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Department of Microelectronics Faculty of Electrical Engineering Czech Technical University in Prague Czech Republic

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Edited by Pavel Kulha (March 2008)

FOREWORD

The Department of Microelectronics belongs to The Faculty of Electrical Engineering (FEE) that is one of the six faculties forming the Czech Technical University in Prague (CTU in Prague). The roots of CTU in Prague can be followed as far back as the year 1705, when Christian Josef Willenberg (1655 - 1731) wrote a letter to Emperor Leopold I. in Vienna seeking permission to begin public teaching of engineering sciences. This was granted by a decree of Emperor Josef I (successor to Leopold I.) on 18 January 1707. For these reasons, the priority of CTU to be the first technical school at university level in the world is usually claimed for.

The Department of Microelectronics has been established in January 1977. During the past 28 years more than 1000 students graduated in the branch of Microelectronics and nearly 50 Ph.D and 5 DrSc. degrees have been awarded. Five persons from the Department staff became professors and 14 Associate Professors. The Department offers the B.Sc., M.Sc. and Ph.D. degrees in Electronics.

The Department maintains international co-operation with many universities, research laboratories, and institutes in the Europe. This is in connection with the LEONARDO and SOCRATES Programmes, EUROPRACTICE projects, the NATO Science for Peace programme, and the Framework Programmes of the European Community.

The Department gives a high priority to collaborative research with industry. The donation from Cadence is being used to continue the education of IC design at industrial level. Several domestic electronic factories were supported by R&D works from the Department this year.

This brochure is the 17th annual review of our Department. The content of this report emphasises our effort for continuing the close association of teaching, research and co-operation with external subjects at both national and international levels.

Prague February 2008 Pavel Kulha Editor

STAFF OF THE DEPARTMENT

Head of the Department:	M. Husák, M.Sc., Ph.D.
Deputy:	J. Foit, M.Sc., Ph.D.
Professors	M Husák M Sc. Ph D
1101035013.	I Kodeš M Sc. Ph D. DrSc.
	(Emeritus Professor)
	L Vohecký M Sc. Ph D. DrSc
	J . V 000000Ky, 141.50., 141.20., D150.
Associate Professors:	Z. Burian, M.Sc., Ph.D.
	J. Foit, M.Sc., Ph.D.
	P. Hazdra, MSc., Ph.D.
	M. Šemberová, M.Sc., Ph.D.
	V. Třeštíková, M.Sc., Ph.D.
	F. Vaníček, M.Sc., Ph.D.
	J. Voves, M.Sc., Ph.D.
Assistant Professors:	A. Bouřa, M.Sc.
	J. Jakovenko, M.Sc., Ph.D.
	V. Janíček, M.Sc.
	V. Jeřábek, M.Sc., PhD.
	L. Jirásek, M.Sc., Ph.D.
	P. Kulha, M.Sc.
	V. Komarnickij, M.Sc. (PhD 2007)
	A. Krejčiřík, M.Sc., Ph.D.
	J. Novák, M.Sc. PhD
	V. Prajzler, M.Sc. (PhD 2007)
	V. Záhlava, M.Sc., Ph.D.
Ph.D. students:	J. A. Arciniega, M.Sc.
	J. Baloun, M.Sc.
	K. Frýd M.Sc.
	J. Kroutil, M.Sc.
	Miloslav Kubař, M.Sc.
	A. Laposa, M.Sc.
	P. Suchánek, M.Sc.
	R.Taragel, M.Sc.
	T. Teplý, M.Sc.
	T. Třebický, M.Sc.
	T. Vítek, M.Sc. (Part-time res. fellow)
	P. Vrchota M.Sc.

SUPPORT STAFF

Department Secretary	H. Kubátová
Administration	R. Burianová
Teaching Laboratories:	L. Kafka
Technical Service:	M. Horník

ABOUT THE STAFF



Miroslav Husák was born in Kladno in 1953. He graduated in Radioengineering branch from FEE-CTU in Prague in 1978. Ph.D. in 1985, Assoc. Professor in 1997, Full Professor in 2000. Manager of Microsystems Group. Author or co-author 6 lecture notes and more than 240 scientific and technical papers. Research in the field of microsytems and integrated sensor systems. Teaching the Sensor systems, Sensors in Electronics. courses Biomedical Sensors, Power Suppliers in Electronics, Electronic Security Systems and Microsystems. Supervizor of Electronics branch (Master and Ph.D. study).







Jiří Kodeš was born in 1932. He received MSc., Ph.D., and D.Sc. degrees in electronics, semiconductor physics and microelectronics from the CTU in Prague in 1956, 1963 and 1990, resp. At present, he is Full Professor at the Department. His area of research includes electronic transport in semiconductors and quantum electronics devices. He is the author or co-author of numerous technical papers in journals and conference proceedings. He has written several textbooks for students.

Jan Vobecký - born 1957, Prague. MSc. (1981) and Ph.D. (1988) from FEE-CTU, Assoc. Professor 1992, DrSc. 1999, Full Professor 2000. Visiting fellow: University of Uppsala (1988, 1989-90), MOTOROLA Toulouse (1993). Author and reviewer of numerous scientific papers, 2 patents, 1 textbook, 9 printed lectures. Education: Electronics, TCAD, Modern Power Devices. Research: Power devices & ICs, Si technology. Scientific Board: FEE-CTU in Prague, Academy of Sciences. Senior Member IEEE. Vice Chairmen CS Section IEEE.

Zdeněk Burian was born in 1944. He graduated from the FEE-CTU in 1966. In 1975 he received PhD. degree. He is the author of 35 technical papers, 10 printed lectures and he owns 7 technical inventions. He is Assoc. Professor and gives lectures on optoelectronics. He is working in the field of optical sensors, integrated optics and planar optical waveguides. He researched the optical waveguides in silica in University of York, U.K.. Member of EOS and Czech Society of Photonics.



Julius Foit was born in 1932. He received MSc., PhD. and Ass. Prof. degrees in Radar Engineering, Colour TV Eng. and Multiphase Signal Processing from the CTU in Prague in 1954, 1961 and 1978, resp.. Dean of the Faculty in the University of Maiduguri, Nigeria in 1987-1989 and B. Tech. Programme Coordinator in the University of Zimbabwe, Harare, in 1990-1993. Currently, he is Associate Professor in the Dept. He is the author of many papers, several monographs and textbooks for students. He is a Fellow of ZIE and Past-President of Rotary Int.



Pavel Hazdra was born in 1960. M.Sc. and Ph.D. in Microelectronics from FEE-CTU (1984, 1991), Assistant (1987) and Associate (1996) Professor, Vice Dean of the FEE CTU (2006-7). In 1988, 1992, and 1993 4 visiting fellow at the University of Surrey, Hull, and Lund, resp. Research on defects in semiconductors, quantum structures and their characterization. Manager of the Electron Device Group. More than 180 scientific and technical papers, 2 patents and printed lectures. SM IEEE and vice chairman of the IEEE MTT/AP/ED Chapter in the Czech Republic.





Miroslava Šemberová was born in 1939. She graduated in Radioelectronics from the FEE-CTU in Prague, in 1961. She received PhD. degree in 1973 and Associate Professorship in 1985. She is author of 12 technical papers and 10 printed lectures. She was giving lectures in the area of electronic and microelectronic components. She was involved in research program concerning MOS integrated circuits and, at present, she is interested in sensors.

Vladimíra Třeštíková was born in 1943. She graduated in Automation technique from the FEE CTU in Prague, in 1965. She received PhD. degree in 1980 and became Associate Professor in 1985. She is presently teaching Electronic and Microelectronic Devices. She is the author of 5 printed lectures and 12 technical papers. She was involved in research program concerning MOS integrated circuit technology and, at present, she is interested in sensors.



František Vaníček was born in 1936. He graduated in Radioelectronics from the FEE-CTU in Prague, in 1960. PhD. in 1972 and Assoc. Professorship in 1978. From 1972 to 1975 he gave lectures in MTC Kahira, Egypt, and from 1981 to 1983 in HIE Beni Walid, Lybia. He is the author of 15 techn. papers and 10 printed lectures. He is teaching in the area of semiconductor structures and their models. The winter term of 1992 and 1993 he spent in KIHWV Ostende in the frame of TEMPUS programme.



Jan Voves was born in Prague in 1960. MSc. and RNDr. degree in Physical Electronics and Optics from the Charles' University in Prague in 1984. Since 1984, Research Assistant in the Department (characterisation of ion implanted doping profiles in semiconductors). From 1987 and 1996, Assistant and Assoc. Professor, resp. Ph.D in 1993. Research in the device physical modelling (Monte Carlo Method). Author of about 30 technical papers and 3 printed lectures. Member of the IEEE.



Jiří Jakovenko born 1972, Prague. He graduated in Microelectronics from FEE-CTU, Ph.D. from FEE-CTU in 2004. Member of Microsystems group. Research: MEMS design and modeling. In 1998 he spent 4 months in Hogeschool Gent in the frame of TEMPUS programme. Author of many scientific and technical papers. Since 1999 Assistant Professor at the Dept. Education: Microelectronics, IC Design, Design of VLSI, Practice of IC design, Electronics.



Vladimír Janíček was born in 1974 in Most. He graduated in Microelectronics from the FEE-CTU in Prague and he belongs to the Microsystems group. His Ph.D. research is in the field of polymer electronics power supply. At present, he is IT manager of the Department



Vítězslav Jeřábek born 1951. 1975: MSc. from FEE-CTU in Prague. 1987: PhD. in Optoelectronics. 1976-91: TESLA Research Institute, Prague. 1981: Optoelectronics Division, dynamics and modelling of optoelectronics devices & broad band optoelectronic modules. 1991-98: Head R&D lab. Dattel Ltd. - integr. optoelectronics modules and systems. teaching technology Since 1999: of optics and optoelectronics components and systems for transmission and processing of information. Author of 35 technical papers, 2 printed lectures and 3 patents, Member IEEE, Committee member of IEE in the Czech Republic.



Lubor Jirásek was born in Prague in 1953. He graduated from the FEE CTU in Prague, in 1978. He received PhD. degree in Electronics in 1983. From 1978 to 1983 he was working as a Research Fellow in the area of high-power devices. He is author of 7 technical papers and 3 printed lectures. He is teaching in the area of semiconductor devices and solid-state physics. Presently, he is responsible for the curriculum of the Department.



Vladimir Komarnitskij was born in Ukraine in 1980. In 2002, he graduated Chernivtsy National University, Ukraine, from the specialization physics electronics. He received Ph.D. degree in Electronics from FEE-CTU in 2006. He is currently working as a postdoc in the Electron Device Group. His research is in the field of radiation defects in semiconductors and characterization of quantum structures.



Alexandr Krejčiřík was born in 1947. He graduated in Electrotechnology from the Faculty of Electrical Engineering, CTU in Prague, in 1971. He received PhD. degree Mathematics and Physics in _ branch Semiconductors. He is the author of 10 technical papers, 21 printed lectures and 12 textbooks. He is teaching courses on Electronics, Power supplies in Electronics and Design of Power Supplies.



Pavel Kulha was born in Písek in 1978. He graduated in Microelectronic from the FEE-CTU in 2002. He is working towards hid PhD in the Microsystem group. He is working as assistant professor since September 2004. His work is concentrated on microsensors and microsystems for high temperature applications.



Jan Novák was born in Prague in 1973. He graduated in Microelectronics from FEE-CTU, Ph.D. from FEE-CTU in 2006. Member of Microsystems group. Research: Electromagnetic compatibility of integrated circuits and microsystems. Since 2001 he is an Assistant Professor at the Department. He is teaching Electronics, PCB Design and IC Design. He is finance manager of the Department.



Václav Prajzler was born in Prague, the Czech Republic in April 10th 1976. In 2001 he graduated from the Faculty of Electrical Engineering at the Czech Technical University in Prague at Department of Microelectronics. Since 2005 he has been working at the Czech Technical University in Prague, Faculty of Electrical Engineering, Department of Microelectronics as a research fellow. In 2007 he obtained the PhD degree from the same university. His current research is focused on fabrication and investigation of the properties of optical materials doped with rare earth ions with special focus on semiconductor and polymeric materials.



Vít Záhlava was born in Prague in 1965. He graduated in Microelectronics from the FEE-CTU in 1988. Ph.D. degree in 1994. He is teaching Electronics and PCB design. Active in EMC on PCB, design, application and testing. He is a member of the Academic Senate of the Faculty. He is the author of 4 textbooks, several printed lectures for students, and technical papers on power devices.



Adam Bouřa Adam Bouřa was born in Ostrava in 1980. He graduated in Microelectronics from the FEE-CTU in Prague in 2004. Since 2004 he is a PhD student at the Department of Microelectronic and member of the Microsystems group. His work is concentrated on wireless sensor systems. Since January 2005 to February 2006 he was part-time research fellow and since February 2006 he is an assistant professor at the Department. He is teaching Electronics, Electronic Devices and Structures, Sensors for Electronic and Sensors for Medicine.



Julio Armas was born in Ecuador in 1973. In 2000, he graduated in Electronics and telecomunications from the ESCUELA POLITECNICA NACIONAL in Quito, Ecuador. He is currently working as a PhD student in the Optoelectronics group. His work is concentrated on the fabrication and simulation of Microwave Optoelectronics Transmitters and Receivers.



Jiří Baloun was born in Humpolec in 1982. He graduated in Microelectronics from the CTU-FEE in Prague in 2007. Since 2007 he is a PhD student at the Department of Microelectronic. He is a member of the Microsystems group.



Roman Jackiv was born in Ukraine in 1980. In 2002, he graduated from Chernivtcy National University, Ukraine, in specialization "Alternative Power Energy". The theme of his magister work was "High Temperature Annealing of CdTe Crystals Doped by Chlorine." He is working towards his Ph.D. in Electron Device Group. His work is Experimental and Theoretical Study of Resonant Tunneling Diodes.



Jiří Kroutil was born in Tábor in 1980. He graduated in Microelectronics from the CTU-FEE in Prague in 2005. Since 2005 he is a PhD student at the Department of Microelectronic. He is a member of the Microsystems group. His work is focused on inteligent microsystem structures.



Miloslav KUBAŘ was born in 1981. He gets his MSc. degree in electronics from Czech Technical University (CTU), Prague, in 2007. He worked with STMicroelectronics in 2006 as analog IC designer. He is currently working toward Ph.D. in microsensor signal processing at CTU and is also working with Asicentrum s.r.o. as IC designer.



Alexandr Laposa was born in Pardubice in 1978. He graduated in Automation and Computer Science from Faculty of Mechanical Engineering from Brno University of Technology. He is working towards his Ph.D. in Microsystems Group. His work is concentrated on inteligent microsystem structures.



Pavel Suchánek was born in in Přerov in 1979. He graduated in Microelectronics from the FEE-CTU in Prague. He is working towards his PhD in the Microsystem group. His work is concentrated on the design of electronic devices for polymer electronics. Since October 2005 he is part-time research fellow at the Department.



Tomáš Teplý was born in Chrudim in 1979. He graduated in Microelectronics from the FEE-CTU in Prague in 2005. He is working towards his PhD in the Microsystems group. His work is concentrated on simulation and optimization of microsystems. Since October 2005 he is part-time research fellow at the Department.



Tomáš Třebický was born in Žatec in 1980. He graduated in Microelectronics from the FEE-CTU in Prague in 2004. He is working towards his Ph.D. in the Electron Device Group. His work is concetrated on the simulation of quantum devices.



Tomáš Vítek was born in Opava in 1980. He graduated in Microelectronics from the FEE-CTU in Prague in 2005. Since March 2005 he is a PhD student at the Department of Microelectronic. He is a member of the Microsystems group. His work is focused on microsystems and security systems. Since October 2005 he is part-time research fellow in the Department.



Hana Kubátová was born in Český Brod in 1941. She graduated from Secondary Business School in 1958. She joined the Department of Microelectronics in 1977. Since that she has been in charge of organisational and administrative work of the Department, mainly as the Departments secretary. At present, she is the Secretary of the Head of the Department.



Renáta Burianová was born in Prague in 1960. She graduated from grammar school in 1979 and Secondary school for librarians in 1981. She joined the Department of Microelectronics in September, 1981. From that time she has been in charge of administrative work of the Department.



Lubomír Kafka was born in 1943. He attended the grammar school from 1958 to 1961. From 1961 to 1963 he studied the secondary school on "Mechanic of electronic equipments". In 1965 he joined the CTU in Prague as a technician. At present, he is working as a technician in the Department. He is responsible for teaching laboratories. He is engaged in mechanical and electronic service.



Miroslav Horník was born in Prague in 1946. He graduated in 1966 at a Secondary school specialized in Machinery engineering in Prague. He joined CTU Prague, then the Institute of Physics, Czechoslovak Academy of Science and, nowadays, he is working in the Department as a technician. He provides repair and service of miscellaneous tools and equipments.

UNDERGRADUATE TEACHING

Organization of study at the Faculty of Electrical Engineering



BRANCH OF STUDY ELECTRONICS

The objective of the electronic branch of study is to educate electrical engineers competent to solve problems concerning the wide spectrum of the structure of electrical industry and also extending to the field of information and computing technology, ecology, health care, mechanical engineering, robotics, etc.

The study involves the necessary theoretical introduction into subjects that provide general education for an electrical engineer which is followed by specialized courses. As to specialized orientation, the stress is laid on electronic components, semiconductor structures, digital and analog electronic circuits, microelectronics, application specific integrated circuit design, microcomputers, signals and electronic systems, sensors, sensor systems, design of electronic equipment, integrated and coherent optics, radiation sources and detectors, applications of optoelectronics and telecommunication systems. The study of the applied electronic structures and systems aims to prepare engineers who are able to solve problems of the applications of integrated circuits and of the special electronic structures and systems, as well as the electronic instrumentation design. The students master the digital signal processing methods and the implementation of algorithms in the special processor systems.

The optional subjects in the higher terms provide the students an opportunity of individual choice of their further specialization emphasizing the applications of electronics and optoelectronics.

The topics of lectures, laboratory and seminar exercises have been selected so that a student can master the reported stuff perfectly also in practice. The Department of Microelectronics endeavors to give the students, especially those with excellent results, the possibility of satisfying their professional ambition home, as well as abroad. The graduates are also offered a possibility of further postgraduate (Ph.D) studies. We believe that the graduates of our specialization will find good jobs in the industry of developed countries.

COURSES DELIVERED BY THE DEPARTMENT In summer semester 2006/2007

Courses in Czech – new curriculum

Course Code	Course Name	Lectures and exercises in hours per week
X34APS	Applications of Modern Devices	2+2
X34BAP	Bachelor Project	0+5
X34BPJ	Semestral Project	2+2
X34ELE	Electronics	2+2
X34ESS	Electronic Devices and Structures	2+2
X34FOT	Photonics	2+2
X34NZE	Design of Power Supplies for Electronics	2+2
X34PMT	Team Project	0+4
X34PPN	Principles and Rules of electronic design	1+2
X34SEE	Sensors in Electronics	2+2
X34SIE	Synthesis of integrated electrical circuits	2+2
X34SOS	Devices for optoelectronics	2+2
X34TCA	TCAD	2+2

Course in Czech – old curriculum

Course Code	Course Name	Lectures and exercises in hours per week
34APS	Applications of Modern Devices	2+2
34BP	Bachelor Project	0+4
34DP	Diploma Project	0+14
34DS	Diploma Seminar	0+4
34EL	Electronics	2+2
34EZS	Electronic Security Systems	2+2
34LBR	Practices in Laboratories of Electronics	0+4
34MPS	Device Interconnection Techniques	1+3
34NNZ	Design of Power Supplies	2+2
34NSE	New Trends in Electronics	3+2
34NVL	Design of VLSI Circuits	2+2
34PRS	Programable Devices	2+2
34SEM	Semestral Project	0+4
34SP	Semestral Project	0+4
34TCE	TCAD for Electronics	2+2

Courses in English

Course Code	Course Name	Lectures and exercises in hours per week
XE34APS	Applications of Modern Devices	2+2
XE34ESS	Electronic Devices and Structures	2+2
XE34NZE	Design of Power Supplies for Electronics	2+2
XE34SIE	Synthesis of integrated electrical circuits	2+2
XE34TCA	TCAD	2+2

Courses for Ph.D. students

Course Code	Course Name	Lectures and exercises in hours per week
XP34APD	Modern Power Semiconductor Devices	3+0
XP34AT	Application of TCAD tools	2+1
XP34MSY	Microsystems	3+0
XP34ORD	Radiation Sources and Detectors	3+0
XP34SRS	Semiconductor Radiation Sources	3+0
XP34TOS	Technology of Optoelectronic Structures	3+0

Courses for vocational students

Course Code	Course Name	Lectures and exercises in hours per week
D34SP	Semestral Project	0+4
XD34BAP	Bachelor Project	0+15
XD34ELE	Electronics	14+6
XD34ESS	Electronic Devices and Structures	14+6
XD34FOT	Photonics	14+6

COURSES DELIVERED BY THE DEPARTMENT In winter semester 2007/2008

Courses in Czech – new curriculum

Course Code	Course Name	Lectures and exercises in hours per week
X34APS	Applications of Modern Devices	2+2
X34AVS	Application of Power Semiconductor Devices	2+2
X34BAP	Bachelor Project	2+2
X34BMS	Biomedical Sensors	2+2
X34BPJ	Semestral Project	2+2
X34ELE	Electronics	2+2
X34EPO	Physics of Semiconductor Devices	2+2
X34ESS	Electronic Devices and Structures	2+2
X34EZS	Electronic Security Systems	2+2
X34FOT	Photonics	2+2
X34FPV	Photonic Receivers and Transmitters	2+2
X34MIT	Microcomputer Systems	2+2
X34MPC	Microcomputers	1+2
X34NFS	Design of Photonic Devices	2+2
X34NII	Design of Integrated Circuits	2+2
X34NIO	Design of Integrated Circuits	2+2
X34NNZ	Design of Power Supplies	2+1
X34NOS	Design of Optoelectronic Devices	2+2
X34NZE	Design of Power Supplies for electronics	2+2
X34PFO	Practice of Photonics	0+4
X34PMI	Individual Project	0+4
X34PMT	Team Project	0+4
X34POP	Practice of Optoelectronics	0+4
X34PPN	Principles and Rules of Electronic Design	1+2
X34SEE	Sensors in Electronics	2+2
X34SES	Sensor Systems	2+2
X34SIE	Synthesis of Integrated Electrical Circuits	2+2
X34SIF	Devices of Integrated and Fibre Optics	K 2+2
X34SIO	Structures of Integrated Circuits	2+2
X34SOS	Devices for Optoelectronics	2+2
X34TCA	TCAD	2+2

Course Code	Course Name	Lectures and exercises in hours per week
34APS	Applications of Modern Devices	2+2
34AVS	Application of Power Semiconductor Devices	2+2
34BP	Bachelor Project	0+4
34DP	Diploma Project	0+14
34DS	Diploma Seminar	0+4
34EZS	Electronic Security Systems	2+2
34LBR	Practices in Laboratories of Electronics	0+4
34MIK	Microelectronics	2+2
34MPS	Device interconnection Techniques	1+3
34NNZ	Design of Power Supplies	2+2
34NSE	New Trends in Electronics	3+2
34NVL	Design of VLSI Circuits	2+2
34OP2	Optoelectronics II.	3+2
34PN	Practice of IC Design	1+3
34POP	Practice of Optoelectronics	0+4
34PRS	Programable Devices	2+2
34SEM	Semestral Project	0+4
34SP	Semestral Project	0+4
34TCE	TCAD for Electronics	2+2
34ZZD	Radiation Sources and Detectors	2+2

Courses in Czech – old curriculum

Courses in English

Course Code	Course Name	Lectures and exercises in hours per week
XE34APS	Applications of Modern Devices	2+2
XE34ELE	Electronics	2+2
XE34EPO	Physics of Semiconductor Devices	2+2
XE34ESS	Electronic Devices and Structures	2+2
XE34NZE	Design of Power Supplies for electronics	2+2
XE34SIE	Synthesis of Integrated Electrical Circuits	2+2
XE34SIO	Structures of Integrated Circuits	2+2
XE34TCA	TCAD	2+2

Courses for Ph.D. students

Course Code	Course Name	Lectures and exercises in hours per week
XP34APD	Modern Power Semiconductor Devices	3+0
XP34AT	Application of TCAD tools	2+1
XP34CNO	Crystal optics and Non-linear Optics	3+0
XP34ETS	Electrical Transport in Semiconductors	2+2
XP34IO	Integrated Optics	3+0
XP34MSY	Microsystems	3+0
XP34ORD	Radiation Sources and Detectors	3+0
XP34PED	Advanced Electronic Devices	3+0
XP34PIC	Design of Programmable Integrated Circuits	4+0
XP34SRS	Semiconductor Radiation Sources	3+0
XP34STV	Structures and Technology of VLSI	4+0
XP34TOS	Technology for Optoelectronics	3+0

Courses for vocational srudents

Course Code	Course Name	Lectures and exercises in hours per week
D34SP	Semester Project	0+4
XD34BAP	Bachelor Project	
XD34BPJ	Semestral Project	14+6
XD34ELE	Electronics	14+6
XD34ESS	Electronic Devices and Structures	14+6
XD34FOT	Photonics	14+6

A BRIEF DESCRIPTION OF COURSES DELIVERED BY THE DEPARTMENT

Electronics, **BSc**

Lectures given by J. Foit and J. Vobecký

Semiconductors. PN junction, diodes, Schottky diode. Rectifiers. Bipolar transistors, biasing circuits. JFET and MOSFET, biasing circuits. Small signal amplifier, power amplifier. Switching circuits. Power amplifier classes. Thyristor, latch-up. Operational Amplifiers – negative and positive feedback, basic circuits. Optoelectronics – LED, laser, photodiode, phototransistor, photoresistor. Introduction to digital technique – CMOS, LSTTL.

Electronic Devices and Structures, BSc

Lectures given by L. Jirásek

Diodes, unipolar and bipolar transistors, switching, optoelectronic and passive components, vacuum tubes. Physical mechanisms, principles of device operation, properties, characteristics, parameters and models of devices. Basic circuits, recommended applications, switching operation. Noise parameters. Basic structures of integrated circuits. Computer modeling and experimental verification.

Power Supplies in Electronics, BSc

Lectures given by M. Husák

Rectifiers. Stabilisers - parametric, with continuous control. IC voltage regulators. Fly-back converter. Forward converter. Push-pull converter, double forward converter. Monolithic regulators. EMC. Over current protection. Over voltage, under voltage, output reverse voltage protection. Overload and thermal protection. Batteries, solar battery, accumulator, chargers. References.

Microcomputers, BSc

Lectures given by T. Teplý

Microchip PIC18F252 family. I/O tasks, programmable peripheral ICs. Development and debugging tools. Design and programming of instruments and systems based on single-chip computers. Individual students' projects.

Photonics, **BSc**

Lectures given by Z. Burian, V.Jeřábek, M.Klíma, K. Novotný

The major aim of these lectures is to explain the principles and using of the main parts of modern optical systems, both from the theoretical and application point of view. Measurement methods for optoelectronics are presented. The part of lectures is devoted to optical display structures, optical processors and to the image processing.

Microelectronics, BSc

Lectures given by J. Jakovenko

Basic functional structures of ICs. Passive and active elements. Technological process. Bipolar and unipolar structures. Logic integrated circuits, VLSI circuit systems. Analogue integrated circuits. Design of vertical structure, layout, design rules. System of IC process quality control. IC functional and parametric testing, test structures, yield and reliability.

Sensor Systems, BSc

Lectures given by M. Husák

Sensor - classification, materials, production. General characteristics - static and dynamic parameters, errors, noise, linearisation, calibration. Microelectronic sensors materials, physical principles, design, integration. Temperature sensors, pressure sensors, SAW sensors, optoelectronic sensors, fibre optic sensors. Radiation sensors. Magnetosensors. Chemical sensors, biosensors. Humidity sensors. Flow meters. Level sensors. Sensor signals processing. Smart sensors. Application of sensors.

Physics of Semiconductor Devices, MSc

Lectures given by J. Voves

Semiconductor crystal lattices, band structure of semiconductors, statistical distributions, charge transport, scattering mechanisms, non-equilibrium carrier densities, non-homogeneous semiconductor systems, heterostructures, physics of bipolar and unipolar devices, semiconductor sources and detectors of radiation, laser physics, low dimensional structures.

Design of Integrated Circuits, MSc

Lectures given by J. Jakovenko

Importance of ICs. Economic aspects of IC. Design methodologies: gate arrays, standard cells and functional blocks, full custom design. Design hierarchy: behavioural description, logic and electric design, simulation, layout capture and verification. CAD tools for IC design: HDL, front end tools, simulators, layout editors, structural synthesis, silicon compilers. IC testing.

Sensors in Security Systems, MSc

Lectures given by M. Husák

Security, safety and multi-channel systems. Dynamic analysis and optimisation. Signal interference and system internal noise. Input quantities. Analog and digital signal processing, conversions. Signal representation and sensor signal code. System calibration. Communication in system, interface. Output unit communication, indication, registration, protection, switch, local and remote control, actuators.

Application of Power Devices, MSc

Lectures given by L. Jirásek

Static and dynamic processes of power structures in forward, blocking and reverse mode of operation. Power diodes, BJTs, thyristors and special thyristor structures, field controlled power devices, HF and HV devices, power ICs, characteristics and features. Packaging and cooling, transient thermal impedance. Principles of application in power circuits, basic trigger and application circuits.

Practice of IC Design I, MSc

Lectures given by J. Jakovenko

Main purpose of this course is to enable students to design their own integrated circuit. Students will work in groups (of 5 to 10 students) on the design project using industrial standard CAD tools (CADENCE, SYNOPSYS). Successful circuits could be fabricated via EUROPRACTICE project. The lectures will be concentrated in the first three weeks of the term and will be devoted to IC design methodologies, CAD tools, description of available libraries and design rules.

Advanced Semiconductor Technologies, MSc

Lectures given by J. Jakovenko

Electrical characteristics of processed materials. Bulk crystal growth. Oxidation. Lithography. Doping. Etching. Chemical vapour deposition. Physical vapour deposition. Ion implantation. Packaging. VLSI Processes. Microsystems. Cleanliness and purity in the process environmental.

Applications of Modern Devices, MSc

Lectures given by J. Foit

Analog devices, optimisation. Interference of different types of signal transmission, optimisation. Rules for optimisation of large arrays, power distribution, interfacing. Mixed-mode devices. Diagnostics in ADC's and DAC's, minimising residual errors. Standards for interface buses, sensors, actuators, ergonomics. Processing of small and large signals, noise, insulation.

Design of Power Supplies, MSc.

Lectures given by A. Krejčiřík

This represents extension of the subject "Power Supplies in Electronics". The main field comprises Integrated circuits for SMPS (principles, design, verification.) Coils, transformers, regulators, synchronous rectifiers, resonance power supplies. Switcher CAD. Magnetic design Tool. Filter CAD. MicroPower Switcher CAD.

TCAD for Electronics

Lectures given by J. Vobecký

Principles of Technology CAD – Silvaco tools. Introduction to the ATLAS device simulator. Drift-diffusion approximation. Poisson and continuity equations. SRH model. Models of Auger, optical generation-recombination and surface recombination, impact ionization and mobility. Heat flow equation. Boundary conditions. Boltzmann transport equation. Mathematical background of simulation techniques. The practice of device simulation: diode, BJT, MOSFET. Individual projects. Hands-on principle of seminars.

Device Interconnection Techniques

Lectures given by V. Záhlava

Computer design of printed circuit boards (PCB). System OrCAD. Design rules for PCB according to EMC in analog, digital and power applications. Supply and grounding techniques. Technological processes and fabrication of PCB, classes of accuracy. Surface mount technology and devices, circuit layout process and soldering. Technological and design trends. Design of student PCB by use of PC in departments computer room.

Synthesis of Integrated Electronic Systems, MSc Lectures given by P. Hazdra

Introduction to basic building blocks, architecture and design methodologies of advanced VLSI systems. Structure and design of digital and analogue integrated circuit subsystems. Integrated system description and synthesis using cell libraries and IP cores. Synchronization, power consumption and parasitics reduction issues. Testing and reliability of integrated systems. In seminars and labs, the hardware description language VHDL will be explained and used for practical design, synthesis and testing of a system on chip.

Programmable Logic Devices, BSc., MSc.

Lectures given by P. Hazdra

Programmable logic devices (PLD): types, principles, internal architecture, and production technologies. SPLDs (PAL, GAL, PLA), CPLD devices and field programmable gate arrays (FPGA): architecture of internal elements, interconnections, development systems, configuration and reconfiguration. Configurable Systems on Chip. PLD design using VHSIC HDL (VHDL): synthesis, mapping and testing. Practical design of CPLD and FPGA using Xilinx ISE.

Microsystems

Lectures given by M.Husak

Fundamental definitions and characteristics of microsystems. Microsensors and microactuators - basic principles of operation, structures and materials. Intelligent microsystems, design, simulations and modelling, data processing in microsystems. Microactuator functions, structures and behaviours. individual principles of microsystems, electrical, magnetic, thermal, optic (MOEMS), mechanical (MEMS), chemical and biochemical principles and combinations

(MOES, MEMOS). Microsystem technologies. Microsystems applications in medicine and industry

Design of CMOS and BiCMOS Circuits, MSc

Lectures given by J. Jakovenko

Trends in CMOS and BiCMOS technologies. Parameters of basic structures. Modeling and simulation. Parasitic structures. Design rules, layout design. CMOS and BiCMOS logic gates. Standard CMOS and BiCMOS ICs families. CMOS and EECMOS memories. PLDs, FPGAs. Analogue CMOS and BiCMOS circuits. Switched-capacitor and switched-current techniques, MOST-C filters. Comparators, operational amplifiers, OTAs.

Photonics Practise

Lectures given by Z.Burian, A.Jančárek (FJFI)

The aim of the subject is to give the basic practical laboratory experience in the field of optical radiation behaviour and properties, measurement of the optical sources and detector properties and fundamentals of optical transfer of information.

Optoelectronics Practise

Lectures given by Z.Burian and A.Jančárek (FJFI)

The subject treats the basic practical laboratory experience in the field of the optical radiation sources and detectors measurement and the principles of the optical transfer information processing.

Integrated and Fibre Photonics Components

Lectures given by V.Jeřábek

The subject studies principles of the devices important for different optoelectronic systems. The devices are studied from the point of view of the operation principles, as well as of the application possibilities. The main stress is placed on the devices for optical communication an for the sensor application. Some measuring methods are treated, too.

Structures for Optoelectronics Systems

Lectures given by V.Jeřábek and Z.Burian

The aim of the subject is to explain principles of the devices important for different optical communication, sensors measurement application. The methods of the application of the devices and methods of their properties measurement are treated, too.

Photonics Receivers and Transmitters

Lectures given by Z.Burian

The subject introduces application properties of the radiation sources and detectors. Injection lasers of all types, optical amplifiers and detectors are treated in details. Their application properties in the field of optical communication and optical sensors are studied.

Photonics Component and Circuit Design

Lectures given by Z.Burian and V.Jeřábek

The lectures enable to get the practical experiences for the design and system application of important photonic components.

Optoelectronics Component and Circuit Design

Lectures given by Z.Burian and V.Jeřábek

The lectures enable to get the practical experiences for the design and system application of important optoelectronics components.

COURSES FOR VOCATIONAL STUDENTS (IN CZECH)

Elektronika

Lectures given by J. Foit

Compulsory course for all undergraduate students, delivered in the second semester. Deals with the necessary basic physics, electronic device internal structures, principles of operation and basic applications, including engineering calculation methods. In addition to the single-crystal semiconductor devices, principles and basic applications of polycrystalline as well as vacuum and plasma devices are mentioned briefly as well.

COURSES FOR PhD. STUDENTS (IN CZECH)

Applications of TCAD Tools

Lectures given by J. Voves

Fundamentals of TCAD. Device and mixed device-circuit simulators, principles and application. ATLAS, principles and application. Semiconductor equations. Boundary conditions. Numerical methods. Models of recombination, impact ionization, mobility. Practical exercises according to individual projects on SUN workstations.

Crystaloptics and Non-linear Optics

Lectures given by J. Čtyroký

Optical medium type classification. Single- and double-axis optical anisotropy. Chiral media. Propagation of planar waves, polarisation, phase and group velocity vectors. Energy balance and reciprocity. Reflection and refraction. Electro-optical and piezoelectric tensors. Theory and design of beam handling devices.

Programmable IC Design

Lectures given by P. Hazdra

IC's, reasons for integration, processes and methods of IC design. Custom IC's, programmable IC's. PICs with AND-OR matrices (PLD). Higher grade PLD-CPLD structures; architecture, logical blocks, interconnections. Programmable gate arrays (PGA) - principles, internal architecture. LCA-type PGA, "fine grain" structures. Tools for automated PIC design. Description of the PIC by a schematic diagram. The VHDL language for CPLD and PGA. Design of basic

logic blocks in CPLD and PGA structures. Methods of PIC design, distribution to blocks. Data paths analysis, timing, testability. Advanced PICs: re-configurable and mixed-mode structures. PIC choice strategy and economics of PIC-based design.

Integrated Optics

Lectures given by V. Jeřábek

Theoretical and technological principles of IO. Light propagation in dielectric waveguide structures. Methods of waveguide structures solution. Basic physical effects and interactions used for IO structures. Fabrication of dielectric waveguides and IO structures. Passive and dynamic waveguide devices. Non-linear devices. Semiconductor integrated optoelectronics.

Optical Radiation Detection and Detectors

Lectures given by Z. Burian

Electromagnetic radiation spectrum. Radiometric and photometric units. Detection of optical radiation. Ideal detector, internal and external photo-effect. Optical receivers, design principles, properties. Noise. Detectors based on external or internal photo-effect, on thermal phenomena and others. Solar cells, properties.

Advanced Electron Devices

Lectures given by J. Voves

Energy band engineering, quantum well, wire, point. 2-D electron gas devices (HEMT, MOD FET) and double-barrier resonance tunneling (RDTB, RHET) as memories, generators, multipliers etc. Heterostructures, microwave and cryotronic devices. Recording media.

Advanced Power Semiconductor Devices and ICs

Lectures given by J. Vobecký

Physical and technological principles of advanced power devices. Trends of evolution. Parameters and applications of advanced devices. Bipolar structures. MOS structures. BiMOS structures. PN diodes. Schottky diodes. BJT transistors. DMOS and IGBT transistors. Thyristors, including GTO and MCT. Secondary breakdown theory and design rules. Smart-power devices. High voltage devices, applications.

Semiconductor Radiation Sources

Lectures given by Z. Burian

Stimulated emission in semiconductors, Homogeneous junction and heterojunction. Double heterostructure lasers. Waveguide resonators, DFB structures. Types and properties of lasers. Bistable and memory devices, switches. Non-coherent LEDs. Super-LEDs. Laser injection amplifiers. Applications and measurement of various types.

COURSES DELIVERED IN ENGLISH

Electronics

Lectures given by J. Foit

Compulsory course for all undergraduate students, delivered in the second semester. Deals with the necessary basic physics, electronic device internal structures, principles of operation and basic applications, including engineering calculation methods. In addition to the single-crystal semiconductor devices, principles and basic applications of polycrystalline as well as vacuum and plasma devices are mentioned briefly as well.

Application of modern electronic devices

Lectures given by J. Foit

A course for M.Sc. grade students, broadening and deepening their knowledge of significant details of the internal structures of electronic devices, especially monolithic integrated devices, targeted at the optimization of performance of high-grade, high-accuracy electronic circuits and systems, using analog, digital and mixed signals.

Technology of Optoelectronic Structures

Lectures given by V. Jeřábek

Preparation of optoelectronic materials and structures, diagnostic and testing methods. Fabrication of semiconductor waveguides, LEDs, lasers, photodetectors and QW structures. Design and fabrication of planar dielectric waveguide structures for distribution and harnessing of optical radiation. Measuring and testing methods. Properties of various structures, practical examples.

VLSI Structures and Technologies

Lectures given by J. Jakovenko

Functional structures of integrated circuits, unipolar and BiMOS structures. 3D structures, submicron technologies. Problems associated with dimensional reduction. Memory cells. Test structures. VLSI processes. New technologies. IC design, layout, design rules. Reliability and yield. Limitations in ICs.

Electrical Transport in Semiconductors

Lectures given by J. Voves

Electrons and holes in semiconductor crystals. Boltzmann transport equation, scattering. High field transport. Quantum transport, resonant tunneling. Single electron transport, Coulomb blockade. Ballistic transport. Transport in magnetic field, quantum Hall effect.

RESEARCH ACTIVITIES

The Department has continued in research activities through grants and contracts from the Ministry of Education of the Czech Republic, Grant Agency of the Czech Republic, and CTU in Prague. A significant part of research activities was supported by the Programmes of the Ministry of Education in the following fields in alphabetical order:

- Development, Reliability and Safety of Electro-Energetic Systems,
- Information and Communication Technology,
- Methods and Systems for Measurement of Physical Quantities and Data Processing,
- Trans-Disciplinary Biomedical Engineering Research.

The international projects were those of the Framework Programmes of the European Community.

In the field of research contracts the co-operation with Texas Institue of Science, Cadence, ST Microelectronics.

The research activities of the Department are focused on Electron Devices, Optoelectronics and Microsystems as listed below in the order of their date of origin. These three directions constitute the organization scheme of research in our Department and are schematically shown below. This scheme is supplemented by a brief summary of activities of individual research groups and list of their members. This is followed by the description of relevant research projects of individual research groups. The list of contracts is given as well.



MICROSYSTEMS GROUP

Head of the Research Group: M. Husák

Members: J. Foit, J. Jakovenko, V. Janíček, L. Jirásek, P. Kulha, J. Novák, A. Bouřa, P. Suchánek, T. Vítek, T. Teplý, A. Laposa, J. Kroutil, K. Frýd, P. Vrchota

Research Activities:

- Modeling of Temperature and Mechanical Behaviour of Microsystem Structures
- Design of Strain Gauge Sensors for High-Temperature
- Diamod structures for sensors
- Structure of SAW chemical sensor
- Semiconductor Microsystem Structures
- Sensor Signals Processing and Wireless Transmission
- Sensors with ZigBee and Bluetooth standards
- Sensor Control Systems
- Integrated Circuit Design

ELECTRON DEVICE GROUP

Head of the Research Group: P. Hazdra

Members: J. Vobecký, J. Voves, V. Záhlava, J. Kodeš, V. Komarnickij D. Kolesnikov, M. Atef Elsayed Abdelaal, T. Třebický.

Research Activities:

- Quantum Devices and Nanostructures
- Device and Process Simulation
- Lifetime and Defect Engineering
- Ion Irradiation
- Power Devices and Integrated Circuits
- Current Injection Capability of Microcontroller Units
- Programmable Logic Devices
- PCB Design and EMC

OPTOELECTRONICS GROUP

Head of the Research Group: V. Jeřábek

Members: Z. Burian, V. Prajzler, K. Bušek, J. A. Arciniega

Research Activities:

- Preparation and Testing of Planar Waveguides
- Analysis, Preparation and Testing of Novel Planar Electro-Optic Structures for Distribution and Harnessing of Optical Radiation
- Analysis, Preparation and Testing of Novel Devices and Integrated Planar Electro-Optic Structures for Transmitting and Receiving of Opt. Radiation
- Modeling of Electro-Optic Structures
- Research toward the Integrated Optic Circuits for Measurement and Sensor Applications

RESEARCH PROJECTS

MICROSYSTEMS GROUP

THE APPLICATION OF POLYMER ELECTRONICS TOWARDS AMBIENT INTELLIGENCE

M. Husák, V. Janíček, J. Jakovenko, P. Kulha, J. Novák

Project support: under European Commission's 6th Framework Program Nr. 507143 **POLYAPPLY**

PolyApply aims to lay the foundations of a scalable and ubiquitously applicable communication technology. The boundary condition is the cost of the micro system, combining basic RF communication with sensor functions. The key to achieving a fundamentally different cost structure than what the evolution of existing technologies (e.g. CMOS) can achieve is to resolutely move to a disruptive new manufacturing technology: going from batch processing to inline manufacturing technology. The semiconductor system envisaged for this end is based on polymers. Scalability refers to PolyApply's plan to develop generic technologies with a meaningful impact in the mid- to long term, rather than propose a solution for a certain generation of RF communication devices useful at one point in time. In other words, the developed technologies will lead to an extendable family of products, ranging from "simple" RF tags at ultra-low cost to RF communication devices with complex capability, such as integrated re-writable memory, sensory inputs, display, etc...

TOP AMPLIFIER RESEARCH GROUPS IN A EUROPEAN TEAM M. Husák, V. Janíček, J. Jakovenko, P. Kulha, J. Novák

Project support: under European Commission's 6th Framework Program Nr.507893 **TARGET**

The aim of TARGET is to overcome the current fragmentation of European research in the field of microwave power amplifiers for broadband wireless access by creating a progressive and durable integration of research capacities of the network partners. The scientific fields of TARGET - amplifier and microwave research - are central for broadband wireless access in a mobile information society. There is pressing need to develop power stage circuits and design criteria to attain the highest performances, both in terms of amplifier efficiency and linearity.

MICRO AND NANO SENSOR STRUCTURES AND SYSTEMS WITH EMBEDDED INTELLIGENCE (MINASES) Project leader: M. Husák

Grant No. GA102/06/1624.

The goal of the proposed project is research and development of new types of intelligent integrated micro and nano sensors structures and actuators incl. electronic circuits for data signal processing and transfer. For the sensor realization will be used micro technology resources together with nano-technologies namely in the area of materials and chemical sensors and biosensors structures. Project includes modelling, properties simulation of RF MEMS switch and MEMS structure for absorptive sensor of HF emission realization, development of active integrated strain gauges and wireless, Bluetooth and ZigBee data signal transfer, development of sensors using polymeric electronic, research of new opto-chemical sensors for pollutant concentration measurement of living environment, development of micro and nano sensors for chemical and biochemical applications, build-in intelligence of integrated sensors systems, electro-magnetic compatibility in integrated circuits structures and bio-systems.

FAST RF MEMS MICROWAVE SIGNAL SWITCH J. Jakovenko, M. Husák

Project support: Grant Agency of the Czech Republic, No. 102/06/1624

The aim is the development of a fast MEMS structure of a microwave signal switch in a suitable MEMS technology, utilizing nano-properties of materials to improve the device parameters. The mechanical and thermal properties of the structure will be verified in the development, models will be created, with equivalent electrical parameters, mechanical models of the structure will be used as inputs for simulations in the CoventorWare program.

RF SENSOR MICRO- AND NANO-STRUCTURE FOR MEASUREMENT OF MICROWAVE RADIATION ABSORPTION.

J. Jakovenko

Project support: Grant Agency of the Czech Republic, No. 102/06/1624

The aim of this work is the design, simulation and optimization of a micromechanical structure and thermal as well as mechanical distribution of a thermal transducer of a RF microsensor capable to measure high-frequency power up to the millimeter waves region. The expected power range is 0 to 6 mW with 1 μ W resolution threshold. Creation of models for the CoventorWare program, verification of congruity of the models with the real sensor.

SENSOR SYSTEM WITH ACTIVE INTEGRATED STRAIN GAUGE. P. Kulha, M. Husák

Project support: Grant Agency of the Czech Republic, No. 102/06/1624

The aim of the project is the development of a sensor system for measurement of deformations at high temperatures, with evaluating and transmitting circuits for contactless transmission of the sensor data. Creation of models of the mechanical and electrical behavior of the strain gauge, characterization of prepared strain gauge samples.

INTEGRATED SENSOR STRUCTURES WITH WIRELESS DATA TRANSMISSION.

A. Bouřa, M. Husák

Project support: Grant Agency of the Czech Republic, No. 102/06/1624

The aim of this project is the development of sensor structures with selfcontained smartness and transmitting section, in order to minimize the power supply demand of the sensor section. the principles are to be implemented in the development of a sensor system for velocity and pressure measurement.

POLYMER ELECTRONIC STRUCTURES AND THEIR APPLICATIONS IN SENSORS.

V. Janíček, P. Suchánek, M. Husák

Project support: Grant Agency of the Czech Republic, No. 102/06/1624

The aim of the project is the design, development, simulation and optimization of the properties of basic electronic structures and of a multilayer pressure sensor built in the polymer technology. The creation of models of the mechanical and thermal behavior of the structure, their application in the CoventorWare simulator. Comparison of models fit to prepared samples.

EFFECTS OF INTEGRATED CIRCUIT ARCHITECTURES ON BIOLOGICAL ENVIRONMENT.

J. Novák, J. Foit

Project support: Grant Agency of the Czech Republic, No. 102/06/1624

The aim of the research and development is the minimization of risks (of unwanted interaction) between the architecture of microelectronic devices and systems, and the biological environment. The output will be methods, procedures and design rules for prediction of behavior of integrated devices designed for operation in direct contact with biological systems.

ELECTRON DEVICE GROUP

CHARACTERIZATION AND SIMULATION OF ELECTRONIC STATES IN MOVPE GROWN InAs/GaAs QUANTUM DOTS P. Hazdra , M. Atef, V. Komarnitskyy , J. Oswald*, K. Kuldová*, A. Hospodková*, E. Hulicius* and J. Pangrác*

*Institute of Physics, The Academy of Sciences, Prague Project support: the grant No. 202/06/0718 of the Grant Agency of the Czech Republic, Research Programme MSM 6840770014 - Ministry of Education, Youth and Sports of the Czech Republic

The aim of the project was to use extensive simulations of electronic states in InAs QDs structures to analyze photoluminescence (PL) data received on different QD structures grown by low-pressure metalorganic vapor phase epitaxy in a RAS LayTec equipped AIXTRON 200 reactor. The structures were first characterised by AFM using NTEGRA Prima system from NT-MTD and subsequently PL of the QDs was measured at 300 K. Then the simulation model of QD structures for Nextnano³ simulator was developed and further used for analysis of the effect of QD dimensions on electronic transitions in QDs.

AFM results showed that uncovered LP-MOVPE grown QD structures are formed by elliptical lens shaped QDs which exhibit a good uniformity and relatively high average density of 1×10^{10} cm⁻². QDs have an elongated basis in the [-110] direction 24.4±8.8 nm while their width along [110] axis is 9.5 ± 3.5 nm and height scatters around 4.1 ± 0.5 nm. To be embedded into devices, QDs must be overgrown by a GaAs/InGaAs cap. This unfortunately modifies not only the QDs band structure, but also their size and uniformity. To interpret AFM and optical data, a 3D model of a lens shaped QD embedded in GaAs was proposed and subsequently used for analyzing the effect of increasing capping layer (CL) thickness which causes blue shift of the emitted wavelength from QDs. Simulation revealed that this is due to the strain in the QD which grows with increasing CL thickness. Increasing hydrostatic strain in the QD modifies its band structure and compresses electron and light-hole wave functions into the volume of the dot (especially in the direction of the growth). As a result, the quantum states in the dot lift up. The magnitude of the blue shift given by the GaAs covering can reach up to 136 meV what was in a good agreement with results of PL measurement.

RADIATION DEFECTS AND THERMAL DONORS INTRODUCED IN SILICON BY HYDROGEN AND HELIUM IMPLANTATION AND SUBSEQUENT ANNEALING

P. Hazdra, V. V. Komarnickij

Project support: Research Centre LC06041 and Research Programme MSM 6840770014 - Ministry of Education, Youth and Sports of the Czech Republic

Long range of light (hydrogen or helium) ions enables to locally modify electronic properties of silicon devices in their full depth. Within this project, we systematically investigated effects of hydrogen and helium implantation on generation of radiation defects, hydrogen and thermal donors in the low doped FZ *n*-type silicon. Samples were implanted into the depth of 40 µm with 7 MeV ${}^{4}\text{He}^{2+}$ or 1.8 MeV ${}^{1}\text{H}^{+}$ with fluences ranging from 8×10^{8} to 1×10^{12} cm⁻² and 1.4×10^{10} to 6×10^{12} cm⁻², resp., and then isochronally annealed for 30 minutes in the temperature range up to 550°C. Deep and shallow levels produced by irradiation and subsequent annealing were studied by DLTS and C-V profiling. Results show that radiation damage produced by helium ions remarkably enhances formation of thermal donors (TDs) when annealing temperature exceeds 375°C, i.e. when the majority of vacancy-related recombination centers anneals out. The excess concentration of TDs is proportional to the helium fluence and peaks at $1.6 \times 10^{14} \text{ cm}^{-3}$ if annealing temperature reaches 475°C . Proton irradiation itself introduces hydrogen donors (HDs) which form a Gaussian peak at the proton end-of-range. Formation and annealing of shallow and deep hydrogen-related levels are strongly influenced by electric field at annealing temperatures below 175°C. If annealing temperature exceeds 350°C, HDs disappear and the excessive shallow doping is caused, as in the case of helium irradiation, by radiation enhanced TDs.

OPTOELECTRONICS GROUP

NEW COMPONENTS OF THE INTEGRATED OPTICS MADE BY THE PLANAR HYBRID TECHNOLOGY

Project leader: V. Jeřábek

Grant. No. GA102/06/0424

The planar photonic hybrid integrated circuits (FHIO) are the structures, which are in the current situation of quick development of the informatics and Internet very promising means for increasing the functionality of optical information systems. The subject of the research should be the processing of the theoretical model of the structure between the optoelectronic element and the channel waveguide, technology design and the implementation of the integrated structure of FHIO, which consists of the channel optical waveguide, the classical siliconbased and polymeric thin layers, and the optoelectronic element integrated on one substrate together with the optical waveguide. By the type of the integrated optoelectronic element-laser chip SS-LD(spot-size converter laser diode), (spot-size waveguide photodiode WGPD and/or SS-SOA converter semiconductor amplifier) we would obtain optoelectronic transmitter, receiver or amplifier.

RESEARCH GRANTS AND CONTRACTS

The Application of Polymer Electronics Towards Ambient Intelligence (POLYAPPLY) Grant Nr.507143, 6th Frame programme Project Manager (Czech republic): **M. Husák**

Top Amplifier Research Groups in a European Team (TARGET) Grant Nr.507893, 6th Frame programme Project Manager (Czech republic): **M. Husák**

Modern methods of solving, design and applications of electronic circuits. Grant No. 102/04/H105, Grant Agency of the Czech Republic Project Manager: Z. Kolka (VUT in Brno) (Dept. of Microelectronics: **M. Husák**)

Research, development and optimization of measuring systems and measurement uncertainty estimation by their application Grant No. 102/05/H032 Grant Agency of the Czech Republic Project Manager: V. Haasz (FEE CTU in Prague) (Dept. of Microelectronics: **M. Husák**)

Micro- and nano-sensor structures and systems with embedded intelligence (MINASES)

Grant no. 102/06/1624, Grant Agency of the Czech Republic Project Manager: **M. Husák**

Trans-Disciplinary Biomedical Engineering Research Research Programme no. MSM 6840770012, Ministry of Education Project Manager: Konvičková (Faculty of Mechanical Eng., CTU in Prague) (Dept. of Microelectronics: **M. Husák**)

Research of Methods and Systems for Measurement of Physical Quantities and Measured Data Processing Research Programme no. MSM 6840770015, Ministry of Education Project Manager: V. Haasz (Dept. of Measurements, FEE- CTU in Prague) (Dept. of Microelectronics: **M. Husák**) Engineering of Quantum Dots Grant no. GACR 202/06/0718, Grant Agency of the Czech Republic Project Manager: **P. Hazdra**

Characterization and simulation of power diodes Freescale Semiconducteurs France S.A.S., Toulouse Project Manager: **P. Hazdra**

Current Injection Capability Investigation of Microcontroller Units Freescale Semiconductors UK, East Kilbride Project Manager: **P. Hazdra**

Structures for spintronics and quantum phenomena created by electron beam lithography Project leader: **J. Voves** Grant No. KAN400100652

Spintronic applications of ferromagnetic semiconductor nanostructures Project leader: **J. Voves** Grant No. GA102/06/0381

Optical 3D-DVD Memory Media based on New Photochromatic Polymers Project leader: **V. Záhlava** Grant No. 1ET310330507

Synthesis of novel defects in silicon by ion irradiation for future application in semiconductor technology Project leader: V. Komarnitskyy GAČR grant *No*. 102/08/P488

EDUCATIONAL GRANTS AND CONTRACTS

Innovation of Subjects in structured study with Focus on Microprocesors and Biomedical Sensors The Ministry of Education, Project of the University Development Fund No. FRVS 2302/2007 Project Manager: M. Husák

PUBLICATIONS

BOOKS (IN ENGLISH)

Foit, J., Vobecký, J., Záhlava, V.: *Electronics - laboratory measurements*. 101 str., 172 obr., Vyd. ČVUT, Praha 2007 ISBN 978-80-01-03182-7

JOURNALS (SCI & SCI EXPANDED)

Hazdra, P. - Komarnitskyy, V.: Local Lifetime Control in Silicon Power Diode by Ion Irradiation: Introduction and Stability of Shallow Donors. *IET Circuits, Devices & Systems*. 2007, vol. 1, no. 5, p. 321-326. ISSN 1751-858X.

Vobecký, J. - Hazdra, P.: Radiation-Enhanced Diffusion of Palladium for a Local Lifetime Control in Power Devices. *IEEE Transactions on Electron Devices*. 2007, vol. 54, no. 6, p. 1521-1526. ISSN 0018-9383.

JOURNALS (IN ENGLISH)

El-Sayed Abd-Elaal, M. - Hazdra, P. - Komarnitskyy, V. - Oswald, J. - Kuldová, K. - et al.: Study of InAs/GaAs quantum dots grown by LP-MOVPE. *Acta Metallurgica Slovaca Spec.Issue*. 2007, vol. 13, no. 5-9, p. 99-104. ISSN 1335-1532.

Jakovenko, J. - Husák, M. - Lalinsky, T.L. - Drzik, M.D.: Micromechanical GaAs Hot Plates for Gas Sensors. *Sensors and Transducers* [online]. 2007, vol. 2007, no. 10, p. 84-92. Internet: www.sensorsportal.com. ISSN 1726-5479.

Jakovenko, J. - Husák, M. - Lalinsky, T.L.: Design and Characterization of MEMS Thermal Converter. *Sensors and Transducers* [online]. 2007, vol. 2007, no. 10, p. 101-110. Internet: www.sensorsportal.com. ISSN 1726-5479.

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Barri, Dalibor	OTA-C filter design and optimization using evolutionary algorithms	
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Brom, Petr	Semiautomatic Bender Machine	
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Chládek, Martin	A design of electronic circuits based on evolutionary algorithms	
Čurda, Jan	Autozero Operational Amplifier	
Autozero Operational Amplifier	DRM Radio Receiver	
Hlaváč, Ondřej	Construction of Measure System of Optical Losses for Planar Waveguides	
Hugec, Stanislav	Power Class D Audioamplifier - Kit for Function Demo and Simulation	
Janoška, Zdenko	Car Tracking Using GPS	
Jebas, Martin	Functional generator with counter	
Kašpar, Jiří	Sensor data transfer using ZigBee	
Kubař, Miloslav	A-D converter	
Matys, Jan	Switched-Current filters based on integrators	
Měsíček, Vladimír	The Battery Testing and Charging Station	
Metter, Josef	Measurement of optical field distribution in channel optical waveguides	
Myslík, Martin	Measurement of optical properties of polymer layers	
Oberreiter, Petr	Smart Thermostat with Wireless Sensor Communication	
Šimůnek, Zdeněk	Intelligent Switched Power Supply	
Skalský, Miloš	ESD Protection for Integrated Circuits	
Skočný, Martin	Modern Portable Electronic Welder Operating at 100kHz-200kHz	
Stanislav, Libor	Electronic Vario	
Starý, Richard	Analogue wave fiter design	
Taragel', Roman	Remote Monitoring of Gas Boiler Operation	
Vágner, Petr	Machine-controlled system for management of liquid samples in optical sensors with surface plasmons	
Vala, Josef	Parameter Measurement of the Power IGBTs	
Vrána, Leoš	Testing of CoolMOS transistor	
Zralíková, Vladimíra	Comparison of Speech Processing Strategies for Cochlear Implants Nucleus 24	

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Defended Bachelor Works

Adamec, Michal	Smart Sensor Net	
Barda, Lukáš	Intelligent Home - Data Sensor System (Pick-up and Processing)	
Blecha, Jiří	Tester of the Solenoid Injectors Common Rail	
Burian, Lukáš	Nabíječka NiMH článků se zamezením přebíjení pro zvýšení životnosti článků	
Csík, Ondrej	Laboratory Power Supply for Electolytic Surface Metal Cleaning and Metal Plating.	
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Heger, Michal	Design of the board with microcontroller MICROCHIP	
Heřman, Pavel	PCB Manufacturing	
Hladílek, David	Design of Wirelles Data Transfer	
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Horáček, Jan	Amplifier with Variable Amplification	
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