



ANNUAL REPORT
OF
THE INSTITUTE
OF MICROELECTRONICS
AND OPTOELECTRONICS

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CONTENTS:

1. GENERAL INFORMATION	4
1.1. MISSION AND ORGANISATION OF THE INSTITUTE	4
1.2. BOARD OF DIRECTORS	4
1.3. MICROELECTRONICS DIVISION.....	4
1.4. MICROWAVE DEVICES DIVISION	5
1.5. ELECTRONIC MATERIALS AND PROCESSING DIVISION	6
1.6. OPTOELECTRONICS DIVISION	6
1.7. IMAGE PROCESSING DIVISION	7
1.8. VACUUM SCIENCE AND TECHNOLOGY GROUP	7
1.9. STATISTICAL DATA.....	8
2. STAFF.....	9
2.1. SENIOR ACADEMIC STAFF.....	9
2.2. JUNIOR ACADEMIC STAFF.....	13
2.3. TECHNICAL AND ADMINISTRATIVE STAFF.....	14
3. TEACHING ACTIVITIES.....	15
3.1. BASIC COURSES	15
3.2. ADVANCED COURSES	16
3.3. COURSES IN ENGLISH.....	16
3.4. INTERNATIONAL CO-OPERATION IN EDUCATION	16
4. RESEARCH PROJECTS.....	17
4.1. PROJECTS GRANTED BY THE UNIVERSITY.....	17
4.2. PROJECTS GRANTED BY THE STATE COMMITTEE FOR SCIENTIFIC RESEARCH (KBN)	23
4.3. PROJECTS GRANTED BY INTERNATIONAL INSTITUTIONS	25
5. DEGREES AWARDED.....	28
5.1. PH.D. DEGREES	28
5.2. M.SC. DEGREES.....	28
5.3. B.SC. DEGREES	29
6. PUBLICATIONS	30
6.1. SCIENTIFIC AND TECHNICAL BOOKS	30
6.2. SCIENTIFIC AND TECHNICAL PAPERS PUBLISHED IN JOURNALS INCLUDED IN THE ISI DATABASE.....	30
6.3. SCIENTIFIC AND TECHNICAL PAPERS PUBLISHED IN JOURNALS NOT INCLUDED IN THE ISI DATABASE.....	31
6.4. SCIENTIFIC AND TECHNICAL PAPERS PUBLISHED IN CONFERENCE PROCEEDINGS.....	31
6.5. OTHER PUBLICATIONS	33
6.6. TEACHING AIDS TO COURSES GIVEN IN ENGLISH.....	35
7. RESEARCH REPORTS.....	36
8. PATENTS	37
9. CONFERENCES, SEMINARS AND MEETINGS.....	37
9.1. INTERNATIONAL CONFERENCES.....	37
9.2. LOCAL CONFERENCES	37
9.3. SCHOOLS AND SEMINARS.....	37
9.4. MEETINGS.....	38

1. GENERAL INFORMATION

From the Director

The Institute of Microelectronics and Optoelectronics was founded in 1970 and grew out of the Chair of Radio Engineering created by Professor Janusz Groszkowski in 1929. This Annual Report summarises the research activities of the Institute in 1998, as well as the teaching activities in the corresponding winter and summer terms of the academic year 1997/98 and 1998/1999.

The year 1998 was characterised by the expansion of scientific relationships and major projects funded by several institutions. Key research areas which have been addressed are:

- process engineering, modelling and diagnostics of semiconductor structures;
- characterisation of materials for electronics applications;
- microwave devices;
- design of analogue and digital integrated circuits;
- hybrid technologies and assembly techniques;
- physics and applications of lasers;
- optoelectronic devices;
- electronic imaging and image processing.

The Institute of Microelectronics and Optoelectronics participates in numerous international programs of scientific exchange set up by the European Community. Moreover, co-operation with several regional and European companies has been activated in 1998.

I wish to thank all friends and partner institutions for their continuous encouragement and assistance.

I express my sincere appreciation to all the staff of the Institute for their efforts and contributions to our success in microelectronics and optoelectronics. Particularly, the most important and stimulating development has been the co-operation with guest scientists which has created an environment where not only scientific adventures can flourish.

Warsaw, January 1999

1.1. Mission and Organisation of the Institute

The Institute of Microelectronics and Optoelectronics belongs to the Faculty of Electronics and Information Technology, which is the largest department of the Warsaw University of Technology.

The main research activity in the Institute comprises of:

- modelling of physical effects occurring in modern semiconductor devices;
- monocrystalline and amorphous silicon processing and its modelling, and non-standard dielectric layer deposition techniques;
- development of new methods and measuring systems for electronic materials;
- generation of microwaves, microwave measurement techniques, and numerical methods for electromagnetics;
- processing, device design, optimisation techniques and development of VLSI (very large scale integration of circuits) computer-aided tools;

- manufacturing of hybrid circuits with special emphasis on thick-film technology and its applications to hybrid microwave integrated circuits;
- laser physics (Fabry-Perot and distributed feedback lasers), laser spectroscopy of solid state active materials, and applications of lasers in medicine, manufacturing and telecommunications;
- the fabrication and characterisation of optoelectronics elements and devices;
- computer-aided design of photoelectronic image devices, image processing and visualisation of results of experiments with image devices;
- vacuum science and technology - CAD (computer-aided design) and modelling of gas flow in vacuum systems mainly focused on metrological systems.

The academic staff of the Institute give lectures in: vacuum science and technology; silicon technology; VLSI systems design; hybrid integrated circuits technology; fundamentals of optoelectronics; laser physics; optoelectronics devices; fibre sensors and optoelectronic measurements; semiconductor thin-films; microwave measurements of materials; surface-mounted technology; measurements of optoelectronic systems and non-linear fibre optics.

The Institute of Microelectronics and Optoelectronics consists of five research and teaching divisions, namely:

- Microelectronics Division,
- Microwave Devices Division,
- Electronic Materials and Processing Division,
- Optoelectronics Division,
- Image Processing Division,
- and Vacuum Science and Technology Group.

The structure of the Institute also includes Financial Service, Maintenance and Supply Service, and Secretariats.

The offices and laboratories of the Institute are located in the two buildings: Building of the Faculty of Electronics and Information Technology (GE) and Building of Radioelectronics (GR).

1.2. Board of Directors

Director of the Institute

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1.3. Microelectronics Division

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Bogdan Majkusiak, Ph.D., D.Sc., Professor
Jan Szmids, Ph.D., D.Sc., Professor
Romuald B. Beck, Ph.D., D.Sc., Associate Professor
Jerzy Ruńyło, Ph.D., D.Sc., Associate Professor
Tomasz Brońek, Ph.D., Assistant Professor
Tomasz Janik, Ph.D., Assistant Professor
Zbigniew Jaworski, Ph.D., Assistant Professor
Małgorzata Jurczak, Ph.D., Assistant Professor
Lidia Łukasik, Ph.D., Assistant Professor
Mariusz Niewczas, Ph.D., Assistant Professor
Elińbieta Piwowarska, Ph.D., Assistant Professor
Zbigniew Pióro, Ph.D., Assistant Professor
Witold Pleskacz, Ph.D., Assistant Professor
Andrzej Rosiński, Ph.D., Assistant Professor
Adam Wojtasik, Ph.D., Assistant Professor
Andrzej Pfitzner, Ph.D., Senior Lecturer
Antoni Siennicki, Ph.D., Senior Lecturer
Jan Gibki, Ph.D., Lecturer
Józef Maciak, M.Sc., Lecturer

Junior academic staff

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Robert Miklas, M.Sc., Assistant
Andrzej Wielgus, M.Sc., Assistant
Agnieszka Zaręba, M.Sc., Assistant
Adam Lejman, M.Sc., Ph.D. Student
Aleksander Werbowy, M.Sc., Ph.D. Student
Krzysztof Domański, M.Sc., Ph.D. Student
Jacek Laskowski, M.Sc., Ph.D. Student
Emilian Pórolnik, M.Sc., Ph.D. Student
Sławomir Szostak, M.Sc., Ph.D. Student
Karol Szymański, M.Sc., Ph.D. Student
Jakub Walczak, M.Sc., Ph.D. Student
Andrzej Wojtkiewicz, M.Sc., Ph.D. Student
Kamil Kosiel M.Sc., Ph.D. Student
Piotr Brzozowski M.Sc., Ph.D. Student
Marcin Malicki M.Sc., Ph.D. Student
Tomasz Dźbiski M.Sc., Ph.D. Student
Marek Kostana M.Sc., Ph.D. Student

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Kazimierz Dalbiak
Jerzy Gempel, M.Sc.
Stanisław Jeszka, M.Sc.
Krzysztof Krogulski
Marcin Sadowski, M.Sc.
Małgorzata Trzaskowska
Andrzej Wałkanis, M.Sc.

The Microelectronics Division consists of two research and teaching groups:

- Technology Diagnostics and Modelling Group;
- CAD Research Group.

The research carried out in the former group falls into three main areas: technology, diagnostics and modelling of MOS (metal-oxide-semiconductor) structures, as well as design of microelectronics IC's (integrated circuits) and application of microelectronics in digital signal processing.

To name a few examples of its research topics:

- modelling and investigation on kinetics of silicon oxidation;
- wear-out and degradation processes in MOS structures (breakdown of dielectric layers, hot carries effects, radiation damage effects);
- transport mechanisms and quantum effects in MOS structures (transistor, tunnel diode) with ultrathin oxides;
- new materials for microelectronics applications (e.g. diamond-like carbon, borazone);
- theoretical studies on MOS-SOI (silicon on insulator) structures physics;
- methods of formal and functional verification of IC design: methods of verification of logical circuits, methods of determination of circuit topography sensitivity on point defects;
- novel mathematical methods of technological processing modelling in application to statistical simulation;
- novel two-dimensional mathematical simulation of semiconductor devices.

Current research projects in the latter research group of the Division are as follows:

- methodologies of integrated circuit design for manufacturability: application of statistical process and device simulation in IC design, investigations of spatial on-chip correlations of random process disturbances, analysis of layout sensitivity to spot defects;
- design of analogue VLSI circuits: analogue implementations of fuzzy logic controllers with biomedical applications, methodologies of testing and design for testability of analogue VLSI integrated circuits;
- development of CAD tools for integrated circuit design and verification, with special emphasis on analogue full custom ASICs design;
- investigations of signal propagation and crosstalk in long interconnections in submicron VLSI circuits;
- design of digital and mixed VLSI circuits for special applications: speech synthesis, data processing in physical experiments, etc.

1.4. Microwave Devices Division**Head of the Division**

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Senior academic staff

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Jerzy Piotrowski, Ph.D., Assistant Professor
Bernard Jakubowski, Ph.D., Senior Lecturer

Junior academic staff

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Andrzej Krzysztofik, M.Sc., Assistant
Jarosław Dawidczyk, M.Sc., Ph.D. Student
Zbigniew Pieńkowski, M.Sc., Ph.D. Student
Zenon Szczepaniak, M.Sc., Ph.D. Student

Technical and administrative staff

Barbara Szymulska

The research activity of the Microwave Devices Division is concerned with propagative electronics. The characteristic feature of the electronics branch is the comparability between the time of system state change and the time of signal propagation between particular system points.

The research activity of the Microwave Devices Division is concentrated on:

- 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;
- analysis methods of transmission lines for modern mm-wave microwave integrated circuits.

From the new topics of research activity we can mention:

- modelling and computer aided design of microwave transmission lines and devices;
- microwave sensors for industrial applications;
- controlling of microwave circuits parameters by means of optical signals
- optoelectronics and microwave devices for data transmission networks.

1.5. Electronic Materials and Processing Division**Head of the Division**

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Senior academic staff

Jerzy Krupka, Ph.D., D.Sc., Associate Professor
Mikołaj Baszun, Ph.D., Assistant Professor
Michał Borecki, Ph.D., Assistant Professor
Jerzy Kalenik, Ph.D., Assistant Professor
Ryszard Kisiel, Ph.D., Assistant Professor
Krystyna Lachowska, Ph.D., Assistant Professor
Stanisław Pietruszko, Ph.D., Assistant Professor
Julitta Pogorzelska, Ph.D., Assistant Professor
Zbigniew Szczepański, Ph.D., Senior Lecturer
Maria Beblowska, Ph.D., Senior Lecturer
Zdzisław Mśczeński, Ph.D., Senior Lecturer
Janusz Rogowski, Ph.D., Senior Lecturer

Junior academic staff

Agata Jasik, M.Sc., Ph.D. Student
Leszek Ksiśśek, M.Sc., Ph.D. Student
Krzysztof Kśdra, M.Sc., Ph.D. Student

Technical and administrative staff

Ryszard Biaduń
Marek Gutkowski, M.Sc.
Zbigniew Rudkowski
Krystyna Szyłko

The research activity of the Division concentrates on electronic materials and processing. Fundamental and applied

research are carried out. Research groups are organised for defined tasks.

The main research areas are as follows:

- fabrication and investigation of the following optoelectronic devices: integrated passive and active lightwave guiding structures (modulators, bistable switches etc.) and fibre optic sensors;
- computer engineering for fibre optics;
- surface wave engineering: constructions of delay lines for TV, band filters, spectrum analysers, sensors;
- new techniques of surface mounted devices on PCB (printed circuit boards);
- application of thin and thick film technology in gas sensors and pressure sensors;
- invention of equipment for measurement of magnetic and dielectric material parameters in a wide frequency range;
- investigation of the electronic structure, stability and optical properties of amorphous silicon and its devices (thin film transistors, solar cells, etc.).

1.6. Optoelectronics Division**Head of the Division**

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Senior academic staff

Michał Malinowski, Ph.D., D.Sc., Professor
Paweł Szczepański, Ph.D., D.Sc., Associate Professor
Tadeusz Adamowicz, Ph.D., Assistant Professor
Jerzy Kśsik, Ph.D., Assistant Professor
Anna Tyszka-Zawadzka, Ph.D., Assistant Professor
Agnieszka Mossakowska-Wyszyńska, Ph.D., Assistant Professor

Junior academic staff

Krzysztof Dziściołowski, M.Sc., Ph.D. Student
Marcin Kaczkan, M.Sc., Ph.D. Student
Wojciech Kwaśniewski, M.Sc., Ph.D. Student
Ryszard Piramidowicz, M.Sc., Ph.D. Student
Piotr Warda, M.Sc., Ph.D. Student
Piotr Witoński, M.Sc., Ph.D. Student
Artur Wnuk, M.Sc., Ph.D. Student

Technical and administrative staff

Stanisław Jonak, M.Sc.
Marek Markiewicz
Radosław Wolski, M.Sc.

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, laser spectroscopy, laser construction and laser applications in medicine and air pollution monitoring.

The academic staff of the Division give lectures in photonics, laser physics, laser technology, laser applications, laser spectroscopy, integrated optoelectronics and optical computing, all of which are accompanied by appropriate laboratory class activities

The main research activity of the Division comprises:

- solid state laser construction and investigation of 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;
- theoretical research of laser generation in planar, fibre and hollow waveguide gas lasers, analysis of light generation in DFB (distributed feedback) structures and in lasers with non-linear optical elements, investigation of the statistical properties of the light generated in various laser structures;
- research of light generation in metal vapour gas lasers, measurement of laser parameters, investigation of light generation in hollow cathode lasers, analysis of plasma discharge processes, research of the optogalvanic effect;
- 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.

1.7. Image Processing Division

Head of the Division

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Senior academic staff

Hanna Górkiewicz-Galwas, Ph.D., Senior Lecturer

Junior academic staff

Grzegorz Kukielka, M.Sc., Assistant
Artur Przygoda, M.Sc., Ph.D. Student
Bartosz Dudziński, M.Sc., Ph.D. Student
Ryszard Pajżk, M.Sc., Ph.D. Student

Technical and administrative staff

Jerzy Domański, M.Sc.

The main areas of activity of the Division are education and research, both in the field of the technology of electronic imaging and of digital image processing. Members of the academic staff are involved in research and development works on:

- theoretical principles of image modelling;
 - numerical methods of image analysis;
 - implementation of digital image processing for detection, inspection and identification of objects;
- application of image processing methods for diagnostic control and measurement systems in industry, medicine, research and commerce.

1.8. Vacuum Science and Technology Group

Senior academic staff

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Junior academic staff

Marek Niewiżski, M.Sc., Assistant
Karol Szymański, M.Sc., Ph.D. Student

Technical and administrative staff

Piotr Karwański
Wojciech Skulski

The research work of the Vacuum Technology Team is concentrated on the three main fields:

- vacuum metrology (adaptation of Polish rules to European standards),
- gas flow simulation in vacuum systems,
- development of CAD of vacuum systems.

These works are focused on modelling of low pressure standards.

1.9. Statistical data

SPECIFICATION	1997	1998	DIFFERENCE
Academic staff	88	87	-1
Full professors	5	5	0
Professors	3	4	+1
Associate professors	5	4	-1
Assistant professors	25	25	0
Senior lecturers	8	8	0
Lecturers	2	3	+1
Assistants and Ph.D. students	40	38	-2
Technical staff	22	18	-4
Administrative staff	5	5	0
Space	3135.3	3135.3	0
Teaching laboratories	1318.7	1318.7	0
Other laboratories	269.3	269.3	0
Offices of academic staff	1547.3	1547.3	0
Computers	138	148	+10
Library resources	9265	9265	0
Books (number of volumes)	9260	9260	0
Journals (number of titles subscribed to)	5	5	0
Teaching activities	64	65	+1
Basic courses	39	54	+15
Advanced courses	23	7	-16
Special courses	0	2	+2
International projects	2	2	0
Research projects	56	67	+11
Granted by the University	17	26	+9
Granted by State Institutions	17	20	+3
Granted by International Institutions	22	21	-1
Other projects	0	0	0
Degrees awarded	35	37	+2
D.Sc. degrees	0	0	0
Ph.D. degrees	2	2	0
M.Sc. degrees	33	30	-3
B.Sc. degrees	0	5	+5
Publications	183	166	-17
Sci.-tech. books	2	2	0
Sci.-tech. papers in journals	57	30	-27
Sci.-tech. papers in conference proceedings	124	89	-35
Teaching aids	0	9	+9
Other publications	0	36	+36
Reports	29	23	-6
Research reports	29	23	-6
Other reports	0	0	0
Patents	2	2	0
Conferences			
Organised by the Institute (number of conferences)	2	2	0
Organised by the Institute (number of participants)	57	12	-45
Others (number of conferences)	44	34	-10
Others (number of participants from the Institute)	66	63	-3

2. STAFF

2.1. Senior Academic Staff

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the Institute of Vacuum Technology ('90-), Member of Research Council of the Institute
of Applied Optics ('78-), Chairman of Prog. Council of the Journal „Elektronika” ('78-),
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2.2. Junior Academic Staff

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Aleksander Werbowy	M.Sc.	Ph.D. Student	660-7773
Andrzej Krzysztofik	M.Sc.	Assistant	660-7949
Andrzej Wielgus	M.Sc.	Assistant	660-7207
Andrzej Wojtkiewicz	M.Sc.	Ph.D. Student	660-7773
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Artur Wnuk	M.Sc.	Ph.D. Student	660-7783
Bartosz Dudziński	M.Sc.	Ph.D. Student	660-7780
Emilian Pórolnik	M.Sc.	Ph.D. Student	660-7773
Grzegorz Kukiełka	M.Sc.	Assistant	660-7780
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Józef Maciak	M.Sc.	Lecturer	660-7775
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Marcin Malicki	M.Sc.	Ph.D. Student	660-7773
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Tomasz Dębski	M.Sc.	Ph.D. Student	660-7773
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Zbigniew Pieżkowski	M.Sc.	Ph.D. Student	660-7949
Zenon Szczepaniak	M.Sc.	Ph.D. Student	660-7949

2.3. Technical and Administrative Staff

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Stanisław Jonak	M.Sc.	Senior R&D Engineer	660-7778
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Krzysztof Krogulski		Laboratory Technician	660-7775
Marek Markiewicz		Senior Technician	660-7778
Jadwiga Radzyńska		Secretary	660-7777
Zbigniew Rudkowski		Senior Foreman	660-7908
Marcin Sadowski	M.Sc.	Senior Technician	660-7207
Wojciech Skulski		Senior Foreman	660-5479
Anna Sikorska		Finance Manager	660-7243
Krystyna Szyłko		Foreman	660-7851
Barbara Szymulska		R&D Engineer	660-7939
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Andrzej Wałkanis	M.Sc.	Senior Technician	660-7207
Radosław Wolski	M.Sc.	Senior R&D Engineer	660-7783

3. TEACHING ACTIVITIES

3.1. Basic Courses

- [Edu1] **Basics of Electron Technology - Laboratory** (Podstawy technologii elektronicznej - laboratorium), **PTEL**, Maria Bełłowska
- [Edu2] **Basics of Optics** (Podstawy Optyki), **POPT**, Kazimierz Gniadek
- [Edu3] **C Language Programming - Laboratory** (Laboratorium programowania w języku C), **LPC**, Adam Wojtasiak
- [Edu4] **CAD for PCB (PADS)** (Wspomaganie komputerowe projektowania obwodów drukowanych), **PADS**, Ryszard Kisiel, Jerzy Kalenik
- [Edu5] **Characterisation of Microelectronic Structures and Technologies** (Charakteryzacja struktur i technologii mikroelektronicznych), **CSTM**, Bogdan Majkusiak
- [Edu6] **Characterisation of Solid State - Laboratory** (Metody badania ciała stałego - laboratorium), **BCSL**, Piotr Szwemin
- [Edu7] **Characterisation of Solid State** (Metody badania ciała stałego), **BCS**, Piotr Szwemin
- [Edu8] **Computer Aided Design and Manufacturing of Microwave Circuits** (Komputerowe projektowanie i realizacja obwodów mikrofalowych), **KPROM**, Sławomir Palczewski
- [Edu9] **Electronics 1** (Elektronika 1), **ELKA1**, Andrzej Jakubowski, Andrzej Pfizner
- [Edu10] **Electronics 3** (Elektronika 3), **ELKA3**, Wiesław Kuźmicz
- [Edu11] **Fundamentals of Microprocessor Techniques** (Podstawy techniki mikroprocesorowej), **TMIK**, Lidia Łukasiak
- [Edu12] **Fundamentals of Solid State Electronics** (Elektronika ciała stałego), **ELCS**, Jan Szmidt, Witold Pleskacz
- [Edu13] **Fundamentals of Solid State Electronics 2**, (Elektronika Ciała Stałego 2), **ELCS2**, Zdzisław Mźczeński
- [Edu14] **Hardware Implementation of Algorithms in VLSI Circuits** (Sprzętowa implementacja algorytmów w układach VLSI), **SAV**, Krystyna Siekierska (Institute of Electron Technology), Elżbieta Piwowarska
- [Edu15] **High Frequency Techniques** (Podstawy techniki w.cz.), **TWCZ**, Bogdan Galwas
- [Edu16] **Hybrid Integrated Circuits Technology** (Technologia hybrydowych układów scalonych), **THUS**, Zbigniew Szczepański
- [Edu17] **Integrated Optoelectronics** (Optoelektronika zintegrowana), **OZT**, Michał Malinowski
- [Edu18] **Introduction to Semiconductor Devices Design** (Podstawy projektowania przyrządów półprzewodnikowych), **PPPP**, Wiesław Kuźmicz
- [Edu19] **Introduction to the UNIX System** (Użytkowanie systemu UNIX), **USUX**, Andrzej Wielgus
- [Edu20] **Laser Applications** (Zastosowania laserów), **ZLA**, Jerzy Kęsik
- [Edu21] **Laser Engineering** (Technika laserów), **TL**, Faculty of Applied Physics and Mathematics WUT, Tadeusz Adamowicz
- [Edu22] **Laser Physics** (Fizyka laserów), **FLA**, Paweł Szczepański
- [Edu23] **Laser Physics 2** (Fizyka laserów 2), **FL2**, Paweł Szczepański
- [Edu24] **Lasers and Their Applications - Laboratory** (Laboratorium laserów i ich zastosowań), **LLZ**, Tadeusz Adamowicz
- [Edu25] **Lightwave Telecommunication** (Telekomunikacja optofalowa), **TEOP**, Bogdan Galwas
- [Edu26] **Logic Circuits** (Układy logiczne), **UKLO**, Institute of Control and Computation Engineering WUT, Adam Wojtasiak
- [Edu27] **Materials, Elements and Design of Electronic Equipment** (Materiały, elementy i konstrukcje), **MEiK**, Ryszard Kisiel
- [Edu28] **Materials, Elements and Design of Electronic Equipment 2** (Materiały, elementy i konstrukcje2), **MEiK2**, Ryszard Kisiel
- [Edu29] **Measurement Sensors** (Czujniki pomiarowe), **CZP**, Mikołaj Baszun
- [Edu30] **Methods and Algorithms for Design Automation of VLSI circuits** (Metody i algorytmy automatyzacji projektowania struktur scalonych), **MAPS**, Adam Wojtasiak
- [Edu31] **Microelectronics Development Trends** (Kierunki rozwoju mikroelektroniki), **KRM**, Andrzej Jakubowski
- [Edu32] **Microprocessor Techniques** (Podstawy techniki mikroprocesorowej), **TMIK**, Lidia Łukasiak
- [Edu33] **Microwave and Lightwave Integrated Circuits** (Mikrofalowe i optofalowe układy scalone), **MOUS**, Jerzy Piotrowski
- [Edu34] **Microwave and Optowave Integrated Circuits** (Mikrofalowe i optofalowe układy scalone), **MOUS**, Jerzy Piotrowski
- [Edu35] **Models and Systems of Image Processing** (Modele i systemy przetwarzania obrazów), **MSPO**, Jerzy Woźnicki
- [Edu36] **Noise Reduction in Electronics Systems** (Minimalizacja zakłóceń w aparaturze i systemach elektronicznych), **MZA**, Zdzisław Mźczeński
- [Edu37] **Numerical Methods** (Metody numeryczne), **MNM**, Institute of Electronic Fundamentals WUT, Jerzy Krupka
- [Edu38] **Operating Systems 1** (Systemy operacyjne 1), **SOP1**, Andrzej Wielgus
- [Edu39] **Optowave Telecommunication** (Telekomunikacja optofalowa), **TEOP**, Bogdan Galwas
- [Edu40] **Photoelectric Phenomena in Semiconductors** (Zjawiska fotoelektryczne w półprzewodnikach), **ZFPP**, Stanisław Pietruszko
- [Edu41] **Photonics' Fundamentals** (Podstawy fotoniki), **FOT**, Michał Malinowski, Wiesław Woliński
- [Edu42] **Physical Fundamentals of Information Processing** (Fizyczne podstawy przetwarzania informacji), **FPPI**, Bogdan Majkusiak
- [Edu43] **Physics of Solid State** (Fizyka ciała stałego), **FCSR**, Jan Szmidt
- [Edu44] **Program PC-Matlab** (Program PC-Matlab w pracach inżynierskich), **PCMA**, Mikołaj Baszun
- [Edu45] **Programming** (Programowanie), **PROG**, Adam Wojtasiak, Marek Niewiżski
- [Edu46] **Programming of Microcontroller 8051** (Programowanie μ C 8051 w języku asemblera), **PASM**, Lidia Łukasiak
- [Edu47] **Quality and Productivity Management** (Zarządzanie produktywnością i jakością), **ZPJ**, Julita Pogorzelska
- [Edu48] **Quality in Design and Manufacturing** (Jakość w procesach projektowania i wytwarzania), **JPPW**, Ryszard Kisiel

- [Edu49] **Semiconductor Devices** (Przyrządy półprzewodnikowe), **PPR**, Andrzej Jakubowski
 [Edu50] **Semiconductor Devices for Optoelectronics** (Półprzewodnikowe elementy optoelektroniczne), **POE**, Paweł Szczepański
 [Edu51] **Surface Mounting Technology** (Technologia montażu powierzchniowego), **TMP**, Ryszard Kisiel
 [Edu52] **Technology of Integrated Circuits Fabrication** (Technologia monolitycznych układów scalonych), **TWMUS**, Romuald Beck
 [Edu53] **The PowerPC Processor and MacOS Operating System** (Procesor PowerPC i system MacOS), **PPCP**, Adam Lejman
 [Edu54] **Thin Film Material Engineering** (Cienkowarstwowa inżynieria materiałowa), **CIM**, Jerzy Kruszewski

3.2. Advanced Courses

- [Edu55] **Advanced Microelectronic and Optoelectronic Technologies** (Zaawansowane technologie mikroelektroniczne i optoelektroniczne), **ZTMO**, Romuald Beck
 [Edu56] **Advanced Physical Fundamentals of Optoelectronics** (Zaawansowane podstawy fizyczne optoelektroniki), **ZPFO**, Paweł Szczepański
 [Edu57] **Design of VLSI Circuits** (Projektowanie struktur scalonych VLSI), **PSSV**, Wiesław Kuźmicz
 [Edu58] **Digital Image Processing** (Cyfrowe przetwarzanie obrazów), **CPOO**, Jerzy Woźnicki
 [Edu59] **Electronic and Photonic Devices for Telecommunication** (Przyrządy elektroniki i fotoniki dla telekomunikacji), **PEFT**, Bogdan Galwas
 [Edu60] **Integrated Optoelectronic Circuits and Optical Logic Circuits** (Zintegrowane układy optoelektroniczne i optyczne układy logiczne), **ZOUL**, Michał Malinowski
 [Edu61] **Semiconductor Structures for VLSI and ULSI Circuits** (Struktury półprzewodnikowe dla układów VLSI i ULSI), **SPVU**, Andrzej Jakubowski

3.3. Courses in English

- [Edu62] **Electronics 1**, Bogdan Majkusiak
 [Edu63] **Physics 3**, Bogdan Majkusiak

3.4. International Co-operation in Education

- [Edu64] **Tempus S_JEP 09159-95, Postgraduate Education in ASIC Design**, Warsaw University of Technology - co-ordinator, Poland: Łódź Technical University, University of Mining and Metallurgy, Kraków, foreign institutions: France: Institut National Polytechnique de Grenoble, Germany: Technische Hochschule Darmstadt, Holand: Eindhoven University of Technology, Finland: Helsinki University of Technology, Wiesław Kuźmicz-project leader, 1995-1998, financial support: The European Training Foundation, Commission of the European Union;

The main aim of the project is to establish an ASIC Design Training Centre (ADEC) associated with the participating Polish universities and staffed by them. The goals of the ADEC are as follows:

- Promotion of ASIC technology.
- Dissemination of technical, economical and organisational information concerning ASIC design and manufacture.
- Organisation of intensive ASIC design courses for engineers from the industry.
- Organisation of courses in microelectronics and VLSI design for faculty and staff from other technical high schools in Poland.
- Help to newcomers to ASIC technology (especially start-up companies and SMEs) by providing hardware and software facilities to make their first designs on a non commercial basis.

ADEC will closely cooperate with the ASIC Competence Centre at the Institute of Electron Technology in Warsaw. ADEC will be able to provide courses and help to the residents of other countries in Central/Eastern Europe. To make this possible, teaching materials will be prepared both in Polish and in English and the staff of ADEC will be prepared to teach in English.

- [Edu65] **Tempus S_JEP-11298, Education in Microtechnology (EMIT)** (Kształcenie w dziedzinie mikrotechnologii), Łódź Technical University - co-ordinator, Warsaw University of Technology, Famed-1, S.A., Łódź, Poland, Lamina S.A., Piaseczno, Poland, Miflex S.A., Kutno, Poland, Zemet, Łódź, Poland, foreign institutions: Germany: Technische Universität Berlin, Technische Universität Carolo-Wilhelmina zu Braunschweig, Belgium: Universiteit Gent, France: Ecole Catholique des Arts et Métiers de Lyon, Holland: Joint Research Centre, Petten, Z. Lisik-project leader Łódź Technical University, 1996-1999, financial support: The European Training Foundation, Commission of the European Union;

Establishment of the „Microtechnology Education Centre’ at the Institute of Electronics at Łódź Technical University in order to introduce microtechnology profiles into the undergraduate and postgraduate study programmes of Electrical Engineering, Electronics, Materials Engineering and Physics. For this purpose there will be a restructuring of 5 existing undergraduate courses and an introduction of 12 new undergraduate courses at Master level, and an introduction of 4 new postgraduate courses at Doctor level. A series of three short courses for the benefit of local enterprises will also be developed.

4. RESEARCH PROJECTS

4.1. Projects Granted by the University

- [Pro1] **Preparation of a process of producing Ta₂O₅ layers on a silicon substrate** (Opracowanie procesu wytwarzania warstw Ta₂O₅ na podłożu krzemowym) project leader: Kruszewski Jerzy, co-workers: Gutkowski Marek, Majkusiak Bogdan, Elżbieta Jezierska
 The subject of this study was the preparation of the process of producing thin Ta₂O₅ layers as an alternative to SiO₂ layers in the MOS devices. The scope of the work included: producing Ta₂O₅ layers by a reactive sputtering on Si substrates, the conducting of structural investigation in connection with ellipsometry investigation, production of trial MOS structures and the investigation of their electrical properties.
 The highest values of the refractive index of very thin layers Ta₂O₅ were reached with very low pressure of sputtering gas in the order of $(5\pm 7)\times 10^{-4}$ mbar and with very low amounts of oxygen in the gas - up to 15%. The results of the studies of the microstructure clearly show the amorphous and uniform character of the layers. Microanalysis of the chemical composition has shown an excess of oxygen atoms and the existence of non-saturated Ta - O bonds. The results of the measurements of the current - voltage and the capacitance - voltage characteristics of the trial structures in the Al-Ta₂O₅-Si configuration have shown the presence of a space continuous dielectric structure even in the case of the thinnest of the studied layers. A connection between a change of the histogram of breakdowns and an increase of voltage on the target was not observed, but an increase of oxygen presence in the sputtering gas caused a decrease in the breakdown parameters of the layer.
- [Pro2] **Modelling of nonlinear operation of hollow-waveguide slab lasers with Gaussian output mirror** (Modelowanie generacji promieniowania w gazowych szczelinowych laserach falowodowych ze zwierciadłem o gausowskiej transmisji), project leader: Paweł Szczepański, co-workers: Piotr Witoński, Agnieszka Mossakowska-Wyszyńska, Anna Tyszka-Zawadzka.
 In hollow-waveguide slab lasers the total losses were analysed. It has been shown, that in the laser structure exist optimal positions of end mirrors, which provide to minimal coupling losses. These optimal positions depend on Gaussian mirror parameter and waveguide cross-section. Next, the far field of generated beam was analysed. Using of Gaussian output mirror in classic unstable resonator configurations improve the beam quantity (far field distribution).
 Using energy approach an approximate formula that relates the small signal gain in the active medium to the output power and characteristics parameters of the laser system was derived. It allowed to optimise the laser parameters to maximise output power and improve beam quantity.
- [Pro3] **Chemical components of energetic ashes, and their dielectric properties in the microwave band** (Skład chemiczny popiołów kotłów energetycznych a ich własności dielektryczne w paśmie mikrofal), Bogdan Galwas - project leader, co-workers: Krzysztof Kasiura, Jerzy Piotrowski, Barbara-Różańska, Jerzy Skulski, June 1997 - May 1998.
 The work includes an analyse of chemical composition of energetic ashes and researches their dielectric properties. The dielectric properties has been done by measurements parameters of microwave resonator sensor with using the network analyser type HP 8757. The aim of the project was to investigate the content of unburned coal in the energetic ashes. An calculation procedure to design the content of unburned coal has been done.
- [Pro4] **Investigations on laser generation conditions and processes responsible for population inversion in He-Zn and He-Ag HCD ion lasers** (Badania warunków generacji oraz procesów prowadzących do uzyskania akcji laserowej w jonowych laserach He-Zn i He-Ag), project director: Tadeusz, M. Adamowicz, co-workers: Krzysztof Dzińciołowski, Wojciech Kwańniewski, duration of the project: 1.06.1997 - 31.05.1998.
 Two kinds of high-voltage hollow cathode configuration were studied - the newest design sc. the segmented hollow cathode (SHC) was used for He-Zn laser, and a helical HC for He-Ag laser. For Zn laser operating on blue (492.4 nm), transition the gain exceeding 100 %/m. was found. So far it has been the highest gain ever obtained in visible region for metal ion lasers. For Ag laser and 840 nm line the gain also reached 100 %/m. Using two-pulse excitation of lasing medium diffusion coefficients of both Ag and Zn in helium were evaluated. Two papers resulting from the project were presented during international conferences.
- [Pro5] **Investigation of Electronic Structure of Amorphous Silicon by Field Effect in Thin Film Transistor** (Badanie struktury elektronowej krzemu amorficznego metodą efektu polowego w tranzystorze polowym), Stanisław M. Pietruszko - leader, Piotr Wińkowski, Leszek Gńgała.
 The software program for calculation the density of electronic states in amorphous silicon was written. The thin film transistors was prepared and their current-voltage characteristics were measured and parameters (activation energy, Meyer-Neldel parameter, density of states at the Fermi level, mobility and threshold voltage) were extracted. We found that DOS at the Fermi level was 5×10^{16} eV⁻¹cm⁻³. The I-V characteristics were measured at the temperature range of 300 - 450C.
- [Pro6] **Design of the Equipment to Anodic Bonding of Silicon Sensor Structures to Dielectric Materials** (Opracowanie stanowiska do wykonywania połączeń krzemowych struktur czujników pomiarowych z materiałami dielektrycznymi metodą elektrostatycznego łączenia), project leader: Z.Szczepański
 Anodic bonding is commonly used bonding methods in sensor fabrication, based on silicon structures. This process fulfils most requirements for silicon sensors. To enable of the demonstration of such bonding process in students sensor laboratory, the new bonding stand has been designed and realised. This unit is based on thermocompression ball bonder to reduce cost fabrication.

- The design equipment is provided with high voltage electrode, high voltage supply, positioning systems for precision alignment as well silicon chip to glass support as high voltage electrode to bonding components.
- The researches which were carried out using the equipment to silicon pressure sensors attachment confirmed its full usability.
- [Pro7] **Perspectives of development of selected electronic technologies** (Prognoza rozwoju wybranych technologii elektronicznych dla potrzeb określenia preferowanych kierunków badań oraz kształcenia w Politechnice Warszawskiej), project leader: Alfred Żwit, co-workers: Bogdan Galwas, Andrzej Jakubowski, Jerzy Kruszewski, Wiesław Kuźmicz, Andrzej Pfitzner, Piotr Szwemin, Wiesław Woliński, Jerzy Woliński
- In the report the importance of electronics technologies for information technology is presented. The report concentrates on the following six branches :
- microelectronics,
 - optoelectronics,
 - image processing,
 - electronic materials and processing,
 - microwave electronics,
 - high vacuum technology.
- Perspectives of development in these areas and the its possible impact on the country economy as well as the challenges for the high education system are discussed.
- [Pro8] **Investigation of relaxation of Thermally induced Metastability in Amorphous Silicon** (Badanie relaksacji termicznie indukowanej metastabilności w krzemie amorficznym), Stanisław M. Pietruszko - leader, Marek Kostana, Artur Żliwiński, Jarosław Matyjasiewicz.
- The influence of hydrogen content on the mechanism of carrier transport in amorphous silicon were investigated. We investigated LPCVD a-Si with hydrogen content between 0.06 and 15 at.%. We found that incorporation of hydrogen (even 1 at.%) changes mode of transport in the low temperature region (from 300 to 420 K) from hopping to the transport in the extended states. The conductivity decreases two orders of magnitude. The Arrhenius curve is straight in whole temperature region from 300 to 675 K.
- The relaxation of defects induced by thermal quenching in amorphous silicon was also investigated. The change in conductivity of thin films of amorphous silicon with different hydrogen content annealed in the temperature between 400 - 450 C were investigated. Relaxation of defects takes places according to extended exponent function. Relaxation time of defects decreases with annealing temperature and is thermally activated with the activation energy which does not depend on hydrogen content. The results presented in this work support hydrogen glass model.
- Publication at 2nd World Conference and Exhibition on Photovoltaic Solar Energy Conversion, Vienna, 06-10.07.1998.
- [Pro9] **Research and Formation of Selected Microelectronics and Optoelectronics Devices and Structures** (Modelowanie, wykonanie i badanie wybranych elementów i struktur z zakresu mikroelektroniki i optoelektroniki), Institute of Microelectronics and Optoelectronics, Alfred Żwit – project leader, May 1997-May 1998, **sub-projects:**
- [Pro9.1] **Development of the method of 3D modelling of semiconductor structures with application to simulation of the components of VLSI circuits with structural defects** (Opracowanie podstaw modelowania przestrzennych struktur półprzewodnikowych z zastosowaniem do ekstrakcji modeli elementów układów VLSI wykazujących zaburzenia strukturalne) project leader: Wiesław Kuźmicz, co-workers: Witold Pleskacz
- The aim of the work was to develop several basic algorithms necessary for 3D modelling of semiconductor structures with structural defects and for statistical simulation. The main results are:
- development of a new 3D database for 3D representation of semiconductor devices in a VLSI chip,
 - development of a new technique of generation of spatially correlated pseudo-random process disturbances, taking into account on-chip device positions and its dimensions,
 - development of a new method of estimating of defect-dependent yield as a function of circuit's scaling factor.
- [Pro9.2] **Technology and characterisation of MIS structures with self-centred gate for the laboratory of microelectronic technologies** (Technologia i charakteryzacja struktur MIS z bramkami samocentrującymi dla potrzeb laboratorium technologii mikroelektronicznych), project leader: Jan Szmidt.
- In microelectronics metalization made of refractory metals (Mo, W, Pt) can be used for many purposes. The self-centred gate MIS technology and the metalization layers for high temperature applications are the most common examples. Research in this area deals often with properties of contacts between these metals and wide range of materials e.g. diamond, carbon silicide, and boron, aluminium or carbon nitrides.
- This work achievement is the laboratory-developed technology for the selective formation of refractory metal layers using etching in the wet environment. As a result the self-centred gate MOS technology has been developed. It is important to note, that the new technology allows for metal layer formation on many new materials, which are currently under the research. The technological processes used for selective etching of the metal layers have to be non-destructive for these materials. Technology of the self-centred gate have lead to the construction of MOS transistors with Mo gate created by means of electron gun. The transistors obtained are 10-200um in size (width and length), and typically show very good physical properties and electrical characteristics.
- [Pro9.3] **Optical techniques of transmission of results of measurements and remote control of microwave sensor of dielectric materials** (Optyczne techniki transmisji wyników pomiarów i sterowania mikrofalowych czujników materiałów dielektrycznych), Bogdan Galwas - project leader, co-workers: Jerzy Piotrowski, Jerzy Skulski, Paweł Borkowski, Barbara Szymulska, June 1997 - May 1998.
- The work include a project of fiber optic transmission link to bilateral connection of digital signal. (100 Mb/s) and the tests of transmission between two computers. The models of fiber transmitter was made with using transmitter module type

HFBR-1312T and models of fiber receiver with module type HFBR-2316T . The tests of transmission between two computers has been done with short optical fiber and attenuators.

[Pro9.4] **Intelligent ecological threatens sensor** (Inteligentny czujnik zagrożeń ekologicznych), Institute of Microelectronics and Optoelectronics, Jerzy Kruszewski - project leader, Maria Beblowska, Michał Borecki co-workers, June 1997-May 1998;

Fibre optic properties are important in many different mediums on sensor head influences case. A few fibre optics for intensity sensors head application examination was done. It was find that that for different fibres and light length the intensity sensor heads have different properties. The experiments' results enable integrated humidity, water vapour and smoke sensor head conception elaboration. The sensor head should working in many light length, for example: 585nm, 670nm, 780nm

[Pro9.5] **Problem of the visible light generation in the praseodymium (Pr^{3+}) ion activated solids** (Zagadnienie generacji promieniowania widzialnego w dielektrycznych ośrodkach domieszkowanych jonami Pr^{3+}), project leader: M.Malinowski

Recently, there is interest in developing compact, short wavelength, all solid-state laser sources for display, optical data storage, laser printing, under water communication, material processing and medical applications.

Trivalent praseodymium (Pr^{3+}) ion activated materials can lase in the visible range on a transitions originating from the excited $^3\text{P}_0$ state and terminating at different lower levels. Transition terminating at the ground state, $^3\text{H}_4$ is in the blue part of the spectrum and is effectively a three level laser system. Recently, Pr^{3+} activated fluoride fibers were demonstrated to oscillate at short wavelengths under different upconversion excitation conditions. While optical fibers and fiber amplifiers are used for telecommunication, planar integrated optics devices may be used for optical signal processing on a local scale. Waveguide lasers offer also several optogeometric advantages giving rise to low threshold, high slope efficiency and stability.

In this work, optical properties that impact the blue laser performance of praseodymium activated materials has been measured and analysed. In particular, we measured the $^3\text{P}_0$ upper level energy, lifetime, branching ratio and emission cross section spectra for blue transition of Pr^{3+} in YAG, YAP, GGG, YLF, ZBLAN glass, LNB, $\text{SrLaGa}_3\text{O}_7$ (SLG), $\text{Be}_2\text{La}_2\text{O}_5$ (BLO) and $\text{KPrP}_5\text{O}_{14}$ (KPP). Based on these data and in the framework of presented earlier model the performance: threshold, output power, slope efficiency and modulation bandwidth, of the Pr-based waveguide lasers have been evaluated.

[Pro9.6] **Optimisation of ultraviolet generation of ion argon laser with crystal quartz Brewster windows** (Optymalizacja warunków pracy jonowego lasera argonowego z krystalicznymi okienkami Brewstera w zakresie promieniowania ultrafioletowego), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Jerzy Kńsik - project leader, co-workers: Piotr Warda, Wiesław Woliński, July 1997 -June 1998.

A positive effect of application the crystal quartz Brewster windows instead of fused silica ones has been observed. A significant enhancement of UV laser output power was caused by decreasing of two harmful factors: pink fluorescence of the windows material and Faraday rotation of laser light plane polarisation effect. The second effect was explained using the Jones matrix calculation. After optimisation of argon pressure and axial magnetic field, the 2 watts of UV output laser power from 80 cm long laser tube at 40 A discharge current has been achieved.

[Pro9.7] **The method for designing the digital image database** (Metoda realizacji bazy cyfrowych danych obrazowych), project leader: Jerzy Wońnicki.

The aim of the project was to prepare software to store digital image data in the form of database. The system allows inserting data obtained from any sources like: video cassette recorder, CCD-camera, disk file, in the form of single image or sequence of images.

The system is made in client-server technology and uses standard software for manipulating data in the database. The system consists of data structures in form of tables of the relational database and of program modules made within the project. The main operations realised by the system ware: inserting image data, manipulating on them and searching.

[Pro10] **The Development of Design, Processing and Testing Methods of the Electronic Devices and Materials for Microelectronics and Optoelectronics** (Rozwój metod projektowania oraz metod wytwarzania i badania materiałów i przyrządów w dziedzinie mikroelektroniki i optoelektroniki), Institute of Microelectronics and Optoelectronics, Alfred Ńwit - project leader, May 1997-May 1998, **sub-projects:**

[Pro10.1] **Investigation of High Temperature Processing Influence on Defoliation of Monocrystalline Silicon Thin Films** (Badanie wpływu procesów wysokotemperaturowych na proces defoliacji cienkich warstw monokrystalicznego krzemu) Romuald B. Beck - project leader June 1997-May 1998

The aim of this research project was to study the influence of temperature, time and gas ambient of the high temperature processes on the type and final morphology of the defects created in monocrystalline silicon by ion implantation. Depending on the parameters of the ion implantation process and following high temperature treatment the defects can grow to form local defoliations - "bubbles". The incubation process of these "bubbles" is sensitive to different extend to all of the studied parameters, however the most important ones are depth of the defects location and temperature of the implantation process. An attempt was made to use these precisely located defects to perform long distance horizontal oxidation. The obtained results are promising, although it is difficult to say if the mechanical stiffness of the obtained substrate layer (after oxidation) is high enough to allow construction of semiconductor devices without danger of unwanted defoliation on its base.

[Pro10.2] **Analysis and simulation of modulation and demodulation terms of optical and microwave signals utilising harmonic balance method** (Analiza i symulacja warunków modulacji i demodulacji sygnałów występujących w obecności sygnałów optycznych i mikrofalowych, wykorzystująca metodę równowagi harmonicznych), Bogdan Galwas - project leader, co-workers: Jerzy Piotrowski, Jarosław Dawidczyk, Zenon Szczepaniak, Barbara Szymulska, June 1997 - May 1998.

The work include researches and simulations of modulation and demodulation process of microwave and optical signals in the opto-detector circuit. The investigates and simulations was made for various bias points and power of signals in the

- frequency range of microwave signal from 0.1 to 3 GHz. The simulation was made with using harmonic-balance method. The extraction of linear and non-linear parameters of opto-detector was based on measurements of reflection factors of opto-detector with various bias point, frequency and power of signals.
- [Pro10.3] **Hardware and software base for image processing systems laboratory** (Przygotowanie bazy sprzętowo-programowej do laboratorium systemów przetwarzania obrazu) project leader: H. Górkiewicz-Galwas
The purpose of the project was to set up a new laboratory for didactic and research work in the field of image processing. Three image processing systems have been configured: analysis system for digital microscopic images, shape identification system for 3D objects and image sequences capturing system. Each system bases on the common hardware platform: workstation, image source and image acquisition card. Elaborated software allows the user to control the process of image acquisition, to take up the fundamental operations to improve image quality and to execute other procedures of image processing. General user interface in accordance with MS Windows 95/NT rules has been created.
- [Pro10.4] **Conductive adhesives of component assembly in surface mount technology** (Ocena możliwości zastosowania klejów przewodzących na bazie srebra w technologii montażu podzespołów na płytkach drukowanych) project leader: Ryszard Kisiel
Conductive adhesives can be applied in assembly of components on printed circuits boards. Conductive adhesives named: AX201, produced by Amepox Microelectronics Ltd., was chosen as a research material. Jumpers in packages 1206 were glued to pads (copper, Ni coated and SnPb coated) onto PCB. The influence of printed parameters, curing conditions on resistance of conductive joints and component adhesion to PCB were measured.
It was found that the resistance of conductive adhesives joints was few times larger than solder joints and adhesion is few times smaller. So, conductive adhesives can be applied in such assembly, where joint resistance is not critical for example in consumer electronic.
Thermal conductivity of conductive adhesive was established as 7.7W/mK. More work is necessary to establish the factors which influence resistance variations and to improve the adhesion.
- [Pro10.5] **Software development for evaluation of electronic material properties and intercomparison studies of lumped circuit and field methods of ferrite measurements** (Rozwój oprogramowania do ekstrakcji parametrów materiałów elektronicznych badania porównawcze ferrytów metodami polowymi i obwodowymi), project leader: Jerzy Krupka, co-workers: Mikołaj Baszun, Zdzisław Mzczeński, Janusz Rogowski, Leszek Książek, Krzysztof Kędra
One of the main objectives of this project were intercomparison measurements of complex permeability of ferrite materials using lumped circuit and field methods in the frequency range from 0.1 Hz to 10 GHz. Coaxial line method has been used at frequencies below ferromagnetic resonance and dielectric resonator method has been used at frequencies higher than that. Results of those measurements were published in proceedings of International MIKON'98 Conference.
The second objective of this project was software development for computations of frequency responses of rectangular disc and cylindrical piezoelectric resonators.
- [Pro10.6] **Modelling and investigation of new dielectric laser** (Modelowanie i badanie nowych dielektrycznych ośrodków laserowych) project leader: W.Wolinski
In this project spectroscopic properties of YAG, YAP and GGG crystals as well as Pr³⁺ and Ho³⁺ doped glasses were studied. In the result generation conditions for these solids have been defined.
- [Pro10.7] **Computer program for Designing Vacuum System (SUP)** (Opracowanie modułów do programu SUP), project leader: M. Niewinski, co-workers: P. Szwemin, K.Szymanski
The SUP program is dedicated for quick design of the vacuum system. As the result user gets the graphic scheme of system with list of all components and it properties and pressure vs. time characteristic. The data needed for calculation (chamber volume, maximum pump-down time, temperature, materials) must be entered by user. Vacuum system can contain such components as: chamber, tube, baffle, fore vacuum pump (Roots, rotary), high vacuum pump (diffusion, cryogenic, turbomolecular, sorption). Data base with parameters of pumps and some material and gases are included.
- [Pro10.8] **The thin aluminium masks etching visualisation tool** (Obrazowodowy układ wizualizacji procesów trawienia cienkowarstwowych masek aluminiowych) Jerzy Kruszewski - project leader, co-workers: Maria Bełłowska, Michał Borecki
The thin aluminium masks etching visualisation tool consist of light source, fibre optic cable, input optics, inspection camera microscope, monitor. Etching area is illuminate from halogen light bulb by fibre-optic bundle. Illuminated area is monitoring by input optics coupled with fibre-optic cable, this way mask could be observed from 0.2-1m distance. In this solution Fibre optic cable limits optical resolution to 20µm
- [Pro11] **The Development of Processing and Testing Methods of the Electronic Devices and Materials for Microelectronics and Optoelectronics** (Rozwój metod wytwarzania i badania materiałów i przyrządów w dziedzinie mikroelektroniki i optoelektroniki) Alfred Żwit - project leader, May 1998-May 1999, **sub-projects:**
- [Pro11.1] **Application Of Defected Layers For Lateral Oxidation Of Silicon** (Wykorzystanie poziomu zdefektowanego do utleniania krzemu w kierunku horyzontalnym), project leader: Romuald B.Beck
The experimental study of the feasibility of achieving SOI type substrates by lateral oxidation of silicon monocrystalline substrate. The study concentrates on etching windows to obtain access to damaged layers. The experiments proved that this cannot be achieved by wet etching, however dry etching methods could be the solution to the problem.
- [Pro11.2] **Fuzzy Logic Controllers Realisation On ARM Microprocessor** (Realizacja sterowników działających w oparciu o zasady logiki rozmytej z wykorzystaniem mikroprocesora ARM), project leader: Zbigniew Jaworski, team: Wiesław Kuźmicz, Andrzej Wałkanis, Andrzej Wielgus, Dariusz Sarna (student).
The goal of this work was to determine applicability of microprocessors from the ARM family to rate-adaptive heart pacemakers. The fuzzy logic based control algorithm for pacemakers, developed earlier in another project, has been

programmed in several versions, in order to determine the size of the code, the accuracy and the number of clock cycles necessary to complete a single run of the algorithm and the power consumption.

- [Pro11.3] **Modelling Of Parameters Of Metrological Vacuum System Elements** (Badanie parametrów próżniowych podzespołów metrologicznych), project leader: Piotr Szwemin

The work was focused on the minimising the uncertainties of Monte Carlo method and its application to Vacuum Metrology. High quality Random Number Generator was implemented to MOLY FLOW..er computer program for calculating conductance of composite vacuum system. The program was then adopted for metrological calculations and allows obtaining results with uncertainty below 10^{-5} .

- [Pro11.4] **Analysis, Realisation And Measurement Of Optical Link With Transmission Of Subcarrier** (Analiza, wykonanie i badanie łączy optycznego z modulacją na podnośnej), project leader: Bogdan Galwas

The low loss, low cost, light weight, immunity to electromagnetic interference and extremely high bandwidth make optical fiber an excellent medium for transmission of microwave signals and data. The essence of optical link with transmission of subcarrier is to take all the modulating, demodulating, multiplexing and demultiplexing functions and perform them electrically. The only optical functions that remain are optical generation using a laser, optical transmission over an optical fiber and optical detection using a photodetector. The electrical components are cheaper and more reliable than optical ones, but optical transmission take the advantage of low fiber attenuation. The developed optical link was successfully used for transmission of data between different points of measurement systems.

- [Pro11.5] **An Intelligent Sensor For Liquid Type Detection** (Inteligentny czujnik wyróżniający ośrodki ciekłe), project leader: Jerzy Kruszewski, team: Maria Bełłowska, Michał Borecki

The construction working principles of an intelligent sensor capable of distinguishing water, alcohol and oil has been elaborated. The sensor consists of intensity fiber head, lift and computer measurement device with a detection block. The detection block has an implemented neural network capable of distinguishing the detected medium. The detection is based on the processed data from measurement cycle. One cycle consists of head submerging, submersion, emerging and emergence in detected medium. In this way various physical phenomena are observed in measurement signal. The detector head is the ending of large core polymer optical fiber. The head works on the Fresnel reflection intensity basis.

- [Pro11.6] **Design And Technology Of The Thick Film Piezoresistive Pressure Sensor** (Opracowanie konstrukcji i technologii piezorezystywnego ceramicznego czujnika ciśnienia), project leader: Zbigniew Szczepański.

For thick film pressure sensor application a new paste with high gauge factor (GF) has been elaborated and its piezoresistive properties were evaluated. For this purpose a simple GF measurement method has been designed. A few selected pastes for comparison were tested and the values of GF coefficient were evaluated. On the base of own paste, a model of piezoresistive thick film pressure has been designed and tested.

- [Pro11.7] **Measurement Of Electromagnetic Properties Of Ferrites And Ferroelectric Ceramic Versus Temperature** (Badania termiczne ferrytów oraz ceramiki ferroelektrycznej), project leader: Jerzy Krupka, team: Mikołaj Baszun, Janusz Rogowski, Zdzisław Mńczeński, Leszek Ksińzek, Dariusz Grzńda, Zbigniew Rudkowski

This work comprise research of thermal effects on the properties of ferrites and ferroelectric materials. For characterization of such effects temperature effects have been measured on complex permeability; complex permittivity, magnetic hysteresis loop, electric hysteresis loop, resonant frequencies of electromechanical radial mode resonances and electromechanical radial mode coupling factors. For ferrite type mode resonances of Ni-Zn ferrites and garnets have been investigated. For piezoelectric materials two types of ferroceramic materials PZT type doped by Mg and Nb and modified by Mn/Ni oxides were measured. Appropriate measuring heads were designed and constructed for the above experiments. Results of experiments will be used in electronic material expert system.

- [Pro11.8] **Modelling And Studies Of New Laser Materials Activated By Holmium Ions** (Modelowanie i badanie nowych dielektrycznych ośrodków laserowych domieszkowanych jonami holmu), project leader: Wiesław Woliński

Holmium ions (Ho^{3+}) doped crystals are well known laser materials for 2 and 3 μm ranges. Much less is known about emission properties of these materials at short wavelengths. The main aim of this study was to investigate spectroscopic and laser properties of Ho^{3+} activated YAG and YAP crystals in the UV, blue and green wavelengths. Different excitation schemes, including up-conversion pumping have been investigated.

- [Pro11.9] **Extension Of Hardware And Software Possibilities Of The Image Processing Systems Laboratory** (Rozszerzenie bazy sprzętowej i programowej w laboratorium sytemów przetwarzania obrazów), project leader: Hanna Górkiewicz-Galwas.

The aim of the project was to configure new experimental systems in Laboratory of Image processing Systems. They will be used for analysis of image sequences to detect moving objects and for the acquisition of images from the distant sources. Both systems have been supported by specially developed numerical programs.

- [Pro12] **Investigation And Modelling Of The Electron Wave-Function Effects In The Metal-Insulator-Semiconductor Structures**, project leader Bogdan Majkusiak, June 1998 – June 1999.

The theoretical model of tunnel currents in MOS structures was developed and used for theoretical investigations of the Fowler-Nordheim tunnel current oscillations. The Al-SiO₂-Si(p) test structures were fabricated and the tunnel current was measured and analysed in the Fowler-Nordheim tunnelling regime. The FN current oscillations were experimentally observed. The theoretical model of resonance tunnelling in the system: „energy gap of Si - potential well in the semiconductor surface region - energy gap of SiO₂ - metal” was developed and used for theoretical investigations.

- [Pro13] **Elaboration Of Microwave Dielectrometers With Conical Waveguide Below Cut-Off**, project leader: Jerzy Piotrowski, June 1998 – June 1999.

The project was dedicated to elaborate theoretical background as well as numerical and experimental tool for microwave wideband dielectrometers in which material under test is placed in conical waveguide below cut-off.

- [Pro14] **Investigations Of Ageing Phenomena In Thermistor Ceramics**, project leader: Julitta Pogorzelska, June 1998– June 1999.

- The ageing experiments at the extremum exploitation conditions were carried out. Electrical parameters of NTC thermistors were measured during the ageing process. These results were connected with structural changes of ceramics. Obtained data will be used to the development of universal ageing model for multicomponent ceramic materials.
- [Pro15] **Mathematical Morphology And Its Application To Image Segueure Segmentation And Tracking**, project leader: Grzegorz Kukielka, June 1998 – June 1999.
Its described use of rector mathematical morphology to image segueure segmentation and tracking. In this work the general n- dimensional mathematical morphology theory is presented. The proposition of application of our method of moving object tracking is described.
- [Pro16] **Study of thermally heated pulsed HCD He-Zn ion laser**, project leader: Tadeusz Adamowicz, June 1998 – June 1999.
Two designs of laser hollow cathode discharge (HCD) tube were investigated - a glass tube with helical HCD cathode and ceramic-metal tube with a cylindrical cathode. Lasing on several transitions in visible and IR region was obtained. The dependence of the laser power on the excitation parameters, gas pressure and temperature of Zn reservoir was investigated. Stable laser operation was observed when the excitation pulses repetition rate was increased up to 1000Hz. Small-signal gain for Zn II IR line 758,8nm and blue 492,4nm lines was 100%/m and 30%/m, respectively.
- [Pro17] **Studies Of Interionic Interactions In Ho³⁺ Activated Laser Materials**, project leader: Michał Malinowski, June 1998–June 1999.
We report the optical properties of Y₃Al₅O₁₂ (YAG) and YAlO₃ (YAP) crystals doped with Ho³⁺ ions. Visible emissions from the ³D₃ (at about 33000 cm⁻¹), ⁵S₂ (18500 cm⁻¹) and ⁵F₅ (15500 cm⁻¹) excited states and IR emissions from the ³I_J levels have been characterised under pulsed one-photon excitation and the experimental lifetimes for these levels have been compared with those obtained theoretically by using Judd-Ofelt approach. Cross-relaxation mechanisms responsible for concentration quenching of the ³D₃ and ⁵S₂ emissions and upconversion processes for achieving blue and green fluorescence under one-colour red and IR have been investigated.
- [Pro18] **Automation Of Operation And Spectrum Recording In Auger Spectroscopy**, project leader: Marek Niewiński, June 1998 – June 1999.
The software named Skanpik has been designed and written. It controls the data acquisition card ACL-8316 AdLink Technology Inc. The program allows: defining experiment by setting its parameters (operating range of analysed energy 0-2500 eV, rate of data acquisition 1-30 eV/s, step 0,5-2 eV, frequency and amplitude of modulation signal); setting sequence of experiments in which they should be realized and collecting data in chart format. The ACL-8316 is high resolution and high performance DAQ card based on 16 bit PC/ISA bus architecture. It has the following base futures: 16 bit resolution, on board 1k FIFO, 16 input channels, 2 output channels, up to 100 kHz sampling rates.
- [Pro19] **Plasma Etching of Thin Nitride Films** (Plazmowe trawienie cienkich warstw azotków), project leader: Jan Szmidt, June 1998- June 1999
There were made attempts of BN, AlN, GaN thin films by means of radio frequency plasma (13,56 MHz). The best effects were obtained in air plasma. Analysis of results indicates relatively high efficiency of etching in this mixtures. The predominant mechanism of etching was physical sputtering of processed material.
- [Pro20] **Porous Silicon – remarkable material for microelectronic, optoelectronic and micromechanical applications** (Porowaty krzem – intrygujący materiał dla zastosowań w mikroelektronice, optoelektronice i mikromechanice), project leader: Romuald B. Beck, team: Krzysztof Domański, Emilian Półrolnik, Witold Ciemiewski, Kazimierz Dalbiak, June 1998-June 1999
An investigation of basic properties of porous silicon were carried out. We consider this material as candidate for sacrificial layer in micromechanical structure, buried oxide in FIPOS structure and blue light emitting device. The possibilities of integration of various kinds of porous silicon based devices is briefly discussed.
- [Pro21] **Investigation of Influence of Doping on the Parameters of Amorphous Silicon Thin Film Transistors** (Badanie wpływu domieszkowania na parametry tranzystorów cienkowarstwowych z krzemu amorficznego), project leader: Stanisław M. Pietruszko, team: Michał Urbański, Marek Marczuk, Leszek Gśgała, June 1998-June 1999
The transfer and output current-voltage characteristics of thin film transistors at different temperatures were investigated. The active layer of TFT (amorphous silicon) were doped with different chlor concentrations (4, 6, 8 and 12 at.%). It was found that CL increases threshold voltage, flat band voltage and decreases conductivity of amorphous silicon.
- [Pro22] **Bonding Technologies for Silicon Sensor Structures to Silicon Support** (Opracowanie technologii dołączania krzemowych struktur czujnikowych do podstawek krzemowych), project leader: Zbigniew Szczepański, June 1998-June 1999
Silicon to silicon bonding process has evident advantages, since silicon sensor chip and silicon support have the same thermal expansion coefficient. This way stress will come only from thin interlayer which bonds silicon chip and silicon support. Following bonding technologies were taken into account:
- eutectic bonding,
- silicon to silicon anodic bonding,
- low temperature glass bonding.
- [Pro23] **Frequency Properties of Piezoelectric Resonators with Axial Symmetry** (Analiza własności cząstotliwościowych osiowosymetrycznych rezonatorów piezoelektrycznych), project leader: Jerzy Krupka, team: Mikołaj Baszun, Leszek Ksiśšek, Dariusz Grzśda, Jerzy Rudkowski, June 1998-June 1999
In the work the frequency properties of piezoelectric resonators were calculated and measured. The finite element numerical method implemented in ANSYS software have been adopted for calculation of input admittance and acousto-electric coupled fields spatial distributions. The computer simulations have been done for complex transducer structure: multimaterial, inhomogeneous, anisotropic and showing axial symmetry. Good agreement between theoretical predictions and the measured results have been obtained. The work results could be useful during design of ultrasonic air transducers for robotic applications.
- [Pro24] **Non-equilibrium States in Capacitance-Voltage Characteristics Measurement** (Problemy zjawisk nierównowagowych w

pomiarach charakterystyk pojemnościowo-napięciowych), project leader: Romuald B.Beck, team: Andrzej Jakubowski, Agnieszka Zaręba, Andrzej Wojtkiewicz, Tomasz Dębski, Kazimierz Dalbiak, Witold Ciemiewski, June 1998-June 1999

The aim of this work was to study the possibilities of obtaining the equilibrium state during the measurement of capacitance-voltage characteristics (high frequency). The illumination time of the structures to be measured and appropriate delay time has to be established by means of additional C-t measurement (in order to avoid unnecessary long measurement). The method has been successfully proved on MOS devices with very good quality interface as well as with poor quality devices (MOS-SOI).

- [Pro25] **Analysis of the Influence MOS Transistor Structure Parameters and the Gate Signal On Charge Pumping Current** (Analiza wpływu parametrów tranzystora MOS oraz sygnału bramki na prąd pompowania ładunku), project leader: Lidia Łukasiak, June 1998-June 1999

The aim of this research project was to analyse the influence of signal and structure parameters on the result of charge pumping measurement. In the case of three-level charge pumping the analysis required an appropriate mathematical model of the charge pumping phenomenon to be developed. Comparison of theory with the experimental indicates that the model is in good agreement with the results of measurements.

- [Pro26] **Investigation of Lightwave Properties of Thin Ta₂O₅ layers** (Badanie własności zwiatłowodowych warstw Ta₂O₅), project leader: Jerzy Kruszewski, team: Marek Gutkowski, June 1998-June 1999

The method of Ta₂O₅ thin film production by reactive sputtering was elaborated. Different integrated optoelectronic structures has been realized: lightwave paths, Y-type splitters and planar lenses. The absorption of manufactured light waveguides was on the level of 20dB/cm. It was demonstrated that thin film dividers and lenses functioned properly.

4.2. Projects Granted by the State Committee for Scientific Research (KBN)

- [Pro27] **Research into the Spectroscopic Properties and Generation Conditions of Nonlinear Dielectric Laser Media** (Badania spektroskopowe i generacyjne nieliniowych dielektrycznych ośrodków laserowych), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Wiesław Woliński - project leader, co-workers: Michał Malinowski, Paweł Szczepański, Ryszard Piramidowicz, Radosław Wolski, Stanisław Jonak, July 1996-June 1998;

Solid state lasers have found many applications in optical memory systems, telecommunications, optical integrated circuits, medicine, material working and processing.

The aim of the project is the theoretical analysis and investigation of the spectroscopic properties of non-linear optical laser crystals. In particular, the self-multiplication frequency effect and the direct electro-optical modulation of the active medium are investigated. The materials investigated are as follows: LiNbO₃ and Be₂La₂O₅ crystals doped Pr³⁺, Nd³⁺, Tm³⁺, Tb³⁺, Er³⁺ and Yb³⁺ ions. Results of the project should give us essential information for creating and improving the production technology of the above mentioned crystals for laser applications.

- [Pro28] **Methods for the Characterisation of SOI Materials and Devices** (Metody charakteryzacji materiałów i przyrządów SOI), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Andrzej Jakubowski - project leader, co-workers: Bogdan Majkusiak, Małgorzata Jurczak, Lidia Łukasiak, Tomasz Janik, Romuald B. Beck; October 1996-June 1999;

The aim of the project is to create an efficient methodology for the characterization of SOI materials and devices which could serve to assess reliability. The team carrying out this project has at its disposal SOI test structures (designed and fabricated in co-operation with National Microelectronics Research Centre, Cork, Ireland) and SOI substrates. The project aims to develop a system for the characterization of SOI materials and devices which will include: analysis of current-voltage and capacitance-voltage-time characteristics, charge pumping investigations, analysis of large-signal (e.g. relaxation of drain current) and small-signal (e.g. transconductance, carrier lifetime) properties, extraction of oxide thickness, doping concentration, active layer thickness, mobility, parasitic resistances, characteristic voltages of a MOS structure (flat-band voltage, threshold voltage), characterization of degradation processes in oxide layers.

- [Pro29] **Extraction And Modelling Of Bipolar Elements In VLSI Integrated Circuits** (Ekstrakcja i modelowanie elementów bipolarnych w strukturach scalonych VLSI), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Mirosław Grygolec - project leader, co-worker: Mariusz Niewczas, April 1997-March 1999.

The main goal of the project is to develop the efficient method of modelling of parasitic bipolar transistors inherent to the CMOS technology. During the study the several numerical experiments have been performed to obtain some insight on influence of circuit layout on the bipolar transport in the substrate. The experimental chip with several bipolar structures has been designed and characterisation of the chip is in progress. The measurement data will be compared with simulation results in order to develop simple and efficient enough modelling procedure. It is also intended to develop the software which would support the IC designer with the need of taking into account the influence of the parasitic bipolar elements.

- [Pro30] **Formation Of SOI (Silicon-On-Insulator) Structures On Silicon Wafers With An Epitaxial Layer Deposited On Porous Silicon (FIPOS)** (Wytwarzanie struktur SOI (krzem na izolatorze) na płytkach krzemowych z warstw epitaksjalnych osadzonych na warstwie porowatego krzemu (FIPOS)), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Romuald B. Beck - project leader, co-workers: Krzysztof Domański, Andrzej Jakubowski, Tomasz Janik, Małgorzata Jurczak, Lidia Łukasiak, Bogdan Majkusiak, Emilian Pórolnik, Jan Szmidi, Witold Ciemiewski, Kazimierz Dalbiak, Artur Samulski, Małgorzata Trzaskowska, September 1996-June 1999;

Among the few still competing options for SOI substrates formation, the FIPOS seems to be particularly attractive. It requires however, many optimisation processes, as the porous layer formation, epitaxial layer deposit, porous layer thermal oxidation and even later processing steps have considerable impact one on another. In the first stage of the project (it is only the beginning of this project) the work has been concentrated on obtaining the first FIPOS substrates. The results prove that the morphology of the obtained pores has enormous impact on the kinetics of the layer oxidation. Their morphology, however depends on the

parameters of all the preceding high temperature steps. Thus, the optimising procedures have to cover the whole sequence and not a few individual steps only.

- [Pro31] **The New Calibration And Minimalization Of Measurement Errors Techniques For Measuring Parameters Of Microwave Circuits Using A Dual Six-Port Network Analyser With Homodyne Detectors** (Nowe techniki kalibracji i minimalizacji błędów pomiaru parametrów obwodów mikrofalowych z wykorzystaniem analizatorów sześciowrotowych z detektorami homodynowymi), Institute of Microelectronics and Optoelectronics, Bogdan Galwas - project leader, co-workers: Zbigniew Pienkowski. (July 1996-June 1998)
The measurements of [S] matrix coefficients are the very important in the microwave techniques. The quality of these measurements is closely jointed with the calibration procedure of the measurement system.
The project contains the analysis of network analyser calibration methods and elaborates a new calibration method of dual six-port with homodyne detectors. The new idea implemented in the method is based on using the neutral networks for calibrating the measurement system. This concept has many advantages for defining calibration procedure.
The range of the research work contains the elaborating of mathematical model of neutral networks reflected to the main principles of dual six-port network analyser with phase homodyne detectors. Moreover, the result of this work is the way of learning neutral networks. The new calibration method is implemented in the computer software for controlling the dual six-port network analyser with homodyne detectors. The experimental results of measurement of microwave circuits make possible to estimate the worth of the new calibration concept.
- [Pro32] **Researches On Metal Ion Lasers For Ultraviolet Laser Generation** (Badania laserów jonowych na parach metali dla generacji w obszarze nadfioletu), project director: dr Tadeusz, M. Adamowicz, co-workers: Krzysztof Dzięciołowski, Wojciech Kwaźniewski - Ph.D students, duration of the project: 1.08.1997 - 31.07.1999
A novel ceramic-metal HCD ion laser discharge tube has been constructed. The new design makes possible to build compact and more stable laser tubes with longer active medium, suitable for UV laser operation researches. The tube with total active length of 60 cm has been used for finding far UV (210 nm) laser oscillation in He-Zn mixture.
Laser action on 282.4 nm transition in He-Au segmented hollow cathode discharge was also investigated. The results were presented at international conferences (2 papers) and accepted in SPIE Proceedings.
- [Pro33] **Nanocrystalline layers of Cubic Boron Nitride for electronics** (Warstwy nanokrystalicznego kubicznego azotku boru dla elektroniki), project leader: Jan Szmidt, co-worker: Aleksander Werbowy.(October 1997-September 1998)
- [Pro34] **Vacuum Controller For The Range Of 10^{-10} -100000 Pa** (Opracowanie próżniomierza jonizacyjnego na zakres 10^{-10} - 100000 Pa z mikroprocesorowym układem kontrolnym) project leader P.Szwemin (1996-1998)
Three gauges: convection, Pirani and nude modulated Bayard Alpert all in UHV technology will be constructed as a pressure transducer within the project as well as programmable electronic supply and measuring unit.
- [Pro35] **Studies On Laser-Diode Excitation And Construction Of Planar Waveguide Nd:YAG/YAG Lasers** (Opracowanie metod wzbudzania, podzespołów i konstrukcji falowodowych laserów cienkowarstwowych Nd:YAG/YAG pobudzanych diodami laserowymi) project leader: M.Malinowski (May 1997- October 1999)
The main goal of this work is to elaborate planar waveguide laser with Fabry-Perot or distributed feedback resonator. The project concerns technology by liquid phase epitaxy (LPE) of waveguiding thin active films of neodymium (Nd) doped YAG on YAG substrates. Optical waveguiding is obtained by co-doping with Lu and Gd ions. Further studies involve investigation of the spectroscopic properties of the material, technology of the grating structures and laser experiments.
- [Pro36] **Operation Analysis And Optimisation Of Surface Emitting Planar Dielectric Lasers With Two-Dimensional Distributed Feedback Resonator For Optoelectronics** (Analiza pracy i optymalizacja emitujących powierzchniowo planarnych laserów dielektrycznych nowej generacji posiadających dwuwymiarowy rezonator z rozłożonym sprzężeniem zwrotnym, jako źródłem promieniowania koherentnego dla potrzeb optoelektroniki), project leader: M.Malinowski (September 1997-February 2000)
In this project following subjects are being studied; threshold analysis of circular grating distributed feedback (DFB) lasers, output power optimisation, dynamic operation including modulation bandwidth and analysis of the quantum noise in the surface emitting planar dielectric lasers with two-dimensional resonators.
- [Pro37] **Elaboration Of Fibre Optic Amplifiers At The Range 1060nm For Laser Range-Finder And At 1530nm Pumped By Laser Diodes** (Opracowanie wzmacniaczy włóknowych na zakres 1060 nm dla dalmierza laserowego i na 1530 nm pobudzanych diodami laserowymi), project leader: prof. Wiesław Woliński. (May 1997 – October 1999)
The aim of the problem is an investigation of the amplification conditions of small signals, going from open space in active multimode fibers. Active media are silica fibers, Er doped for wavelength of 1530nm and Nd doped for the 1060nm signal. Laser diodes emitting 980nm and 810nm radiation have to be used for fibers pumping. As a result of the work the models of amplifiers will be realized. The amplifier on the 1060nm wavelength is provided for laser range-finder.
- [Pro38] **The Effect Of Excess Quantum Noise In Mirror Lasers And Distributed Feedback Lasers For Telecommunication Systems** (Analiza nadmiarowych szumów w laserach zwierciadlanych oraz z rozłożonym sprzężeniem zwrotnym współpracujących zwiatłowodowymi sieciami telekomunikacyjnymi), project leader: Paweł Szczepański, co-workers: Anna Tyszk-Zawadzka, Michał Malinowski, Agnieszka Mossakowska-Wyszyńska, Piotr Witoński, Stanisław Jonak. (January 1997-December 1998)
- [Pro39] **The Effect Of Gaussian Variable Reflectivity Mirror On Parameters Of Waveguide Lasers** (Analiza wpływu zastosowania zwierciadeł gaussowskich na parametry laserów objętościowych i falowodowych), project leader: Paweł Szczepański, co-workers: Anna Tyszk-Zawadzka, Michał Malinowski, Agnieszka Mossakowska-Wyszyńska, Piotr Witoński, Stanisław Jonak, Ryszard Piramidowicz, Wojciech Kwaźniewski, prof. Krzysztof Abramski (Wrocław Technical University), dr inż. Mirosław Kopica (WAT), dr inż. Marek Strzelec (WAT), mgr inż. Zygmunt Frukacz (ITME) (July 1999-December 1999)
- [Pro40] **Modulation And Controlling Of Microwave Cuircircuits By Means Of Optical Radiation** (Badania metod modulacji i sterowania układami mikrofalowymi z wykorzystaniem promieniowania optycznego), project leader: Bogdan Galwas, co-workers: Jerzy Piotrowski , Jerzy Skulski, Andrzej Krzysztofik, Jarosław Dawidczyk, Zenon Szczepaniak (March 1998-

December 1999)

The main aims of the Project are focused on:

- investigation of modulation of microwave oscillator by means of an optical signal,
- method of transmission of microwave signals by optical transmission lines,
- controlling of microwave circuit's parameters by means of optical signals.

[Pro41] **Designing And Verification Method Of The Reference Structure Of Submicrometer MOS Transistor For Analytical Models** (Metoda projektowania i weryfikacji wzorcowej struktury submikrometrowego tranzystora MOS dla konstruowania fizycznych modeli elektrycznych.), project leader: Jacek Laskowski (February 1998-February 1999)

A method of designing and verification of reference structure for the submicrometer MOS transistor is proposed. The structure obtained in such a way makes accessible device electrical characteristics that are usually not presented in literature providing details of internal device structure the same time. Thus it allows to develop and evaluate analytical MOS models, particularly for statistical simulation purposes.

[Pro42] **A Verification Method for Analytical Models of Doping in Manufacturing of VLSI** (Metoda weryfikacji analitycznej modeli domieszkiowania dla technologii wytwarzania submikrometrowych układów VLSI), project leader: Adam Lejman (April 1998-April 1999)

The research examined semi-empirical models as a way of fast and accurate modelling for statistical purposes in submicron technology manufacturing process. The model output was compared to fully numerical modelling in order to evaluate criteria of constructing and tuning the model to match reference numerical profiles. Modelling experiment was led to verify the usability of semi-empirical model. Obtained results showed very similar histograms of physical parameters in both simulation cases: fully numerical and using semi-empirical models.

[Pro43] **The Elaboration Of Design Methods And Realisation Of New Microwave Filters With Dielectric Resonators For Telecommunication And Cellular Telephony** (Opracowanie metod projektowania i wykonanie nowych typów filtrów mikrofalowych z rezonatorami dielektrycznymi dla telekomunikacji i telefonii komórkowej), project leader: Jerzy Krupka, Adam Abramowicz, Krzysztof Derzakowski, Zbigniew Rutkowski (January 1998-December 1999)

The aim of the project is elaboration of design methods of new microwave filters with dielectric resonators for telecommunication and cellular telephony and their practical realisation. The tuneable and untuneable filters have been elaborated. Tuneable filters will be tune mechanically in very wide range and electronically by means of ferrite elements. Untuneable filters will be narrow-band with very high quality factor.

[Pro44] **Application Of A Coaxial Line - Waveguide Below Cut-Off Transition For Microwave Methods Of Dielectric Measurements** (Zastosowanie połączenia linia współosiowa - podkrytyczny falowod kołowy w mikrofalowych metodach pomiaru dielektryków), project leader Jerzy K. Piotrowski, Bogdan Galwas, Jerzy Skulski, Zenon Grzymała, Barbara Szymulska, (August.1998 – January 2000)

The coaxial line - circular waveguide transition is studied for use in wideband as well as resonator methods of dielectric measurements. The goal of the project is elaboration of theoretical basis as well as numerical and empirical tools for the above methods.

[Pro45] **Analysis of Delay Lines with Interdigital Transducers for Liquid Sensors Applications** (Analiza linii opóźniających z przetwornikami międzypalczastymi do zastosowań czujnikowych w cieczach), project leader: Mikołaj Baszun, Sylwester Gawor, Leszek Książek, Dariusz Grzda, Paweł Milewski, Lucjan Nafalski, Jerzy Rudkowski (July 1998-December 1999).

The main tasks of this project are:

- theoretical analysis and software tools design for modelling of delay lines with interdigital transducers for different modes of the shear horizontal surface acoustic waves;
- design of microelectronic structures for delay lines to obtain high values of electromagnetic/acoustic energy coupling coefficients;
- application of such delay lines as liquid sensors and research their basic characteristics.

[Pro46] **Modelling And Characterization Of Quantum Effects In MOS SOI Devices** (Modelowanie i charakterystyka efektów kwantowych w przyrządach typu MOS SOI), project leader: Bogdan Majkusiak, team: Tomasz Janik, Andrzej Jakubowski, Jan Szmidt, Romuald B. Beck, Lidia Lukasiak, Agnieszka Zareba, Jakub Walczak, Kamil Kosieli, Antoni Siennicki, Józef Maciak (October 1998-September 2001)

The purpose of the project is consideration of consequences of energy quantization and tunnelling effect on electrical characteristics of the metal-oxide-semiconductor devices fabricated in the silicon-on-insulator (SOI) technology. The detailed tasks are: developing a theoretical model of the MOS SOI tunnel diode, consideration of influence of semiconductor body thickness on tunnel current in MOS SOI tunnel diode and the gate and drain currents in MOS SOI transistor, investigation of the effect of energy quantization on operation of an MOS SOI transistor, investigation of resonance tunnelling in MISIM transistor.

4.3. Projects Granted by International Institutions

[Pro47] **Application of Hardware Based Fuzzy Logic Controller for Adaptive Pacemakers - HARMONY** (COPERNICUS CP 94:0202 Zastosowanie scalonego sterownika rozrusznika serca działającego w oparciu o zasady logiki rozmytej), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Wiesław Kuźmich - project leader, co-workers: Adam Wojtasik, Zbigniew Jaworski, Andrzej Wielgus, Andrzej Wałkanis, Marcin Sadowski, January 1995-January 1998, Financial support: European Union (represented by the Commission of the European Union);

The aim of this project is to develop an analogue fuzzy logic controller for a self-adaptive pacemaker. As a part of the HARMONY project, IMiO provides the general methodology for the design of analogue fuzzy logic controllers, including a set

of analogue standard cells implementing fuzzy logic functions and a CAD software system. It's task is to design a fuzzy logic chip implementing a fuzzy logic algorithm developed by other participants of the project, manufacture the controller as a custom built CMOS chip in a Western European factory and perform the tests of the chip. The last stage includes developing a specialised tester, which on the basis of actually acquired externally accessible signals will generate internal signals for controller testing purposes.

- [Pro48] **Microwave Dielectric Property Measurements of Advanced Materials Used in the Electronics Industry** (Pomiary dielektrycznych właściwości materiałów używanych w przemyśle elektronicznym w paśmie częstotliwości mikrofalowych), Warsaw University of Technology, Institute of Microelectronics and Optoelectronics and NIST USA, Jerzy Krupka - project leader, co-worker: Zbigniew Rudkowski, 1996-1998, financial support: M. Skłodowska - Curie Foundation (Fundusz współpracy polsko - amerykańskiej Fundacji im. M. Skłodowskiej - Curie);
The main objective of this project is to measure the electric and magnetic properties of new and existing dielectric, ferrite and semiconducting materials at microwave frequencies in order to help Polish industry to produce high quality electronic materials that can compete on the world market. These electromagnetic property investigations require expensive test equipment and sophisticated techniques not readily available in the Polish electronics industry. Some of the required test equipment is available in the NIST Boulder laboratory, but measurement methods and fixtures must be developed, designed and built to satisfy specific industrial needs (material and parameter to be measured, frequency and temperature range). The measurements proposed in this project will be directed at future commercial applications of electronic materials both for the Polish and American microelectronic industries. The scientific aspect of this work will be the development of new very accurate standard measurement methods and reference samples (permittivity and permeability standards). The following materials will be investigated: very low-loss single-crystal dielectric materials, piezoelectric materials, electrooptic materials (mainly materials for lasers), and high resistivity semiconductors manufactured by the Institute of Electronic Materials Technology and American industry, and microwave ferrites manufactured by POLFER and American industry.
- [Pro49] **Development of Semiconductor Materials for Microelectronics and Optoelectronics** (Rozwój materiałów półprzewodnikowych dla zastosowań w mikroelektronice i optoelektronice), Research Centre for Integrated Systems, Department of Electrical Engineering, Hiroshima University, Japan, dr. Stanisław M. Pietruszko
- [Pro50] **Development of analysis method of non-linear properties of transistors and microwave amplifiers** (Rozwój metod analizy nieliniowych właściwości tranzystorów i wzmacniaczy mikrofalowych), Università degli Studi di Roma „Tor Vergata”, Italy, prof. dr hab. Bogdan Galwas
- [Pro51] **Interactive engineering design over Internet** (Interakcyjne projektowanie inżynierskie w Internecie.), Loyola University at New Orleans, Department of Mathematics and Computer Science. USA, dr. Mikołaj Baszun
- [Pro52] **Investigations of elementary processes in basic and laser discharges** (Badania procesów elementarnych w wyładowaniach jarzeniowym oraz wznikowym dla uzyskania akcji laserowej), Research Institute for Solid State Physics of Hungarian Academy of Sciences, Budapest, Hungary, dr. inż. Tadeusz Adamowicz
- [Pro53] **Investigation of Semiconductor Materials for Large Area Electronics** (Badanie materiałów półprzewodnikowych dla zastosowań w elektronice dużych powierzchni), Dept. of Physics, Graduate School of Academia Sinica, Beijing, China, dr. Stanisław M. Pietruszko.
- [Pro54] **Investigation of Amorphous Silicon and Development of its Application** (Badanie krzemu amorficznego i rozwój jego zastosowań), Department of Physics, Kyung Hee University, Seoul. Republika Korei, dr. Stanisław M. Pietruszko
- [Pro55] **Modelling of technological processes in microelectronics** (Modelowanie procesów technologicznych w mikroelektronice), Byelorussia State University of Informatics and Radioelectronics, Minsk, Byelorussia, prof. dr hab. Wiesław Kuźmicz.
- [Pro56] **Modelling of thin film transistor** (Modelowanie tranzystorów cienkowarstwowych), National Physics Laboratory, New Delhi, India, prof. dr hab. Andrzej Jakubowski
- [Pro57] **Modelling and characterization of MOS-SOI devices** (Modelowanie i charakteryzacja przyrządów MOS-SOI), Laboratoire de Physique des Composants à Semiconducteurs (LPCS), Ecole Nationale Supérieure d'Electronique de Radioelectricite Grenoble, Francja, dr hab. inż. Romuald B. Beck
- [Pro58] **Photovoltaic Application** (Zastosowania fotowoltaiki), Helsinki University of Technology, Advanced Energy Systems and Technologies Centre, Finland, dr. Stanisław Pietruszko
- [Pro59] **Physics of Non-Conventional Energy Sources** (Fizyka niekonwencjonalnych źródeł energii), Istituto di Chimica e Tecnologia dei Materiali e dei Componenti per l'Electronica (LAMEL), CNR – Consiglio Nazionale delle Ricerche, Bologna and International Centre for Theoretical Physics, Trieste, Italy, dr. Stanisław M. Pietruszko
- [Pro60] **Software for designing of photovoltaics systems** (Oprogramowanie do projektowania systemów fotowoltaicznych), Centre d'Energetique, Ecole de Mines de Paris, France, dr. Stanisław Pietruszko
- [Pro61] **Promotion of Warsaw University of Technology in USA** (Promocja osignięć Politechniki Warszawskiej w USA), Carnegie Mellon University, Pittsburgh, USA, prof. nzw. dr hab. Bogdan Majkusiak
- [Pro62] **Promotion and Simulation of Photovoltaic Energy Conversion Technologies - PROSPECT** contract no ICOP-DISS-2163-96, program INCO-COPERNICUS. Partners:
1. National Microelectronics Research Centre (NMRC), University College, Cork, Ireland
2. Research Institute for Informatics (ICI), Bucharest, Romania
3. Ecole des Mines, ARMINES, Sophia Antipolis, France
4. Institute for Microelectronics and Optoelectronics, Warsaw University for Technology, Warsaw, Poland.
The main objectives of this project :
- promote the usage of the PV simulation software in Eastern Europe based on an existing well established package.
- expand databases to incorporate the experience of users/providers/researchers of Eastern Europe (e.g. local irradiance data, incorporate models for PV components currently in use in Eastern Europe and which are currently not in database).

- to model existing PV plants in Eastern Europe, compare results of simulations with existing data for use in verification of models.
- incorporate improvements to models identified in JOULE II Concerted Action Project, Task 6, Modelling and Simulation
- develop an interface adapted for the special requirements of Eastern European countries (e.g. supply HELP files in selected languages, incorporate other identifiable interface issues).
- combine simulation techniques and design expertise to investigate sizing issues in Eastern Europe. This would involve performing economical assessment, and investigating cost competitiveness.

[Pro63] **Stability issues in thin-film photovoltaics** (Zagadnienia stabilności w fotowoltaice cienkowarstwowej), National Renewable Energy Laboratory, Golden, USA, dr. Stanisław Pietruszko

[Pro64] **Study of amorphous silicon and its alloys** (Badanie krzemu amorficznego i jego zwińzków), Indian Institute of Technology, Department of Physics, Kanpur. Tata Institute of Fundamental Research, Solid State Electronics Group, Bombay, India, dr. Stanisław M. Pietruszko.

[Pro65] **SOI devices - modelling and characterisation** (Przyrzędy SOI – modelowanie i charakteryzacja), National Microelectronics Research Centre, Cork, Irland, prof. dr hab. Andrzej Jakubowski

[Pro66] **Promotion of System Design Training and Information Centres in CEE/NIS -SYTIC** (INCO-COPERNICUS CP 960170) (Rozpowszechnienie szkolenia w dziedzinie projektowania systemow w krajach Europy Srodkowej i Wschodniej). Warsaw University of Technology, Institute of Microelectronics and Optoelectronics, Wieslaw Kuzmicz - project leader, co-workers: Adam Wojtasik, Andrzej Walkanis, Zbigniew Jaworski, Elzbieta Piwowarska, Marcin Sadowski, Stanislaw Jeszka, Jerzy Gempel. April 1997 - March 1999. Financial support:

European Union (represented by the European Commission). The main aim of this project is to promote and support creation of centres of training and research for development of microelectronics-based systems. The tasks of IMiO include distribution and technical support of the IMiOCAD toolset for VLSI design, organisation of international courses and establishment of the centre of competence in the area of design of analogue and mixed integrated circuits for system applications.

[Pro67] **VILAB: Microelectronics Virtual Laboratory for Co-operation in Research and Knowledge Transfer** (INCO-Project 977133). Project partners are:

- FhG-IIS/EAS (Germany)
- Technical University of Budapest (Hungary)
- Tallin Technical University (Estonia)
- Warsaw University of Technology (Institute of Microelectronics and Optoelectronics) (Poland)
- Institute of Electron Technology (Poland)
- Institute of Computer Systems (Slovakia)
- Slovak University of Technology (Slovakia)
- Darmstadt University of technology (Germany)
- Linkoping University (Sweden)

The main objective of this project is to set up and maintain an east-West Virtual Laboratory (VL) for promoting co-operative research, development and training activities between the partner institutions in CEE and EC countries in design of dependable microelectronic systems which is one of the most dynamically developing application fields. The main result of the project will be: establishing of a new Research Network called Virtual Laboratory and new co-operative results in design, research and teaching achieved by joint use of resources and environment of the VL.

5. DEGREES AWARDED

5.1. Ph.D. Degrees

- [PhD1] Piotr Warda, **The influence of magnetic field of permanent ring magnets on ion argon laser parameters** (Wpływ pola magnetycznego pierścieniowych magnesów trwałych na parametry jonowego lasera argonowego), supervisor: Wiesław Woliński
- [PhD2] Fawzi Abdulkheim Ikraim, **Modelling of capacitance-voltage electrical characteristics of MOS capacitors on silicon-on-insulator (SOI) substrates** (Modelowanie charakterystyk pojemnościowo-napięciowych kondensatorów MOS krzem-na izolatorze SOI), supervisor: R.Beck

5.2. M.Sc. Degrees

- [MSc1] Adam Danieluk, **Sterowany komputerowo system do pomiaru charakterystyk prądowo-napięciowych tranzystora MOS**, advisor Lidia Łukasiak, good
- [MSc2] Ireneusz SŻk, **Pomiar pojemności pasywnych metodą "on-chip"**, advisor Elżbieta Piwowska, fairly good
- [MSc3] Mirosław Sobotka, **Interfejs użytkownika systemu analizy obrazów mikroskopowych w środowisku graficznym WINDOWS 95**, advisor Jerzy Woźnicki, very good
- [MSc4] Janusz Jasik, **Badania kolorymetryczne syntezy obrazów kolorowych**, advisor Hanna Górkiewicz-Galwas, good
- [MSc5] Tomasz Adamiak, **Zjawiska sprężenia elektrycznego w cienkowarstwowych strukturach MOS-SOI**, advisor Romuald Beck, very good
- [MSc6] Rafał Hałackiewicz, **Wielopunktowy pomiar odległości z wykorzystaniem piezoceramicznych przetworników fal ultradźwiękowych**, advisor Mikołaj Baszun, very good
- [MSc7] Jacek Siwiński, **Metoda pompowania ładunku jako narzędzie analizy lateralnej w strukturze tranzystora MOS**, advisor Andrzej Jakubowski, excellent, with honors
- [MSc8] Krzysztof Marczak, **Metoda pompowania ładunku jako narzędzie do badania procesów degradacyjnych w tranzystorze MOS**, advisor Lidia Łukasiak, excellent, with honors
- [MSc9] Robert Kopystyński, **Odbiornik mikrofalowy z detekcją bezpośrednią o dużej dynamice**, advisor Bernard Jakubowski, fairly good
- [MSc10] Andrzej Głogowski, **Źwiastłowodowy czujnik wilgotności**, advisor Jerzy Kalenik,
- [MSc11] Rafał Buczyński, **Układ sterowania stolikiem XY automatycznego stanowiska ostrzowego do pomiarów struktur półprzewodnikowych**, advisor Lidia Łukasiak, very good
- [MSc12] Paweł Szeliga, **Źwiastłowodowy czujnik zmiany poziomu oświetlenia**, advisor Jerzy Kruszewski, excellent, with honors
- [MSc13] Przemysław Żulewski, **Pomiary fotometryczne przy wykorzystaniu kamery CCD i metody cyfrowej analizy obrazu**, advisor Jerzy Woźnicki, good
- [MSc14] Jacek BŻbenek, **Mikrofalowe mieszacze podharmoniczne z diodami Schottky'ego**, advisor Bogdan Galwas, very good
- [MSc15] Tomasz Mirowski, **Badanie defektów prekursorskich prowadzących do defoliacji cienkich warstw monokryształu krzemu**, advisor Romuald Beck, very good
- [MSc16] Mikołaj Brzeziński, **Dydaktyczne stanowisko laboratoryjne do analizy zjawiska potencjału powierzchniowego**, advisor Zdzisław MŻczeński, excellent, with honors
- [MSc17] Paweł Wołoski, **Źwiastłowodowy sygnalizator zmiany obciążenia**, advisor Maria Bełowska, good
- [MSc18] Arkadiusz Biegaj, **Zaawansowane techniki ekstrakcji parametrów rezonatorów**, advisor Bogdan Galwas, good
- [MSc19] Zenon Szczepaniak, **Optoelektroniczne metody kontroli warunków pracy oscylatorów mikrofalowych**, advisor Sławomir Palczewski, excellent, with honors
- [MSc20] Jarosław Dawidczyk, **Pomiary odległości metodami mikrofalowymi z falą ciągłą**, advisor Sławomir Palczewski, excellent, with honors
- [MSc21] Daniek Janiak, **Synteza układów próżniowych wspomaganą komputerem**, advisor Piotr Szwemin, good
- [MSc22] Tomasz Łodziński, **Optymalizacja warunków pracy jonowego lasera argonowego w zakresie promieniowania UV**, advisor Jerzy KŻsik, good
- [MSc23] Marcin Kaczkan, **Zagadnienie emisji widzialnej w laserowych kryształach YALO₃:Ho³⁺**, advisor Michał Maliniwski, very good
- [MSc24] Piotr Caban, **Wykorzystywanie systemu ALLIANCE do projektowania układów o stopniu złożoności mikroprocesora**, advisor Elżbieta Piwowska, excellent, with honors
- [MSc25] Wojciech Wawrzak, **Hierarchiczna ekstrakcja schematu elektrycznego**, advisor Adam Wojtasik, good
- [MSc26] Andrzej Zdrojek, **Napięcie progowe tranzystora MOS-SOI: modelowanie i charakterystyka**, advisor Andrzej Jakubowski, good
- [MSc27] Andrzej Adamowicz, **Korelacja przestrzenna napięcia niezrównoważenia wzmacniacza operacyjnego w układzie**

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- scalonym**, advisor Wiesław Kuźmicz, good
- [MSc28] Marcin Domański, **Analityczne modelowanie rezystancji źródła i drenu tranzystora MOS**, advisor Andrzej Pfitzner, good
- [MSc29] Piotr Leszczyński, **Stabilizowane źródło światła modulowanego**, advisor Jerzy Kalenik, good
- [MSc30] Piotr Grzdzki, **Zaprojektowanie karty grafiki dla potrzeb radiolokacji**, advisor Hanna Górkiewicz-Galwas, very good

5.3. B.Sc. Degrees

- [BSc1] Marcin Rusewicz, **Oscylator mikrofalowy przestarajany napięciowo na pasmo L**, advisor Bogdan Galwas, excellent, with honors
- [BSc2] Radosław Józwik, **Zbadanie i wykonanie światłowodowego czujnika wilgotności**, advisor Maria Bełowska, good
- [BSc3] Krzysztof Kosiorek, **Charakterystyki robocze lasera Au-II z katodę wnąkową dla $\lambda=840,4$ nm**, advisor Tadeusz Adamowicz, good
- [BSc4] Dariusz Obrzbski, **Opracowanie modelu jednostki interfejsu I²CBUS w języku VHDL**, advisor Elżbieta Piwowska, very good
- [BSc5] Konrad Habit, **Symulacja i optymalizacja inwertera w technologii GAA SOI**, advisor Tomasz Janik, good

6. PUBLICATIONS

6.1. Scientific and Technical Books

- [Pub1] P.Warda, **The influence of magnetic field of permanent ring magnets on ion argon laser parameters** (Wpływ pola magnetycznego pierścieniowych magnesów trwałych na parametry jonowego lasera argonowego), PhD thesis, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1998.
- [Pub2] F.A.Ikraiim, **Modelling of capacitance-voltage electrical characteristics of MOS capacitors on silicon-on-insulator (SOI) substrates** (Modelowanie charakterystyk pojemnościowo-napięciowych kondensatorów MOS krzem-na izolatorze SOI), PhD thesis, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa 1998.
- [Pub3] K. Braclawski, J. Maciak, K. Sadowski, **Laboratorium przyrządów półprzewodnikowych – diody półprzewodnikowe**, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, (1998), pp.1-240
- [Pub4] Praca zbiorowa pod red. A. Filipkowskiego, (K. Braclawski, M. Jurczak, J. Szmidt), **Elementy i układy elektroniczne – projekt i laboratorium**, Oficyna Wydawnicza Politechniki Warszawskiej, Warszawa, (1998), pp. 1-151.

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

- [Pub5] A. Werbowy, J. Szmidt, A. Olszyna, A. Sokołowska, P. Pawłowski, **Electronic properties of nanocrystalline BN and AlN films deposited on Si and GaAs – comparison**, Diamond and Related Materials (1998).
- [Pub6] A.Abramowicz, K.Derzakowski, J.Krupka, **Comments on Study of Whispering Gallery Modes in Double Disk Sapphire Resonators**, IEEE Transactions On Microwave Theory and Techniques, vol.46. No.5, May 1998, pp.566-567.
- [Pub7] A.Ikraiim, R.B. Beck, A. Jakubowski, **Modeling of SOI-MOS capacitors C-V behaviour: partially - and full-depleted cases**, IEEE Transactions on Electron Devices vol. 45, No 5, May 1998, pp. 1026-1032.
- [Pub8] A.Kraśniewski, J. Woźnicki, **Flexibility and Adaptability in Engineering Education: An Academic Institution Perspective**, IEEE Transactions on Education, vol. 40, No 4, November 1998, pp. 237 – 243.
- [Pub9] A.Werbowy, J. Szmidt, A. Sokołowska, A. Olszyna, **Heterojunction of amorphous wide band gap nitrides and silicon**, Diamond and Related Materials, 7 (1998) pp. 397- 401.
- [Pub10] B. Majkusiak, **Experimental and theoretical study of the current-voltage characteristics of the MISIM tunnel transistor**", IEEE Transactions on Electron Devices vol. 45, No 9, June 1998, pp.1903-1911.
- [Pub11] B.Majkusiak, T. Janik, J. Walczak, **Semiconductor thickness effects in the double-gate SOI MOSFET**", IEEE Transactions on Electron Devices vol. 45, No 5, May 1998, pp. 1127-1134.
- [Pub12] J.Kalenik, R.Pajżk, **A cantilever optical-fiber accelerometer**, Sensors and Actuators A 68 1998,pp.350-355.
- [Pub13] J.Krupka, J.Maziarska, **Improvement of Accuracy in Measurements of the Surface Resistance of Superconductors Using Dielectric Resonators**, IEEE Transactions on Applied Superconductivity, vol.8, No 4, Dec.1998. pp. 164-167.
- [Pub14] M. Jurczak, A. Jakubowski, L. Łukasiak, **The effects of high doping on the I-V characteristics of a thin-films SOI MOSFET**", IEEE Transactions on Electron Devices vol. 45, No 9, June 1998, pp.1985-1992.
- [Pub15] M.E.Tobar, J.G.Hartnett, A.G.Mann, J.Krupka, **Temperature dependence of Ti³⁺ doped sapphire whispering gallery mode resonator**, Electronics Letters 1998 vol.34, no2, pp.195-196.
- [Pub16] M.E.Tobar, J.Krupka, E.N.Ivanov, R.Woode, **Anisotropic complex permittivity measurements of mono-crystalline rutile between 10 and 300 K**, American Inst. of Phys, [S0021-8979], vol.83, no.3, pp.1604-1609., 1998.
- [Pub17] N. Cordero, D. Mulcahy, G. Wrixon, D. Mayer, K. Badowski, S. M. Pietruszko, A. Alexandru, I. Buzatu, D. Buzuloiu, and A. Ginga, **Ashling 7.0: A Software Tool for Promotion and Training in PV using Modelling**", Renewable Energy: Energy Efficiency, Policy and Environment, Pergamon Press 1998, pp. 1836-9.
- [Pub18] N. Martin, P. Boutinaud, M. Malinowski, R. Mahiou, J.C. Cousseins, **Optical spectra and analysis of Pr³⁺ in β-NaYf₄**, Journal of Alloys and Compounds 1998, pp. 275-277 and 304 – 306.
- [Pub19] N.Luiten, M.E.Tobar, J.Krupka, R.Woode, **Microwave properties of a rutile resonator between 2 and 10 K**, J.Phys. D: Appl..Phys. 31, pp.1383-1391.
- [Pub20] P.Agarwal, M. Kostana, S.C. Agarwal, S.M. Pietruszko, **Relaxation of thermally induced defects in LPCVD amorphous silicon**, J. of Non-Crystalline Solids 1998, pp.328-331.
- [Pub21] Piotr Witożski, Paweł Szczepański, Adam Kujawski, **Model of the nonlinear operation of a laser with a Gaussian mirror**, Journal of Modern Optics 1998, vol. 45, No 9, pp. 1957 – 1974.
- [Pub22] S. M. Pietruszko, **The Status and Prospects of Photovoltaics in Poland**" (Invited paper), 1998 Renewable Energy: Energy Efficiency, Policy and Environment, Pergamon Press 1998, pp. 1210-14.

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- [Pub23] T. Brożek, V.R. Rao, A. Sridharan, J. Werking, Y.D. Chan, C.R. Viswanathan, **Charge injection using gate-induced drain-leakage current for characterization of plasma edge damage in CMOS devices**, IEEE Transactions on Semiconductor Manufacturing vol. 11, No.2 (1998), pp. 211 – 216
- [Pub24] T. Brożek, Y.D. Chan, C.R. Viswanathan, **Gate oxide leakage due to temperature accelerated degradation under plasma charging conditions**, Microelectronics and Reliability vol. 38, No 1, (1998) 73 – 79.
- [Pub25] T.Janik, B. Majkusiak, **Analysis of the MOS transistor based on the self-consistent solution to the schrodinger and Poisson equations and on the local mobility model**, IEEE Transactions on Electron Devices vol. 45, No 6, June 1998, pp.1263-1271.

6.3. Scientific and Technical Papers Published in Journals not Included in the ISI Database

- [Pub26] E. Piwowarska, **Effects of interconnection inductances on VLSI circuit performance**, Bulletin of the Polish Academy of Science Technical Sciences Electronics and Electrotechnics 1998, vol. 46 No 3 pp. 353-361.
- [Pub27] Michael E, Tobar, J.Krupka et all, **High- Sapphire-Rutile Frequency-Temperature Compensated Microwave Dielectric Resonators**, IEEE Transactions on Ultrasonics, Ferroelectrics and Frequency Control , vol.45, no 3, May 1998 pp. 830-835.
- [Pub28] M.Baszun, B.Czejdo, **Development of an Interactive Engineering Design Software**, Integrated Design and Process Technology, IDPT-Vol.4, July 1998, pp. 162-170.
- [Pub29] M. Malinowski, R. Piramidowicz, J. Sarnecki, W. Woliński, **Infrared-to-blue-wavelength upconversion in GGG:Pr³⁺ thin film grown liquid phase epitaxy**, J. Phys. Condens. Matter 10, 1998, pp. 1909-1916.
- [Pub30] A. Pfitzner, B. Jucht-Suchta, A. Ńwit, **Semi-empirical boundary conditions at p-n junctions for device simulation**, Kwartalnik Elektroniki i Telekomunikacji 1998, 44, z. 2, pp. 205-218.
- [Pub31] J.Krupka, K.Derzakowski, Bill Riddle, J. Baker-Jarvis, **A dielectric resonator for measurements of complex permittivity of low loss dielectric materials as a function of temperature**, Measurement Sci. Technology , 9(1998) pp.1751-1756.
- [Pub32] Z. Jaworski, I.M. Kudla, W. Kuńmicz, M. Niewczas, **Resistive plate chamber (RPC) based muon trigger system for the CMS experiment - pattern comparator ASIC**, Nuclear Instruments and Methods in Physics Research (ELSEVIER)1998, pp. 707-710.
- [Pub33] L. Szalai, T.M. Adamowicz, A. Tokarz, G. Bánó, K. Kutasi, Z. Donkó, K. Rózsa, **Optimum operating conditions of a hollow-cathode Au - II laser**, Optika'98 5th Congress on Modern Optics 1998, Proceedings of SPIE - The International Society for Optical Engineering SPIE vol. 3573, pp. 28-32.
- [Pub34] W.Jitchin, S.Khodabakhshi, P.Szwemin, **Stromungsleitwert der dunnen Blende**, Vakuum in Forschung und Praxis Nr 4 ss316-320 (1998).

6.4. Scientific and Technical Papers Published in Conference Proceedings

- [Pub35] A.Bardossy, A. Blinowska A. Wojtasik, Z. Jaworski, A. Walkanis, **Application of fuzzy rules to pacemaker control**, Poster Proceedings ICCIMA'98 Intern. Conference on Computational Intelligence and Multimedia Applications-1998.9-11.02. Australia pp. 42-43
- [Pub36] A.Głogowski, J.Kalenik, **Water Adsorption on Optic Fiber Core-Possible Sensor Application**, Proc. XXII IMAPS October 1998, pp.65
- [Pub37] A.Jakubowski, L.Lukasiak, **Silicon microelektronik for speed**, Proc. XXII Intern. Microelectronics and Packaging Society Conf. IMAPS, Zakopane, 1-3 Oct. 1998, p. 12
- [Pub38] A.Sliwinski, M. Kostana, S.M. Pietruszko, **Effect of Doping and Hydrogenation on Metastability of Amorphous Silicon**, Proc. 2nd World Conference and Exhibition on Photovoltaic Solar Energy Conversion, Vienna, 05-10.07.1998, pp. 1004-7
- [Pub39] A.Werbowy, J. Szmidt, A. Sokołowska, **Electric breakdown phenomena in thin nanocrystalline nitride films**, Proc. 9th Intern. Conf. on Modern Materials & Technologies - World Ceramics Congress & Forum On New Materials, CIMTEC'98, Florence (Italy), 14-19 June 1998.
- [Pub40] A.Werbowy, P. Pawłowski, J. Siwiec, J. Szmidt, A. Olszyna, A. Sokołowska, **AlN layers plasmochemically produced as a semiconductor**, Proc. of the 2nd International Symposium Ion Implantation and Other Application of Ions and Electrons, JON'98, Kazimierz Dolny, June 16-19 1998 pp. 119-120.
- [Pub41] A.Wielgus, **Multilevel Synthesis of fuzzy logic functions for hardware VLSI implementation**, Proc. ICCIMA'98 Intern.Conference on Computational Intelligence and Multimedia Applications-1998 9-11.02. Australia 1998, pp. 471-476
- [Pub42] A.Wielgus, Z. Jaworski, **Functional simulation of fuzzy logic controllers for analogue VLSI implementations**, Proc. 5th International Conference Mixed Design of Integrated Circuits and Systems MIXDES'98, Łódź 18-20.06.1998, pp. 117-119
- [Pub43] B.A.Galwas, J. K. Piotrowski, T. Pałko, **Non-resonant and resonant dielectrometer for measurements of bio-liquids at microwave frequencies**, Proc. 10th Int. Conf. on Electrical Bio-impedance, April 5-9, 1998, Barcelona, pp. 441-444.
- [Pub44] B.A.Galwas, **Photonic technology for microwave engineering** (invited paper), Proc. 12th Int. Conf. on Microwave & Radar MIKON'98, May 20-22, 1998, Kraków, vol. 4, pp. 117-134.
- [Pub45] B.A.Galwas, **The common enterprise of the european universities – Travelling International Summer Schools on Microwave and Lightwave Electronics**, Proc. SEFI Annual Conf., Sept. 2-4, 1998, Helsinki, pp. 147-150.

- [Pub46] B.A.Galwas, **The development of the new forms of continuing professional education for telecommunication engineers in Poland**, Proc. 7th World Conf. on Continuing Engineers Education, May 10-13, 1998, Torino, pp. 411-414.
- [Pub47] B.Butkiewicz, J. Pogorzelska, **Rozmyty model procesu spiekania wyrobów z proszku żelaza**, Proc. III Krajowa Konferencja Naukowo-Techniczna: Diagnostyka Procesów Przemysłowych, Jurata, 7-10 Sept. 1998
- [Pub48] B.Galwas, J.Piotrowski, J.Skulski, A.Kulpa, A. Osowski, **Mikrofalowy system pomiarowy do wyznaczania niespalonego węgla w popiołach z kotłów energetycznych**, Proc. Konf. Diagnostyka Jakości Spalania w Energetyce, 25-27 March 1998, Ustroż-Zawodzie pp. 59-65.
- [Pub49] D.Pawlak, K. Woźniak, Z. Frukacz, **New method of determination of the lanthanide ion concentration in the garnet structure**, 1998, Proc. The 12th International Conference on Crystal Growth July 16-31, 1998, Jerusalem, Israel
- [Pub50] G.Wisniewski and S.M. Pietruszko, **Prospects of Solar Energy in Poland**, Proc. 2nd ISES-Europe Solar Congress, Portoroze, Slovenia, 14-17 September 1998 EuroSun'98.
- [Pub51] J.Chramiec, B. Janiczak, J. Komisarczuk, J. K. Piotrowski, W. Gwarek, **CAD models of connectors and transitions used in hybrid microwave integrated circuits**, Proc. 28th European Microwave Conf., Amsterdam 1998, vol. 1, pp. 457-461.
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- [Pub56] J.Krupka, K. Derzakowski, A. Abramowicz, **Computations of 3D Electromagnetic Fields Distributions in Axially Symmetric Multilateral Dielectric Resonators By Means of Galerkin-Rayleigh-Ritz Method**, Proc. 12th International Conference on Microwaves & Radar, MIKON-98, vol 2, May 1998, pp.491-495.
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7. RESEARCH REPORTS

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- [Rep2] P.Szczepański, **Modelling of nonlinear operation of hollow-waveguide slab lasers with Gaussian output mirror** (Modelowanie generacji promieniowania w gazowych szczelinowych laserach falowodowych ze zwierciadłem o gausowskiej transmisji).
- [Rep3] B.Galwas, **Chemical components of energetic ashes, and their dielectric properties in the microwave band** (Skład chemiczny popiołów kotłów energetycznych a ich własności dielektryczne w paśmie mikrofal).
- [Rep4] T.M.Adamowicz, **Investigations on laser generation conditions and processes responsible for population inversion in He-Zn and He-Ag HCD ion lasers** (Badania warunków generacji oraz procesów prowadzących do uzyskania akcji laserowej w jonowych laserach He-Zn i He-Ag).
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- [Rep6] Z.Szczepański, **Design of the Equipment to Anodic Bonding of Silicon Sensor Structures to Dielectric Materials** (Opracowanie stanowiska do wykonywania połączeń krzemowych struktur czujników pomiarowych z materiałami dielektrycznymi metodą elektrostatycznego łączenia).
- [Rep7] A.ńwit, **Perspectives of development of selected electronic technologies** (Prognoza rozwoju wybranych technologii elektronicznych dla potrzeb określenia preferowanych kierunków badań oraz kształcenia w Politechnice Warszawskiej).
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- [Rep13] M.Malinowski, **Problem of the visible light generation in the praseodymium (Pr³⁺) ion activated solids** (Zagadnienie generacji promieniowania widzialnego w dielektrycznych ośrodkach domieszkowanych jonami Pr³⁺).
- [Rep14] J.Kńsik **Optimization of ultraviolet generation of ion argon laser with crystal quartz Brewster windows** (Optymalizacja warunków pracy jonowego lasera argonowego z krystalicznymi okienkami Brewstera w zakresie promieniowania ultrafioletowego).
- [Rep15] J.Wońnicki, **The method for designing the digital image database** (Metoda realizacji bazy cyfrowych danych obrazowych).
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- [Rep17] B.Galwas, **Analysis and simulation of modulation and demodulation terms of optical and microwave signals utilising harmonic balance method** (Analiza i symulacja warunków modulacji i demodulacji sygnałów występujących w obecności sygnałów optycznych i mikrofalowych, wykorzystująca metodę równowagi harmonicznych).
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8. PATENTS

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9. CONFERENCES, SEMINARS AND MEETINGS

9.1. International Conferences

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- [Con2] **21st Inter. Spring Seminar on Electronics Technology - ISSE'98**, Austria, invited paper, R. Kisiel
- [Con3] **2nd World Conference on PU Solar Energy**, Austria, Wien, 2 regular papers, S. Pietruszko
- [Con4] **5th NIRIM International Symposium on Advanced Materials ISAM'98**, Japan, regular paper, J.Szmidt
- [Con5] **7th Inter. Scientific Conference**, Poland, Zakopane, M. Baszun
- [Con6] **9th European Conference on Diamond Like Materials, Nitrides and Silicon Carbide**, Greece, J. Szmidt
- [Con7] **9th Inter. Conference on Modern Materials & Technologies - CIMTEC'98**, Italy, Florence, poster, A.Werbowy, J. Szmidt, A. Sokołowska
- [Con8] **Conf. Modern Optics'98**, Hungary, regular paper, T. Adamowicz
- [Con9] **Conference - On Integrated Design and Process Technology**, Germany, Berlin, M. Baszun
- [Con10] **European Materials Research Society Meeting (E-MRS)**, France, S. Pietruszko
- [Con11] **Information Society Technologies - IST'98**, Austria, W. Kuńmicz
- [Con12] **Integrating Information of Communication Technology**, Holland, B. Majkusiak
- [Con13] **International Conference on Computational Intelligence and Multimedia Applications - ICCIMA'98**, Australia, regular paper, A. Wielgus
- [Con14] **International Conference on Computational Intelligence and Multimedia Applications - ICCIMA'98**, Australia, poster and seminar, Z. Jaworski
- [Con15] **ISES Energy Congress**, Slovenia, 2 regular papers, S. Pietruszko
- [Con16] **PIERS'98**, France, Nantes, regular paper, session chairman, J. Krupka
- [Con17] **The First Southern Symposium on Computing**, USA, M. Baszun
- [Con18] **V World Renewable Energy Congress**, Italy, Florence, regular paper, S. Pietruszko
- [Con19] **X Inter. Conference on Electrical Bio-Impedance**, Spain, regular paper B. Galwas

9.2. Local Conferences

- [Con20] **COE'98**, Jurata, M. Bełowska, M. Borecki
- [Con21] **ISHM**, Zakopane, A. Jakubowski, L. Łukasiak
- [Con22] **JON'98**, Kazimierz Dolny, J. Szmidt
- [Con23] **KKTOiUE'98**, Poznań, W. Kuńmicz
- [Con24] **Konf. Diagnostyka Jakości Spalania w Energetyce**, Ustroń, J. Skulski
- [Con25] **Konf. MODERN OPTICS'98**, Jurata, A.Piramidowicz, M. Kowalska, S. Tarasiuk, T. Kossek, P. Szczepański, W.Kwańniewski, P. Witoński, T. Adamowicz, K. Dzińciołowski
- [Con26] **Konf. Światłowodowy w telekomunikacji**, Bukowina Tatrzańska, W. Woliński, S. Jonak
- [Con27] **I Kongres PTP**, Kraków, P. Szwemin
- [Con28] **Krajowe Sympozjum Telekomunikacji**, Bydgoszcz, W. Woliński
- [Con29] **MIKON'98**, Kraków, B. Galwas, J. Piotrowski, Zb. Pieńkowski, J. Krupka
- [Con30] **MIXDES'98**, Łódź, A. Jakubowski, (invited paper, session chairman) W. Kuńmicz, W. Pleskacz, A. Wielgus (regular paper), Z. Jaworski, A. Pfitzner, J. Laskowski
- [Con31] **XXII Konf. IMPAS POLAND**, Zakopane, Z. Szczepański, R. Kisiel, J. Kalenik

9.3. Schools and Seminars

- [Con32] **Szkoła Letnia TEMPUS**, Zakopane, A. Werbowy, S. Szostak, K. Domański, A. Ceryngier, J. Walczak, R. Beck, J. Szmidt, T. Janik, L. Łukasiak, A. Jakubowski
- [Con33] **Inter. Summer School**, Gemany, J. Piotrowski (lecturer), B. Galwas (lecturer), P. Szczepański

9.4. Meetings

- [Con34] **Forum Energetyczne**, Gdańsk, S. Pietruszko
- [Con35] **Wymiana ciepła i energie odnawialne**, świnoujście, S. Pietruszko
- [Con36] **Seminarium „Redukcja Kosztów”**, Boczkowo k/Leszna, J. Pogorzelska