Łukasiewicz – Institute of Microelectronics and Photonics

Product and service overview

Łukasiewicz
Institute of Microelectronics
and Photonics

Contents

About us

Łukasiewicz Research Network 03

Mission, vision, values and activity range of Łukasiewicz Network 04

Challenges of Łukasiewicz 05

Łukasiewicz – Institute of Microelectronics and Photonics 06

Products and service 08

Products and offer

Photonic Materials 13

Functional Materials 17

Graphene and Composites 20

Characterization of Materials and Devices 23

Integrated Circuits and Systems Design 25

Infrared Photonics 28

Silicon Technology and Sensor Systems 31

GaN-based Devices, Sensors, Thin-film Structures and Porous Materials 33

LTCC Technology and Printed Electronics 38

Testing and Certification Center – PREDOM 42

Łukasiewicz Research Network

We are the third largest research network in Europe
and R&D leader in Central and Eastern Europe
We integrate 32 research and development institutes

We are a modern research institution
We have 440 R&D laboratories

We have specialized research equipment
3762 units, including 497 unique in Poland

The best people work for us
Łukasiewicz employs nearly 4500 research, engineering and technical staff

Mission, vision, values and activity of Łukasiewicz Network

mission

Creative people who create with passion innovative solutions for the development of Polish companies and society

vision

Dynamic network organization creating innovative solutions applied in key economy sectors

values

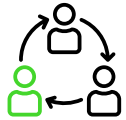
PASSION + CREATIVITY + DEVOTION + RETAILITY + COOPERATION

activity range

- Sustainable Economy and Energy
- Digital Transformation
- Smart Clean Mobility
- Health

Łukasiewicz Challenges

in 15 days we provide you with a solution to a technical problem you face – free of charge



Cascading Your Challenge
Our Institutes' experts start working on a solution for You

Internal Project Panel
Experts developing solutions experts select the best ideas

We sign a contract
We proceed to implement the project on mutually agreed terms

up to 5 days | up to 10 days | up to 2-3 weeks | SUCCESS

We analyze Your needs
You will find the form:
www.lukasiewicz.gov.pl/biznes/

We are building a database of recommended solutions
We map the necessary R&D resources of the entire Łukasiewicz

Meeting with the client
We present our best solutions

Łukasiewicz – Institute of Microelectronics and Photonics

Łukasiewicz – Institute of Microelectronics and Photonics has a history of more than 50 years in R&D.
As of April 2019, it is part of the Łukasiewicz Research Network.

Łukasiewicz
Institute of Microelectronics and Photonics

Our scientists conduct research and development works in the fields of micro- and nano-electronics, materials engineering, optoelectronics and nanophotonics, microwave electronics, power electronics, transparent and flexible electronics. We implement the results of these works in products and services to provide them with an added value, our aim is to actively acquire industrial partners towards long-term collaboration.

The scope of the Institute's operations includes in particular:

- design and development towards modern micro- and opto-electronic solid-state devices, including: microwave and photonic discrete elements, detectors and sensors, integrated circuits microsystems and electronic subassemblies, microelectronic hybrid systems power devices, diffraction elements
- development of methods for the design of micro- and optoelectronic solid-state devices, and development of new methods for characterization materials, structures and solid-state devices;
- technologies for the production of new materials, such as, silicon carbide, epitaxial graphene, flake graphene, ceramic-metal composites, advanced ceramics, as well as testing their properties for industrial use;
- standardization, certification and approval activities.

Łukasiewicz – Institute of Microelectronics and Photonics

The research at the Institute is organized around technology lines for:,

- optoelectronic assemblies
- silicon assemblies
- wide band gap semiconductor assemblies
- low temperature co-fired ceramics (LTCC)

These state-of-the-art lines enable the scientific community to participate in an applied research, and entrepreneurs to develop new products and services.

Łukasiewicz – Institute of Microelectronics and Photonics

Products and services

Łukasiewicz
Institute of Microelectronics
and Photonics

Photonic Materials

Research Group Leader
Ryszard Buczyński, Prof., Ph.D., D.Sc.

activity

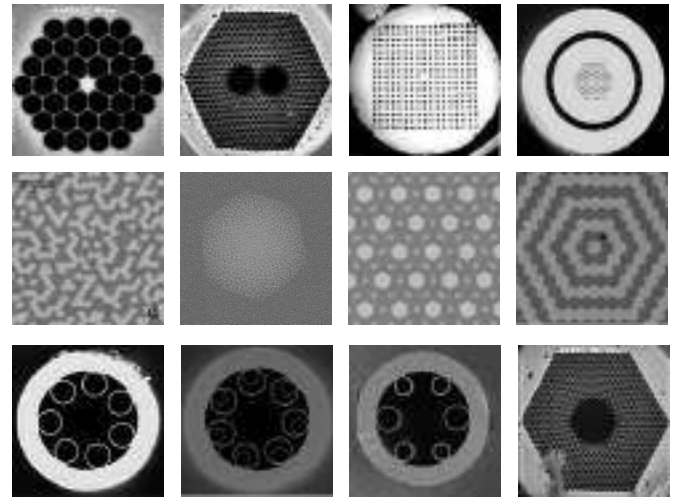
The research activities of Photonic Materials Research Group include the development and characterization of special optical fibers, micro-optical components, transparent and bioactive ceramics and special glasses. The area of application and practical use of developed components comprises micro-fluidic systems for sensing or biomedicine, all-fiber systems for lasing, beam delivery or telecomunications, biocompatible ceramics for medical treatment.

TECHNOLOGICAL OFFER – OPTICAL FIBERS

Research Group offers design, fabrication and characterization of optical fibers. Three drawing towers are equipped with high temperature furnaces allowing for drawing optical fibers made of fused silica glasses, as well as other multicomponent glasses with moderate and low melting temperatures.

We offer customized and special optical fibers:

- **Photonic Crystal Fibers**, including standard mesh made with air holes or all-solid structures for nonlinear applications,
- **Nanostructured fibers**, free-form fibers with shaped properties (dispersion, birefringence, photosensitivity, mode shape and modal characteristics, ect.) for various applications including material processing, Bragg grating inscription, all-fiber laser systems
- **Anti-resonant optical fibers**, for low-latency communication, low-loss transmission up to 5µm, delivering high power and energy pulses, and for liquid and gas sensors



TECHNOLOGICAL OFFER – TRANSPARENT CERAMICS, CERAMIC FOR LASERS

Research Group also deals with the engineering of ceramic materials and ceramic composites. A number of technologies for the production of the materials have been developed, including transparent ceramics with special transmission and luminescent properties, including yttrium-aluminum garnet doped with rare earth ions and transition metals, as well as spinel and yttrium ceramics. These types of ceramics are in demand for defense purposes and compact laser systems.

Photonic Materials

Research Group Leader
Ryszard Buczyński, Prof., Ph.D., D.Sc.

TECHNOLOGICAL OFFER – NANOSTRUCTURED MICRO-OPTICS

The unique **nanostructuring** technology developed by the Research Group allows to obtain free-form structures with any refractive index distribution and unique properties.

We offer following **nanostructured micro-optical components**:

- **Nanostructured graded-index lenses – separate GRIN lens or lens attached to the optical fiber** tip for coupling light from/into optical fiber, laser ablation, applications in opto-fluidics systems, i.e. for optical micro-manipulators (moving elements of few μm size with use of focused light beam without direct contact) (Fig. 1)
- **Axicon lens** – for generation of ring-shaped beam useful for laser processing of materials and tissues (eye surgery), for generation of non-difractive Bessel beams and for optical trapping (Fig.2).
- **Phase mask** – for generation of optical vortices used in metrology of turbulent media and in microscopy in highly scattering media, optical manipulators (optical tweezers and optical spanners), for measuring forces in the microscale (Fig.3)
- **Lens matrices or phase mask matrices** – for high-resolution three-dimensional (3D) imaging (Fig. 4), and Shack-Hartmann detector used in astronomy for wave front analysis and in metrology for shape analysis

Fig. 1

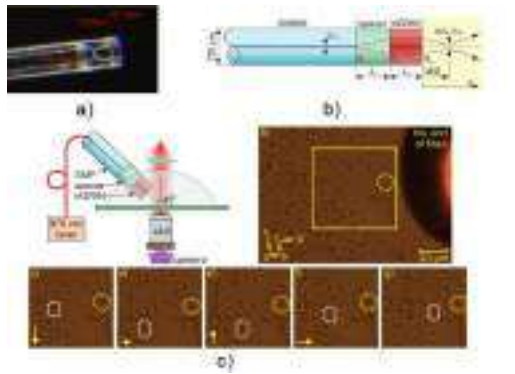


Fig. 2

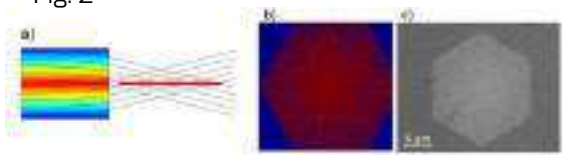


Fig. 3

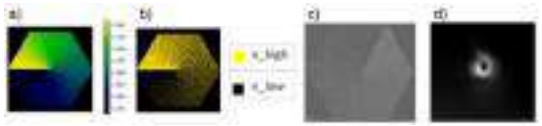
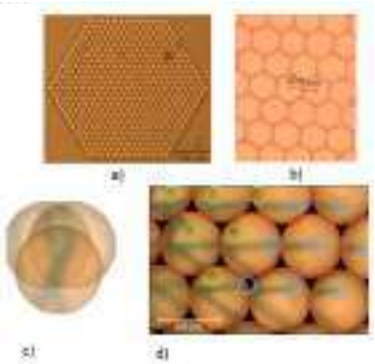


Fig.4



Photonic Materials

Research Group Leader
Ryszard Buczyński, Prof., Ph.D., D.Sc.

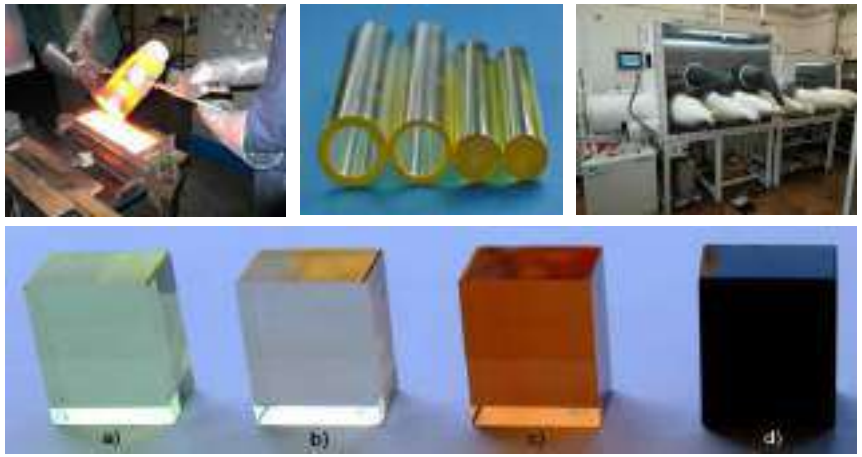
TECHNOLOGICAL OFFER – GLASS SYNTHESIS

The B1 IMIF team has over 40 years of experience in development and synthesis of various types of multicomponent glasses including:

- Fluoride – transmission up to 8µm, RE doping, mid-IR appications
- Tellurite – transmission up to 6µm, extrusion, mid-IR applications, S.C. generation
- Phosphate – transmission up to 2.5µm, RE doping, high power fiber lases, bio applications
- Multicomponent silicates – borosilicates and lead silicates, transmission up to 2.8µm, fibers with complex internal structure (design, RI contrast and distribution)
- Filter glass for different spectral ranges

Ready glasses are avaiable in form of blocks, tubes, plates according to required application. Depending on the glass type single synthesis batch is from 50g to 2000g.

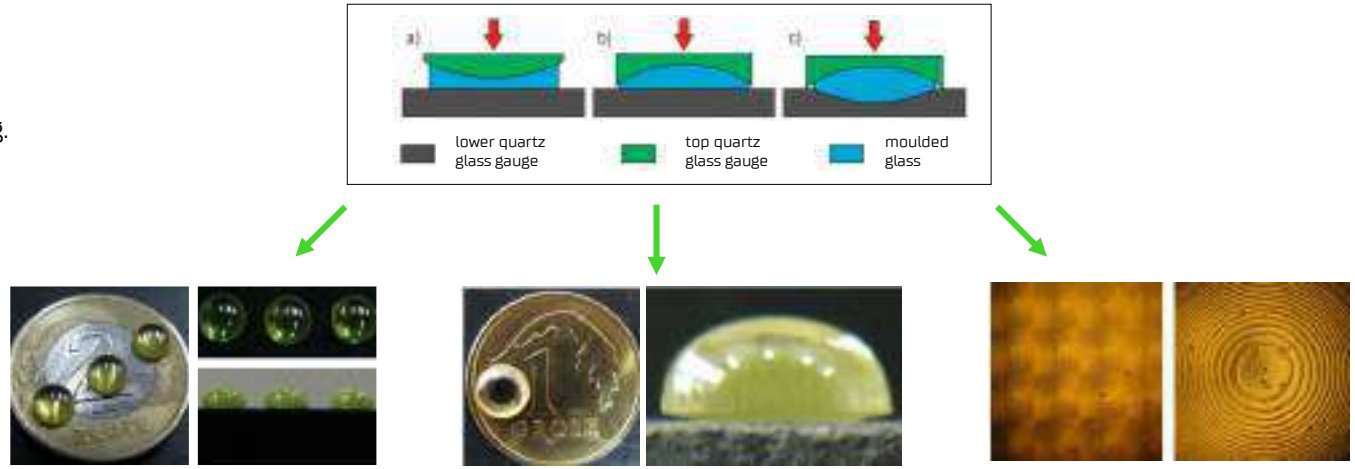
For all above glasses we offer mechanical processing including cutting, rounding, grinding and polishing.



TECHNOLOGICAL OFFER – HOT EMBOSSING

The HOT EMBOSSING (glass molding) – forming the glass substrates in elevated temperatures to desired shape i.e. refractive and diffractive lenses, diffraction grating.

- Cost-effetive method, no need for mechanical machining
- Ability to introduce continous manufacturing
- Ability to chose different glass according to requirements (lead-free, mid-IR)
- Technology intended for small series production and customized solutions



Photonic Materials – gallery

Functional materials

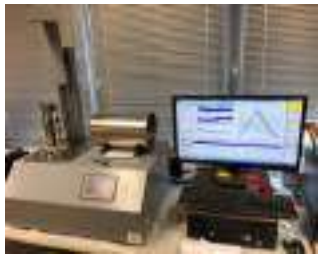
Research Group Leader
Anna Kozłowska, Ph.D., D.Sc.

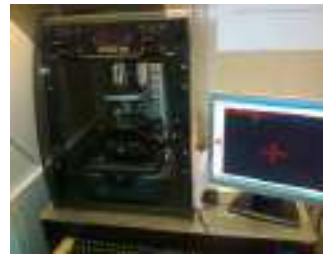
activity

The Functional Materials Group responds to challenges of a modern industry by designing and developing materials with new, unique properties through an interdisciplinary approach, advanced equipment (thin-film technology, 3D printing, SPS materials sintering, HIP and Vacuum Sintering) and versatile material analysis (optical, electric, heat transfer, photocatalysis and mechanical research). The team consists of people with passion, whose ambitions contribute to scientific growth and are focused on specific applications (including thermoelectric materials and composite coatings within the Sustainable Economy field, cancer diagnostics materials within the Health field, sensors and solar cells in packages for intelligent and clean mobility).

SERVICE OFFER

- Manufacturing of ceramic, metallic and dielectric thin-films
- Design and material research of sensors and white light sources
- Advanced materials sintering technology, including metalic, ceramic, composite, semiconductor materials using of powder metallurgy techniques (Spark Plasma Sintering, Hot Isostatic Pressing, Vacuum Sintering)
- Photolithography
- Technological attemps of manufacturing materials and thermoelectric modules intended for „thermal to electrical" energy conversion
- Heat treating, annealing in an inert, oxidizing or reducing atmosphere
- Precise montage of equipment and subassemblies
- Manufacturing of metallic elements (steel, aluminium and alloys, titanium and alloys) with 3D printing (Selective Laser Melting)
- A complex analysis of thermal properties of single- and multiphase materials, including measuremens of thermal conductivity, thermal expansion and specific heat capacity, also in elevated temperature conditions
- 2D and 3D measurements of surfaces with profilometer
- Examination of material properties, including optical, photomectric, electrical, tribological, photocatalytic, mechanical, exploitation properties (e.g. theramal shock resistance)
- Mechanical treatment of materials, along with hard-machinable materials, including precision cutting, grinding and polishing



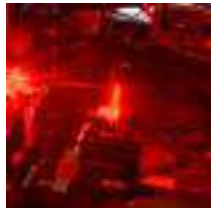


Functional materials

Research Group Leader
Anna Kozłowska, Ph.D., D.Sc.

PRODUCT OFFER

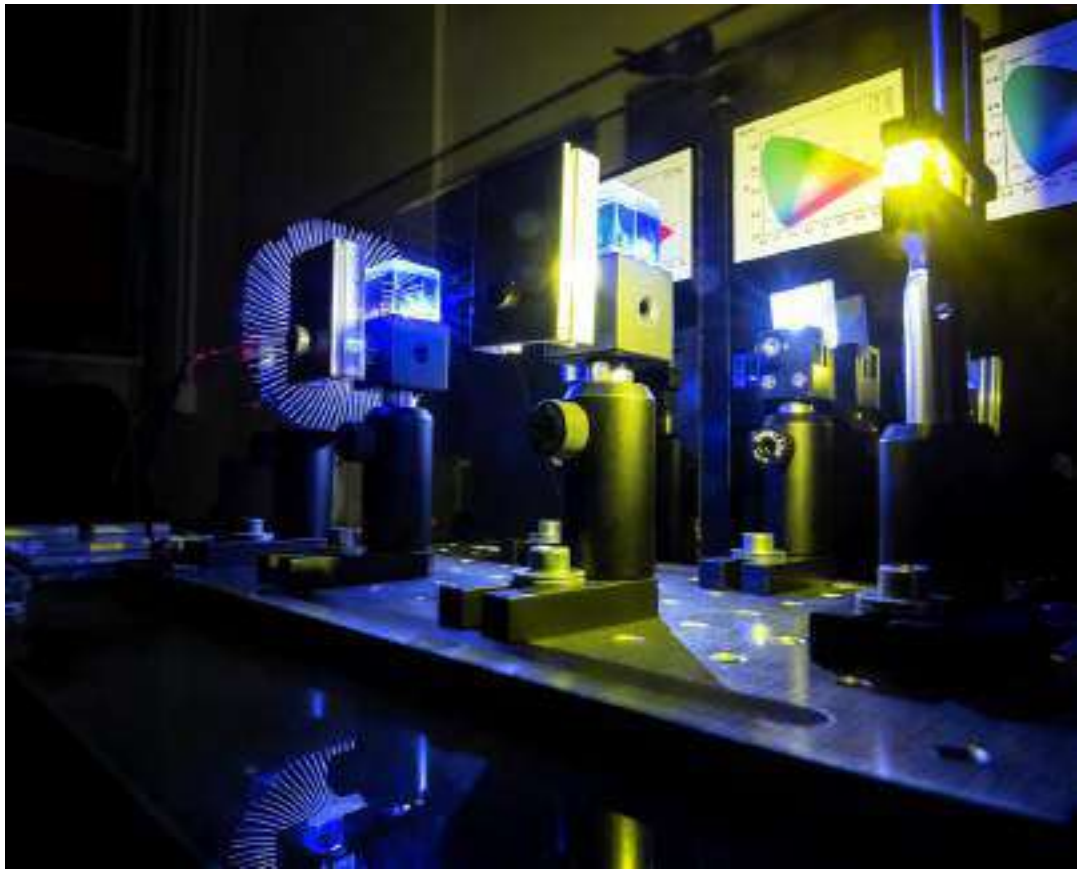
- Biofilters for water purification, disinfecting and self-cleaning layers on metal, glass, ceramic surfaces for disinfection
- Contact layers on semiconductor, glass and ceramic materials for applications in electronics, etc.
- Substrates for heat dissipation based on composite materials
- Materials and thermoelectric modules intended for „thermal to electrical" energy conversion
- Copper – and aluminium-based interpenetrating phase composites
- Porous ceramic preforms



TECHNOLOGICAL AND CHARACTERIZATION OFFER

- Electron-beam physical vapor deposition for manufacturing of multilayer thin-films, metallic and dielectric structures, including photocatalytic layers
- Annealing in high temperature furnace with controlled atmosphere (hydrogen, nitrogen, argon, vacuum)
- Sintering of advanced materials, infiltration of porous ceramic materials and manufacturing materials with incremental techniques
- Densification of ceramic materials with Hot Isostatic Pressing (HIP)
- Measurements of excitation spectra, emission spectra, lifetimes using tunable laser and advanced spectroscopic equipment
- High resolution thermal imaging

Functional materials – gallery



Graphene and composites

Research Group Leader
Tymoteusz Ciuk, Ph.D.

activity

Graphene and composites' (G&C) expertise includes the development of new materials and devices based on various materials including epitaxial graphene, flake graphene, silicon carbide, gallium nitride, nanostructures and composites. The G&C Group is involved in numerous national and international R&D projects, and has state-of-the-art equipment to pursue high-end research. We are open to international cooperation, joint theses and other commercial services.

SERVICE OFFER

The expertise covers three areas:

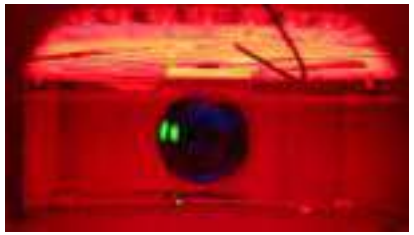
- Materials technology
- Structural and electrical characterisation
- Device technology

The most important measurement techniques include:

- Raman spectroscopy
- Nomarski interference contrast optical imaging (DIC)
- Scanning electron microscopy (SEM)
- Atomic force microscopy (AFM, KPFM and QNM)
- X-ray diffraction (XRD)
- X-ray reflectometry (XRR)
- Spectroscopic ellipsometry (ELL)
- Photoluminescence (PL)
- Deep-level transient spectroscopy (DLTS)
- High-resolution photo-induced transient spectroscopy (HRPITS)
- Capacitance-voltage techniques(CV)
- Current-voltage techniques (IV)
- Classical Hall effect measurements up to 500 °C (Hall)
- Combustion elemental analysis (detection of C, H, N, S, O)
- Electrochemical cells analysis
- Specific surface area analysis (BET)
- Contact-mode and optical profiling
- UV-VIS spectroscopy
- Cell counter

Graphene and composites

Research Group Leader
Tymoteusz Ciuk, Ph.D.

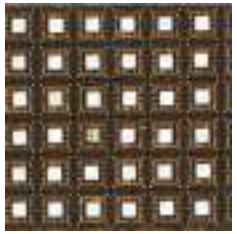


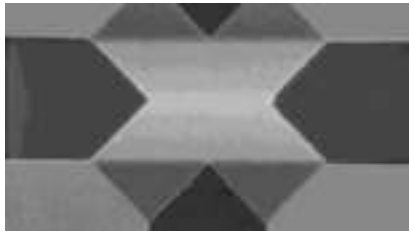
TECHNOLOGY OFFER

- Epitaxy of AIIIBV compound semiconductors based on indium phosphide (InP), gallium arsenide (GaAs) and gallium antimonide (GaSb)
- Epitaxy of AIII–N compound semiconductors based on gallium nitride (GaN, BGaN, AlGaN)
- Homoepitaxy of silicon carbide (SiC)
- Epitaxial graphene on silicon carbide
- CVD graphene on copper
- 2D materials, including hexagonal boron nitride (hBN), molybdenum disulphide (MoS_2) and tungsten disulphide (WS_2)
- Graphene–based polymer composites
- Polymer blends
- Mask alignment and exposure in UV400
- Inductively Coupled Plasma – Reactive Ion Etching (ICP RIE)
- Dry and wet thermal oxidation of silicon and silicon carbide
- Atomic layer deposition of aluminium oxide (ALD)
- E–beam metal deposition (PVD)

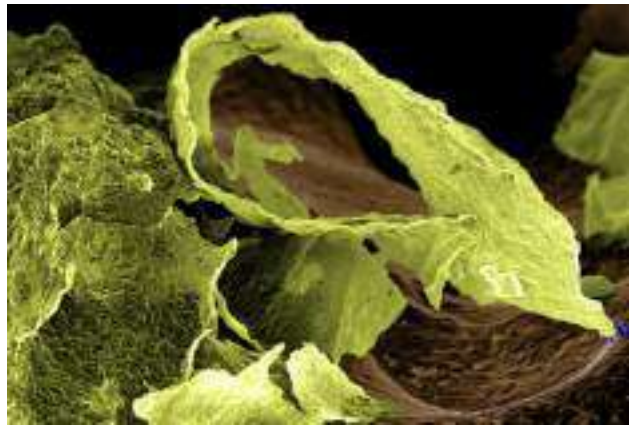
PRODUCT OFFER

- Intercalated graphite
- Thermally expanded graphite
- Graphite oxide
- Graphene oxide (GO), powder or suspension
- Reduced graphene oxide (rGO), powder or suspension
- Graphene paper
- High–temperature magnetic field sensor based on epitaxial graphene on silicon carbide





Graphene and composites – gallery



Characterization of Materials and Devices

Research Group Leader
Paweł Michałowski, Ph.D.

activity

Conducting research activities in the field of the characterization of materials and microelectronic structures.

- Support for internal and external clients (industry, research institutes, universities) in developing new technologies
- Development of research techniques (performance improvement, development of new functionalities)
- Submitting measurement-related project proposals and aiding other Research Groups in preparation of technology-related project proposals
- Writing scientific publications and disseminating measurement possibilities (conferences, seminars)

SERVICE OFFER

Structural analysis

- Secondary ion mass spectrometry (SIMS)
- Transmission electron microscopy (TEM)
- Scanning electron microscopy (SEM)
- X-ray diffraction (XRD) with in-situ temperature measurements
- X-ray fluorescence (XRF)
- Computed tomography (CT)
- Mössbauer effect spectroscopy

SIMS

CT

FTIR/ATR

FIB

Optical analysis

- Raman spectroscopy
- Fourier Transformed Infrared Spectroscopy (FTIR)
- Ellipsometry

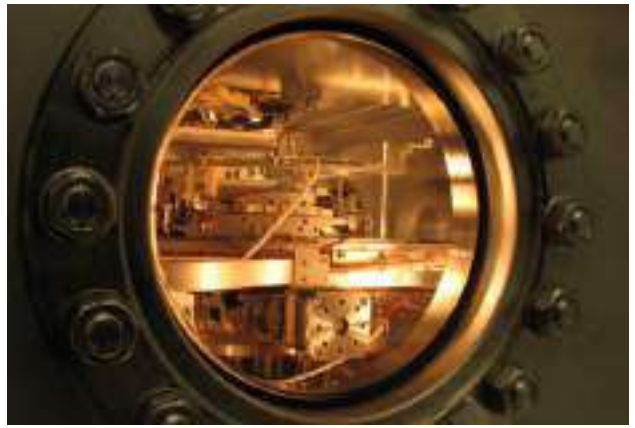
Electrical analysis

- Multiparameter admittance spectroscopy (MPAS)
- Current–voltage characteristic I-V
- Capacitance-voltage characteristic C-V
- Conductance-voltage characteristic G-V
- Transistors reliability testing

Materials modifications

- Ion implantation
- Post-implanted annealing of SiC
- Focused Ion Beam (FIB)

Characterization of Materials and Devices – gallery



Integrated Circuits and Systems Design

Research Group Leader
Grzegorz Janczyk, Ph.D.

activity

- One of the few engineering teams in Poland offering the Application Specific Integrated Circuit (ASIC) and electronics system design, with special emphasis on telemedicine and cybersecurity
- Operating on a fabless basis, we take advantage of the access to manufacturing technologies in the form of international collaboration as well as direct contacts.
- Polish economy needs innovative solutions and high technology products. For many years we have supported that trend.
- The technical value added by our team opens the way towards commercialization of experimental solutions.
- Long-term experience in implementation of the national and international research projects – since FP5 to H2020.

SERVICE OFFER

Design and preparation for fabrication of the Application Specific Integrated Circuit (ASIC) or Application Specific Standard Product (ASSP)

Expertise in digital, analog and mixed-mode integrated circuits ranging the SoC complexity

- Licensed for two kinds of embedded MCUs with wide range of peripheral circuits
- Expertise in both low-power and smart-power circuits. Complete design process, covering, if needed:
- Fixing the product specification – in collaboration with a customer
- Selection of the manufacturing process. An access to European, American and Far-east manufacturing facilities
- Choice of the manufacturing scenario – MPW, dedicated mask set, small volume production
- Schematic capture, simulations, layout design and verification
- Measurement, including design of automated testing environment

Design of electronic system – device or device network

Expertise in MCU-based systems, single board computers, programmable logic.

Whole design process, covering, if needed:

- Fixing the product specification – in collaboration with a customer
- Design of electronic circuits
- Design and sending to manufacturing the PCBs
- Prototypes assembly
- Embedded software development
- Prototype device or network testing and measurements

Integrated Circuits and Systems Design

Research Group Leader
Grzegorz Janczyk, Ph.D.

PRODUCT OFFER

Family of low-noise readout amplifiers – TRL6

- Dedicated to variety of detectors (photodiodes, FET-based THz detectors)

Integrated readout circuit for pollution particle counter – TRL4

- Digital controlled multi-channel photodiode readout circuit

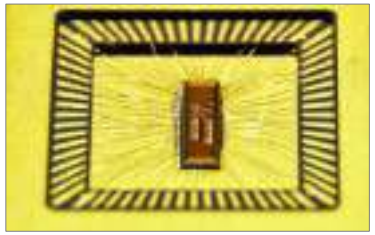
Wireless network of lighting fixtures – smart luminaires – TRL 5

- 2.4 GHz range communication
- Flexible system architecture, multiple operating modes

Sensor network for temperature and humidity measurement in buildings– TRL 7

- Based on Building Management System (BMS) skeleton
- Data source for building automatics, Structure Health Monitoring (SHM)

Test environment for integrated particle counter readout circuit



Particle counter readout IC (UMC 180nm)

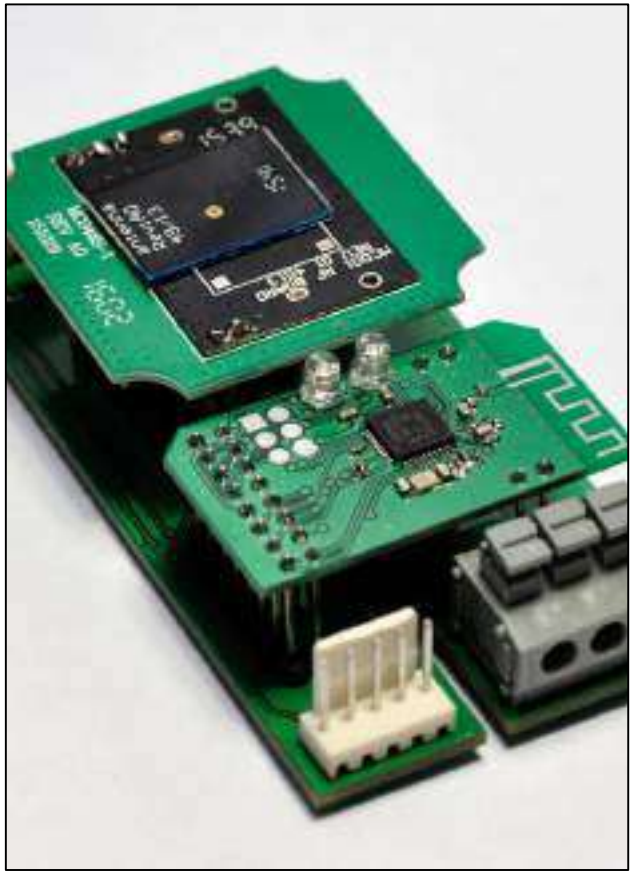
Smart luminaire controller

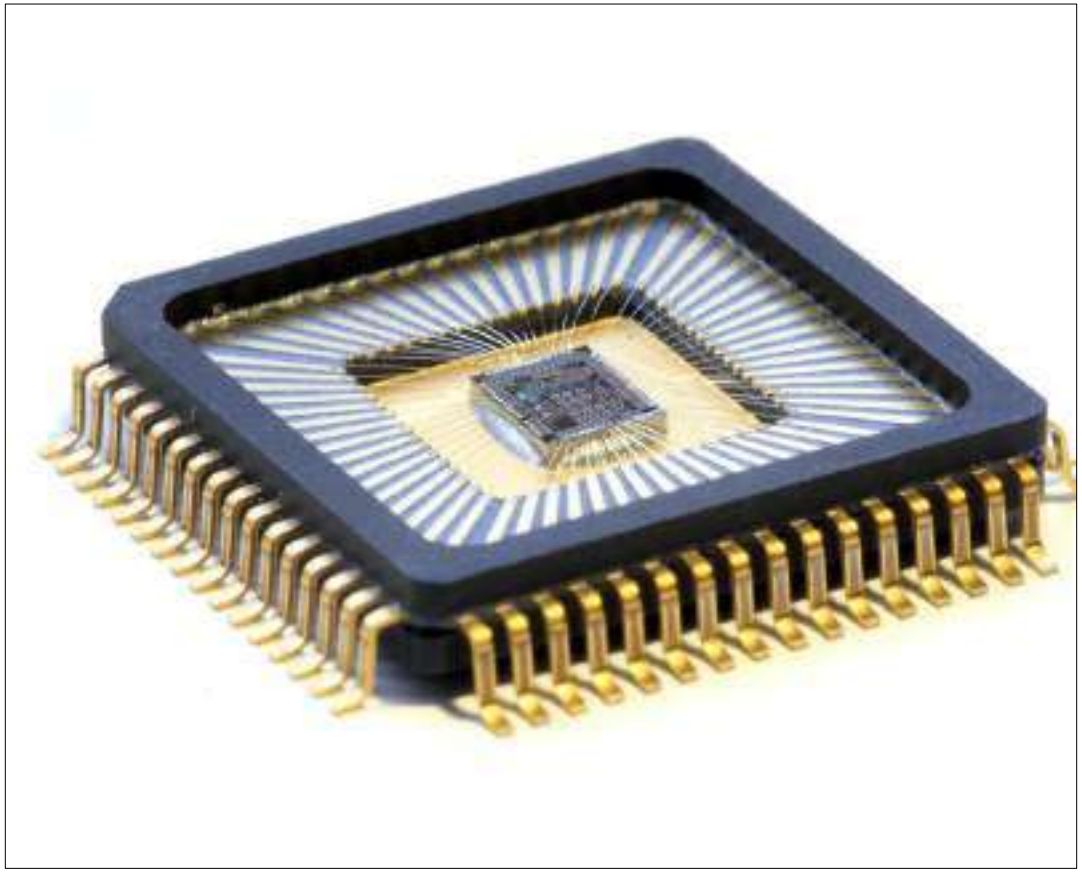
Smart luminaire controller and ZigBee – Bluetooth bridge

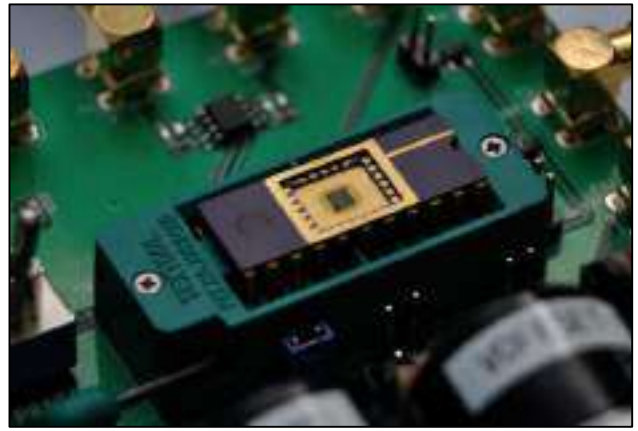
Multi-sensor node – part of the sensor network for T and RH measurements in building

Multi-channel readout IC for FET-based THz detectors (AMS 350nm)

Integrated Circuits and Systems Design – gallery







Infrared Photonics

Research Group Leader
Kamil Pierściński, Ph.D.

activity

- The group conducts R&D works in the field of infrared photonics belonging to current „hot topics", with Focus on quantum cascade lasers and infrared detectors
- The groups offers competences and complete technological line allowing fabrication of optoelectronic devices: form the design and growth of semiconductor heterostructure, through fabrication to complex characterization of final device

SERVICE OFFER

The group offers services in the field of characterization of semiconductor materials and devices, fabrication of optoelectronic devices as well as growth of semiconductor structures.

Measurements of transmission/absorption in infrared spectra range

- Measurement of transmission/absorption in infrared spectra with FTIR spectrometer in broad spectra range (1 to 20 micrometers)

Measurement of contact resistance

- Specific contact resistance measurement of metal contact on semiconductor sample (TLM, cTLM)

Thermoreflectance measurement of temperature of optoelectronic devices

- Measurement of temperature distribution maps on surface of semiconductor device with high spatial and temperature resolution

Growth of semiconductor heterostructures

- Molecular Beam Epitaxy (MBE) growth of III-V semiconductors

Fabrication of optoelectronic devices

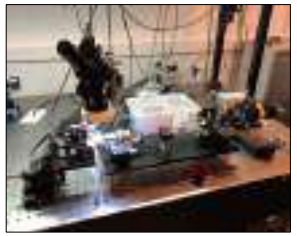
- Photolithography, etching, deposition of metals and dielectrics, die-bonding, wire-bonding

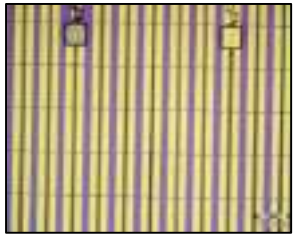
Photoluminescence measurements

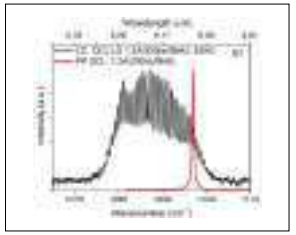
- Measurements of photoluminescence spectra in broad spectral range (350 nm to 15 micrometers) and broad range of temperatures (4K to 300K)

XRD

- Material characterization by X-ray diffraction with data analysis

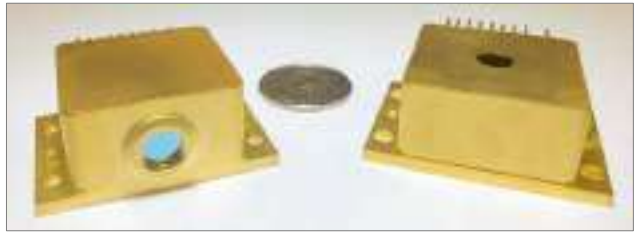






Infrared Photonics

Research Group Leader
Kamil Pierściński, Ph.D.



PRODUCT OFFER

Mid-infrared Quantum Cascade Lasers: MWIR – 4–5 micrometers, LWIR 8–12 micrometers, different geometries and constructions:

- Single-mode QCLs: CC – QCLs, DFB
- High power QCLs: Taper QCLs, multi-emiter bars

TECHNOLOGICAL OFFER

Access to technology of fabrication of optoelectronic devices

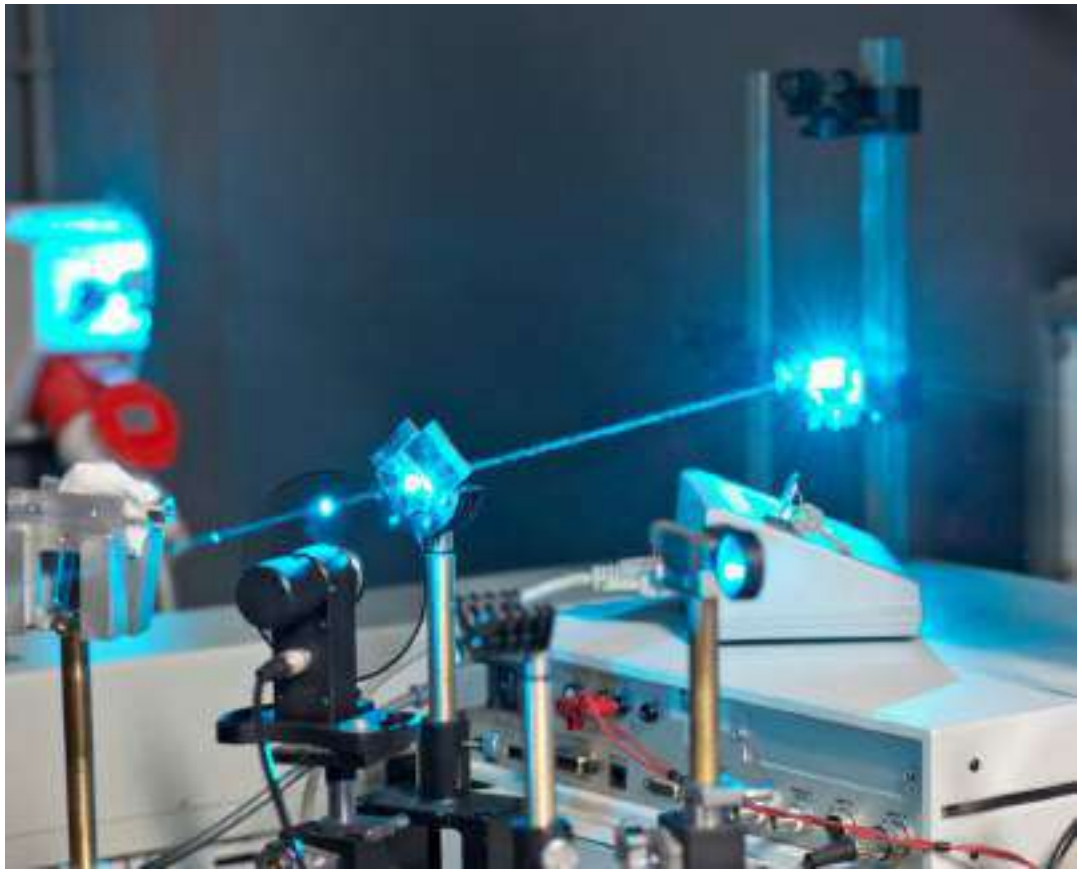
In the field of fabrication of devices we offer: photolithography, etching, deposition of metals and dielectrics, die-bonding, wire-bonding, encapsulation in hermetic housings. The technological equipment at disposal allows realization of work starting from concept and design, through prototype or proof-of-concept, up to small volume production. The offer is addressed at SMEs interested in development of the device customized for specific application.

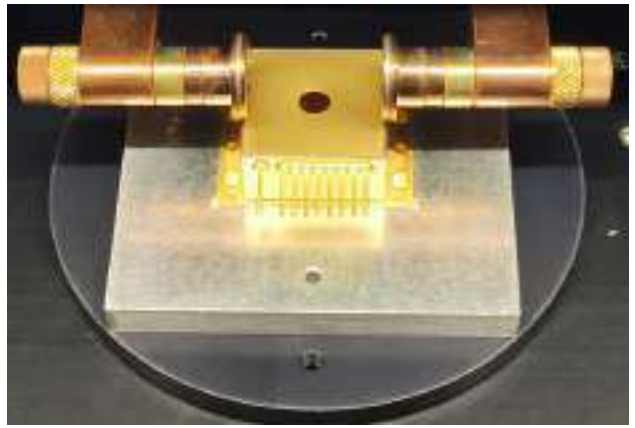
Access to technology of fabrication of infrared sources and detectors

We offer access to technology of fabrication of infrared sources and detectors by means of MBE growth. We specialize in Quantum Cascade lasers and type-II superlattice detectors. Access to unique equipment allows realization of order from concept and design to proof-of-concept or prototype. Starting small volume production is possible. The offer is addressed to SMEs interested in customized device for specific application. The offer concerns:

- Quantum Cascade Lasers emitting in infrared: 4–5 microns and 8–10 microns bands,
- Infrared detectors working in range 3–10 microns, based on type-II SLs

Infrared Photonics – gallery





Silicon Technology and Sensor Systems

Research Group Leader
Dariusz Szmigiel, Ph.D.

activity

The activity of the Research Group focuses on research and development (R&D) in the field of microtechnology based on silicon technology and covers a wide range of topics: silicon photo-diodes and detectors of ionizing radiation, thermal-conductivity detectors, micromechanical sensors using the phenomenon of mechanical resonance, microfluidic structures, microassembly techniques and silicon monocrystallization and its processing.

OFFER

Processing

- RCA cleaning
- Photolitography
- Thermal processes
- Dry etching
- Wet etching
- Metal deposition
- Ion implantation

Microassembly

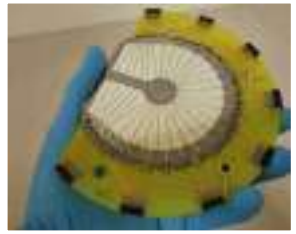
- Die separation – Disco saw
- Die bonding
- Wire bonding
- Encapsulation

Mask workshop

- Development and production of chrome photomasks for semiconductor technology and other applications requiring high precision and high resolution of the pattern
- Standard dimensions 4x4 i 5x5 inch (max. 8x8 inch), resolution 1,5µm (as an option down to 800 nm), on glass plates covered with chromium

Others

- Si photodiodes
- Radiation detectors
- Detector arrays
- Themal Conductivity Detectors (TCDs)
- MEMS-based sensors
- Fabrication of 1"-4" diameter Si substrates

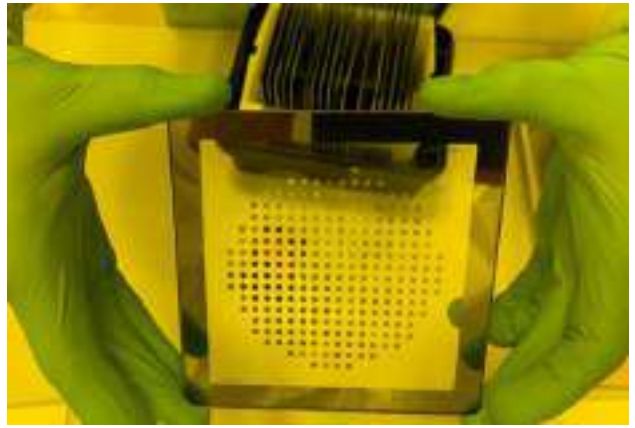


Infrastructure and Technology

- CMOS – based process: batch processing (design rules 3 µm), EBL (< 1 µm)
- Cleanroom 1200 m2
- ISO 4 - 6 (ISO 14644-1)
- Si substrates: 100 i 150 mm
- Diagnostics and microassembly
- Equipment for Czochralski monocrystallization and processing of Si substrates

- Production of detectors according to Customer specification
- Development of technology and implementation
- Niche sensor applications
- Special applications
- Industry 4.0
- Internet of Things
- Biomedical analytics

Silicon Technology and Sensor Systems – gallery



GaN-based devices, sensors, thin-film structures and porous materials

Research Group Leader
Anna Szerling, Ph.D., D.Sc

activity

In Research Group of GaN-based devices, sensors, thin-film structures and porous materials four R&D areas are distinguished:

- GaN-based devices – technology and designing of GaN-based devices;
- Sensors, Thin-Film Structures and Surface Modification- (bio) sensors, thin film structures, medical materials, surface modification for sensors for medical (e.g. screening tests, personalized medicine) or environmental applications and chemical analyses;
- Porous Materials – porous materials for gas sensors and supercapacitor-based energy micro-storage;
- 3D-structures – diffraction optics.

TECHNOLOGICAL OFFER

Individual technological processes or their sequences in the field of e-beam lithography, photolithography, laser lithography and nanoimprint lithography, ICP/RIE plasma etching, ion implantation and thermal processes, in particular:

- Pattern definition by DUV photolithography (critical dimension 0.8-1 μm)
- Pattern definition by e-beam lithography (pattern dimensions up to 200x200 mm^2, 1 nm addressing grid, 50 nm resolution, pattern accuracy <15 nm), including sub-micrometer advanced-shape gates (like T-gate) and air bridges
- Reactive etching of semiconductors, metals and dielectrics by ICP/RIE methods in chlorine or freon plasmas
- Annealing of layers, substrates and devices by RTP method (up to 1100°C; impulse up to 1500°C)
- Ion implantation (e.g. Al, Si, Fe and others) into various semiconductor materials; available energies from approx. 200 keV to 2 MeV.

GaN-based devices, sensors, thin-film structures and porous materials

Research Group Leader
Anna Szerling, Ph.D., D.Sc

TECHNOLOGICAL OFFER

Vacuum deposition of metallic, dielectric and semiconductor thin films and coatings with specific functional properties on various details and substrates up to 6 inches in diameter (metals, crystalline materials, glass, paper, fabrics, polymer materials, organic materials):

- Conventional and refractory metals (Ti, Al, Mo, Cu, Ni, Mg, W, Au, Pt, Cr etc.) and their solid solutions and compounds deposited by physical vapor deposition (PVD) techniques
- Compounds with increased mechanical and thermal resistance (TiN, TiC, RuSiO etc.)
- Dielectric layers deposited by atomic layer deposition (ALD) technique (HfO_2, ZrO_2, Ta_2O_5, Al_2O_3 and others)
- Dielectric layers deposited by plasma-enhanced chemical vapor deposition (PECVD) technique (SiO_2, SiN_x, SiO_xN_y)
- Transparent conductive compounds/shielding/reflecting electromagnetic radiation (ZnO:Al, ITO)
- Oxide semiconductors (ZnO, In-Ga-Zn-O and others)
- Various unconventional materials deposited at temperatures up to 1000°C
- Porous structures and coatings deposited by vacuum techniques with thermal treatments on substrates up to Ø6" in size: (1) „black", light absorbing Zn porous coating and (2) „white", porous coatings of metal doped ZnO for gas sensors







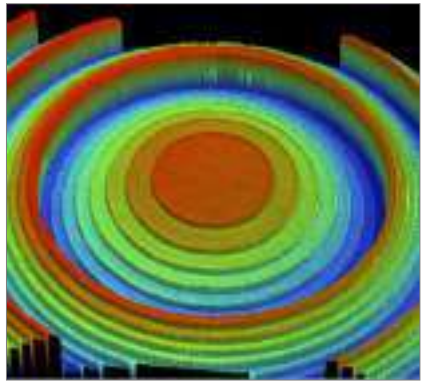
GaN-based devices, sensors, thin-film structures and porous materials

Research Group Leader
Anna Szerling, Ph.D., D.Sc

TECHNOLOGICAL EQUIPMENT

A complete technological line in ISO-5 and ISO-6 class clean rooms with area of approx. 600 m^2 , dedicated to fabrication of GaN-based semiconductor devices on various substrates (GaN, SiC, Si, sapphire) and various types of deposition processes thin metallic, dielectric and semiconductor layers, consisting of:

- E-beam lithography (Vistec SB251, Raith Voyager), photolithography, laser lithography (DWL 66FS, Heidelberg Instruments) and nanoimprint lithography
- High vaccum magnetron sputtering systems, equipped with analytical tools for in-situ monitoring of sputtering processes and properties of the deposited material, in particular Gamma 1000C, Surrey-NanoSystems and TFDS-462U, VST Services Ltd. systems
- Beneq TFS-200-190 rector for deposition of materials using atomic layer deposition
- Oxford Instruments Plasmalab 80 Plus for plasma-enhanced chemical vapor deposition of dielectric materials
- Two-chamber, loadlock Oxford Instruments PlasmaLab System 100 ICP180 system for etching of various materials in ICP chlorine plasma and RIE freon plasma
- Impulse RTP furnaces for fast thermal processes in the temperature range from 450°C to 1200°C (pulses up to 1450°C), in an atmosphere of inert and reactive (6N) process gases: Ar, N_2, O_2, N_2O
- Conventional tube furnaces for heating up to 1050°C in Ar or O_2 atmosphere and for conducting aging tests
- NEC 3SDH-2 Pelletron tandem accelerator for ion implantation and Rutherford backscattering spectrometry (RBS) studies
- Laboratory facilities for conducting chemical processes and inter-operational control of processes



PRODUCT OFFER

- Fabrication of chrome on glass/quartz masks for contact and projection photolithography; substrate sizes from 4 "x4" to 7 "x7", 1 nm addressing grid, mask-to-mask accuracy <5 nm
- Fabrication of diffractive optical elements with binary and multilevel profile, incl. diffractive microlenses and microlens arrays (spherical, cylindrical, elliptical, etc.)
- Making templates and working stamps for nanoimprint processes; substrate sizes from Ø50 mm to Ø100 mm, min. line width (resolution) 50 nm.
- Copying nano-patterns in thin photocurable polymer layers and making replicas of 3D structures on thermoplastic substrates; resolution ≤ 50 nm, maximum substrate size Ø100 mm
- Prototyping of GaN-based semiconductor devices, fabrication of microwave and high voltage transistors, test structures, diodes
- Technological processes and prototyping semiconductor devices on other materials, e.g. silicon carbide (SiC) or oxide semiconductors (Ga_2O_3, ZnO, InGaZnO)

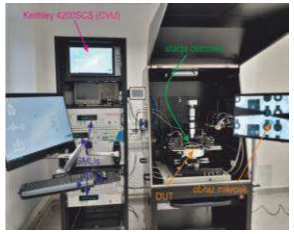
GaN-based devices, sensors, thin-film structures and porous materials

Research Group Leader
Anna Szerling, Ph.D., D.Sc

SERVICE OFFER

- Performing individual technological processes or their sequences in the field of pattern definition, deposition, ion implantation and thermal processes according to the client's design
- Direct fabrication of patterns on semiconductor substrates (maskless lithography); higher accuracy and resolution, shorter time, lower costs of technology development and prototypes developing
- On-wafer electrical characterization of semiconductor devices: low current(~fA), high current (20A DC, 50A pulsed) and high voltage (up to 3kV) measurements of current-voltage characteristics in wide temperature range (RT up to 300°C). Cryogenic probe station with temperature down to 10K.
- On-wafer electrical characterization of semiconductor devices: capacitance-voltage characteristics (C-V) measurements of MOS capacitors or diodes in 1 kHz (or quasi-static)-10 MHz frequency range. Measurements of C-V characteristics of transistors: C_{RSS}, C_{ISS}, C_{OSS}.
- On-wafer electrical characterization of microwave semiconductor devices: S-matrix parameters measurements up to 50 GHz
- Electrical characterization of semiconductor devices in TO-220 and TO-247 packages
- SEM microscopy imaging (measurements of chemical composition using Energy-dispersive X-ray (EDX) spectroscopy) and AFM imaging including magnetic (MFM), electrostatic (EFM), conductive (CAFM) and capacitance (SCM) modes
- XRD, HR-XRD, XRR structural characterization of materials: determination of the phase/composition and structural changes of the materials
- Measurements of electrical and electrochemical properties of coatings (corrosion testing possible)
- Measurements of wavelength dependent optical properties and transparency of layers using variable angle spectroscopic ellipsometry technique
- Chemical composition depth profiling using Rutherford backscattering spectrometry method




GaN-based devices, sensors, thin-film structures and porous materials – gallery

LTCC Technology and Printed Electronics

Research Group Leader
Agata Skwarek, Ph.D., D.Sc

activity

The main goal of the Group is to conduct R&D works in the area of LTCC technology and printed electronics, integration of electronic components and SMT assembly, designing systems, sensors for use in medicine, and environmental protection, photovoltaic installations, power systems, and electricity storage. The technology of manufacturing and characterization of materials and ceramic–polymer composites for applications in electronics is also an essential aspect of the Group's interest. In addition, the research group deals with small series production of the developed products and research and technological services tailored to the needs of customers.

SERVICE OFFER

- development of materials for preparation of functional ceramic green tapes and layers with dedicated properties,
- optimization of the composition of ceramic tapes and the parameters of their fabrication process,
- design of circuits including sensors and microfluidic structures,
- design of multilayer discrete and buried passive components and investigations of their electro–physical parameters and long–term stability,
- sensor design and fabrication,
- analysis in a heating microscope, digital microscope, laser processing
- design of new–generation ceramic packages for sensors,
- assembly and protection of LTCC micromodules,
- techno–climatic investigations of LTCC micromodules
- design of micromodule structures for medical applications,
- experimental low–scale production
- development of power systems – emergency power systems, design and implementation of battery voltage balancers, PV controllers, PCB prototyping

Additionally: the Group offers expert advice and lectures on given topics, research assistance and the possibility of internships.






LTCC Technology and Printed Electronics

Research Group Leader
Agata Skwarek, Ph.D., D.Sc

PRODUCT OFFER

- LTCC structures
- piezoelectric sensors
- substrates and packages for detectors
- resistive elements and heaters on flexible substrates
- battery voltage compensation systems
- SMT assembly
- multilayer passive components
- resistive elements for aerospace industry
- mobile measuring stations
- pH sensors, water conductivity sensors and gas sensors
- special materials with required dielectric properties

Charge controller

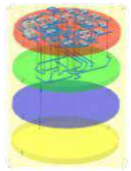
Piezoelectric sensors for the analysis of postural defects

AC / DC converter (LTCC)

Resistive elements for the space industry

LTCC functional materials

Multilayer LTCC circuits



Printed electronics

Specialized measurements of multifunctional materials

Development and assembly of electronic circuits

TEG assembly

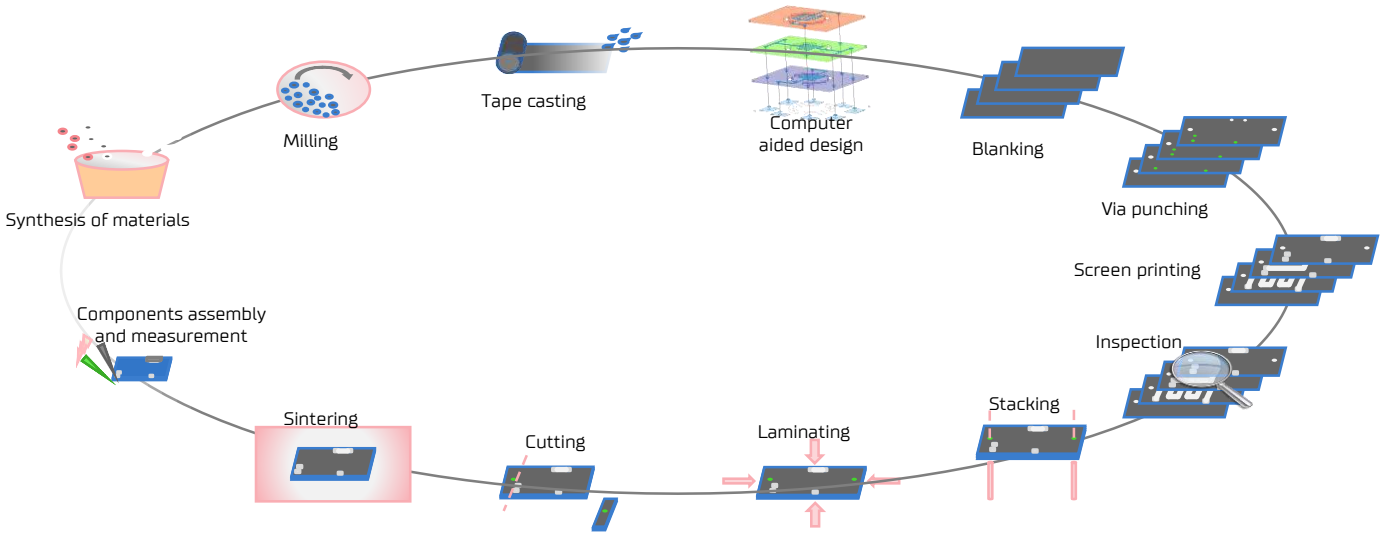
LTCC Technology and Printed Electronics

Research Group Leader
Agata Skwarek, Ph.D., D.Sc

TECHNOLOGICAL OFFER

- LTCC (Low Temperature Cofired Ceramic) technology, allows for the fabrication 3-dimensional structures of electronic circuits on the basis of pressed ceramic foils with printed functional layers. It enables production of microelectronic systems and circuits with a high degree of complexity, high packing density, miniaturization and characterized by a very high reliability. LTCC circuits are manufactured in a comprehensive technological process from the manufacture of ceramic foil through the processes of foil cutting and via forming, printing of conductive, resistive and dielectric layers, structure packaging and pressing, final thermal processing, assembly and protection to final testing.
- Printed electronics – printing of functional layers on substrates (including flexible substrates) by screen printing or jet printing (InkJet) depending on customer needs
- SMT technology – surface mount components on substrates (FR4, ceramic, metal) using reflow soldering in zone ovens or vapor phase soldering (VPS). Analysis of soldered joints.
- Aging tests – shock chambers, thermal, vibration, shock, current loads on customer supplied samples and components.

LTCC PROCESS LINE:



LTCC Technology and Printed Electronics – gallery

Testing and Certification Center – PREDOM

Research Group Leader
Filip Walczak, MSc

activity

PREDOM is one of the largest laboratory in Poland devoted to testing electrical products.
PREDOM – Testing and Certification Centre conducts tests, certification and conformity assessment of electrical and electronic products as well as gas-powered products, including medical, household appliances, lighting, ICT, wirelessly controlled devices.

- Conducts certification of management systems.
- Provides technological services.

THE SCOPE OF RESEARCH:

- safety of usage
- issues of electromagnetic compatibility and radio spectrum
- noise emitted by devices
- functionality matters, including energy efficiency

PARTICIPATION IN DOMESTIC AND FOREIGN ORGANIZATIONS

PREDOM branch is a member of:

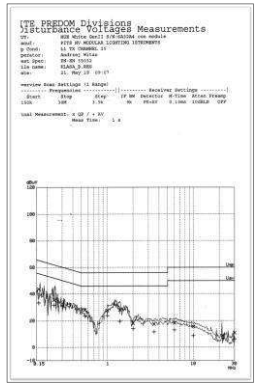
- 13th technical comittee of Polish Commitee of Standardization. Our specialists actively participate in the work of these committes..
- The International Zhaga consortium to Unify the Interface Specification for LED luminaaires
- The Radio Equipment Directive Compliance Association (REDCA)

Testing and Certification Center – PREDOM

Research Group Leader
Filip Walczak, MSc

key competences

National accreditations (accreditations of the Polish Center for Accreditation (PCA) – as a result of verification of the impartiality of the organization, personnel competences, procedures, research equipment)



Research laboratory AB 003 certified since 1993 in the scope of 21 identification codes of research areas / subjects and 1259 standards.

Metrology laboratory AP 153 certified since 2013 calibration of::

- equipment for measuring voltages, currents, resistance, HF generators
- instruments for measuring temperature and pressure
- instruments for measuring geometric quantities

(The PCA accreditation scopes available at www.pca.gov.pl and www.predom.com.pl)

The certification body (BC) certifies over 40 product groups:

- in the area of product certification AC 044 – certificate since 1997,
- in the area of certification of management systems AC 134 – certificate since 2006.

Testing and Certification Center – PREDOM

Research Group Leader
Filip Walczak, MSc

key competences

INTERNATIONAL ACCREDITATIONS:

- IECEE IEC System of Conformity Assessment for Electrotechnical Equipment and Components

EUROPEAN ACCREDITATIONS:

- ETICS – European Testing Inspection and Certification System

PERFORMING TESTS AND CERTIFICATES:

- according to 114 IEC standards for operational safety and functional features..
- on the registered ENEC safety mark and the ENEC+ mark, common for lighting products

AUTHORIZATION and NOTIFICATION:

PREDOM Branch is a unit authorized by the Minister of Development and the Minister of Digitization and notified (since 2004) in the EU No. 1451 in the scope of the following New Approach Directives::

- Directive 2014/30 / EU on electromagnetic compatibility (EMC)
- Directive 2014/53 / EU on radio equipment
- Regulation (EU) 2016/426 on appliances burning gaseous fuels
- Directive 2006/42 / EC on machinery
- Directive 2000/14 / EC on noise emitted by equipment used outdoors
- Directive 92/42 / EEC on the energy efficiency of new water heating boilers

Testing and Certification Center – PREDOM

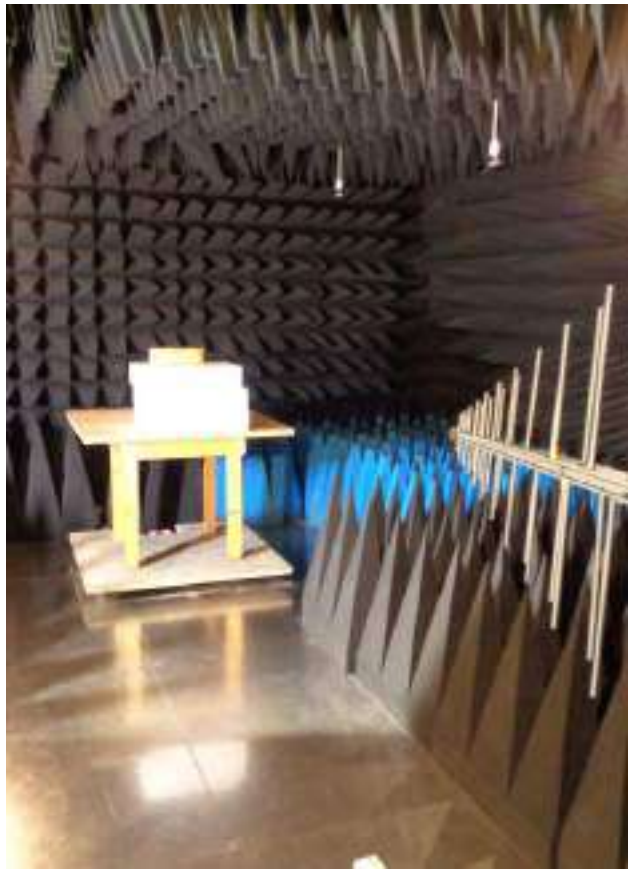
Research Group Leader
Filip Walczak, MSc

FACULTY OF PROTOTYPES AND EXPERIMENTAL PRODUCTION

Products:

- Receptacles / Receptacles with Spring / Angular Receptacles / Receptacles for Housing
- Tabs Wire Terminal / Tab Terminals / Tabs Terminal for Housing / Soldering Tabs / Tabs Termina with Hole / Tabs Terminal for Welding
- Wire Pins / Splices end Wire
- Tongue Terminals / Ring Tongue Terminals
- Socket Contacts / Non-Insulated Socket Contacts
- Terminals
- Brush-Holder
- Wire Terminals / Wire Terminals with Tab

Testing and Certification Center – PREDOM – gallery



Łukasiewicz
Institute of Microelectronics and Photonics

Please join us in working together

Commercialization and Sales Department

Piotr Cywiński
e-mail: piotr.cywinski@imif.lukasiewicz.gov.pl

Sławomir Gadomski
e-mail: slawomir.gadomski@imif.lukasiewicz.gov.pl