepański P.
[Con10]	Conference on Lasers and Electro-Optics Europe and European Quantum Electronics Conference 2019 (CLEO/Europe-EQEC 2019), 23.06.2019 – 27.06.2019, Munich, Germany	Anders K., Jusza A., Komorowski P., Olas J., Pańnikowska A., Piramidowicz R., Słowikowski M., Stopiński S., Szostak S.
[Con11]	European Materials Research Society 2019 Fall Meeting (E-MRS 2019 Fall Meeting), 16.09.2019 – 19.09.2019, Warsaw, Poland	Janaszek B., Kieliszczak M., Szczepański P.
[Con12]	IEEE 14 th Nanotechnology Materials and Devices Conference (NMDC 2019), 27.10.2019 – 30.10.2019, Stockholm, Sweden	Mazurak A., Mroczynski R.
[Con13]	IEEE 22 th International Symposium on Design and Diagnostics of Electronic Circuits and Systems (DDECS 2019), 24.04.2019 – 26.04.2019, Cluj-Napoca, Romania	Derlecki M., Narczyk P., Pleskacz W., Siwiec K.
[Con14]	IEEE International Test Conference, (ITC 2019), 09.11.2019 – 15.11.2019, Washington, USA	Pleskacz W.
[Con15]	IEEE MTT-S International Microwave Symposium (MTT 2019), 02.06.2019 – 07.06.2019, Boston, USA	Krupka J.
[Con16]	International Conference – Quantum and Precision Metrology (QPM 2019) June 17.06.2019 – 19.06.2019, Krakow, Poland	Mazurak A., Rządziejewicz W.

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[Con17]	Polskie Porozumienie na rzecz Rozwoju Sztucznej Inteligencji (PP-RAI'2019), 16.10.2019 – 18.10.2019, Wrocław, Poland	Mroczyński R.
[Con18]	SPIE Photonics West Conference (SPIE OPTO 2019), 02.02.2019 – 07.02.2019, San Francisco, USA	Koba M., Śmietana M.
[Con19]	The Summer XLIV th IEEE-SPIE Joint Symposium on Photonics, Web Engineering, Electronics for Astronomy and High Energy Physics Experiments (Wilga 2019), 27.05.2019 – 02.06.2019, Wilga, Poland	Borecki M., Firek P., Stonio B., Szmidt J.

10.2. Schools, Seminars and Meetings

NUMBER	EVENT	PARTICIPANTS
[Con20]	7 th European Workshop on Optical Fibre Sensors (EWOFS 2019), 01.10.2019 – 04.10.2019, Limassol, Cyprus	Burnat D., Koba M., Śmietana M.
[Con21]	11 th Annual WUT-KNU Joint Research Workshop (WUT-KNU 2019), 13.06.2019 – 13.06.2019, Warsaw, Poland	Jasiński J., Łukasiak L.
[Con22]	42 nd International Spring Seminar on Electronics Technology "Advances in Printed and Ceramic Microsystems" (ISSE 2019), 15.05.2019 – 19.05.2019, Wrocław, Poland	Kisiel R., Myśliwiec M.

11. AWARDS

- [Award1] Janaszek Bartosz, Kieliszczyk Marcin, Tysza-Zawadzka Anna, Szczepański Paweł, **Outstanding Poster Award at Conference ELTE 2019** (Nagroda za wybitny poster na konferencji ELTE 2019), 2019
- [Award2] Janaszek Bartosz, Kieliszczyk Marcin, Witoński Piotr, Mossakowska-Wyszyńska Agnieszka, Tysza-Zawadzka Anna, Szczepański Paweł, **WUT Rector's Collective Award for Scientific Achievements (1st stage)** (Nagroda zespołowa I stopnia JM Rektora PW za działalność naukową w latach 2017–2018), 2019
- [Award3] Jaworski Zbigniew, **Medal of National Education Commission** (Medal Komisji Edukacji Narodowej), 2019
- [Award4] Jusza Anna Maria, **WUT Rector's Individual Award for Scientific Achievements (3rd stage)** (Nagroda indywidualna III stopnia JM Rektora PW za wyróżnioną rozprawę doktorską w roku 2018), 2019
- [Award5] Krupka Jerzy, Salski Bartłomiej Wacław, Kopyt Paweł, Karpisz Tomasz, Pacewicz Adam, Rytel Marcin, Cuper Jerzy, **WUT Rector's Collective Award for Scientific Achievements (1st stage)** (Nagroda zespołowa I stopnia JM Rektora PW za działalność naukową w latach 2017–2018), 2019
- [Award6] Mazurak Andrzej Igor, Jasiński Jakub Maciej, Mroczyński Robert Paweł, Majkusiak Bogdan, Beck Romuald B, **WUT Rector's Collective Award for Scientific Achievements (1st stage)** (Nagroda zespołowa I stopnia JM Rektora PW za działalność naukową w latach 2017–2018), 2019
- [Award7] Mazurak Andrzej Igor, Mroczyński Robert Paweł, **Outstanding Conference Presentation at Conference ELTE 2019** (Nagroda za wybitną prezentację na konferencji ELTE 2019), 2019
- [Award8] Misiurewicz Jacek, Kulpa Krzysztof, Salski Bartłomiej Wacław, Modelski Józef, Malanowski Mateusz Piotr, Jędrzejewski Konrad, Malik Marta, Pleskacz Witold, Reszewicz Szymon, Witczak Andrzej, Górecki Krzysztof, Napieralski Andrzej, **WUT Rector's Collective Award for Organizing Achievements (1st stage)** (Nagroda Zespołowa I stopnia JM Rektora Politechniki Warszawskiej za osiągnięcia Organizacyjne w latach 2017–2018), 2019
- [Award9] Mroczyński Robert, **Bronze Cross of Merit** (Brązowy Krzyż Zasługi Prezydenta Rzeczypospolitej Polskiej), 2019
- [Award10] Pfizner Andrzej, **Gold Cross of Merit** (Złoty Krzyż Zasługi Prezydenta Rzeczypospolitej Polskiej), 2019
- [Award11] Piramidowicz Ryszard, Anders Krzysztof Paweł, Garbat Piotr, Jusza Anna Maria, Kaźmierczak Andrzej, Markowski Konrad, Osuch Tomasz, Pańnikowska Aleksandra, Słowikowski Mateusz, Stopiński Stanisław Tomasz, Dziuda Łukasz, Krej Mariusz, **WUT Rector's Collective Award for Scientific Achievements (1st stage)** (Nagroda zespołowa I stopnia JM Rektora PW za działalność naukową w latach 2017–2018), 2019
- [Award12] Skotnicki Tomasz, **Award for entering the 2nd stage of the Ministry of Science and Higher Education competition "Grants for grants – quality promotion II"** (Nagroda za przejście do II etapu konkursu MNiSW „Granty na granty – promocja jakości II”), 2019
- [Award13] Śmietana Mateusz Jakub, Koba Marcin, **WUT Rector's Collective Award for Scientific Achievements (1st stage)** (Nagroda zespołowa I stopnia JM Rektora PW za działalność naukową w latach 2017–2018), 2019
- [Award14] Wojciechowski Andrzej, Marcinek Krzysztof, Pleskacz Witold, **Young Scientist Paper Award of IEEE Poland Joint Chapter at 26th International Conference Mixed Design of Integrated Circuits and Systems MIXDES 2019 (MIXDES 2019)** (Nagroda dla Młodego Naukowca Polskiej Sekcji IEEE ED Chapter na Konferencji MIXDES 2019), 2019

