TECHNISCHE UNIVERSITÄT DRESDEN

ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT

SOLID-STATE ELECTRONICS LABORATORY

HEAD: PROF. DR.-ING. HABIL. G. GERLACH

2019 ANNUAL REPORT

Solid-State Electronics Laboratory:

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INTRODUCTION

Dear friends and partners of our Institute,

This annual report is intended to give you an overview of the main activities, events and results that have shaped the work of our IFE in the past year 2019.
This year, four young doctoral students from our Institute (Marisa Rio, Anna Schröter, Christoph Kroh) and external doctoral students (Roland Wuchrer) successfully defended their dissertations. Four further doctoral theses (by Sebastian Kümmritz, Tobias Ott, Markus Krenkel and Jan Erfkamp) have already been submitted and will be defended at the beginning of next year. We are pleased that our institute has once again been able to offer our young scientists a good environment for their scientific work and qualification.
Our Research Training Group "Hydrogel-based Microsystems" has hosted and organized the international APMM 2019 Conference on Active Polymeric Materials and Mirosystems. We welcomed about 80 participants, including a considerable number from abroad, e.g. from the USA, Canada, New Zealand, India, the Netherlands, France and Switzerland. The program included hydrogels, electroactive dielectrics and other active polymers and covered the entire range from materials, modelling and simulation to sensor, actuator and microfluidic applications and systems.
In the context of this conference we organized an art action, which reached its climax with the opening of the exhibition "Cribbing allowed! Simply beautiful crib sheets". There you can see the most beautiful crib sheets which the students have made in the last two decades for the permitted use in the exams for our courses. The exhibition can be visited until at least the end of February 2020 (in the SLUB, Departmental Library DrePunct, office building Zellescher Weg 17); a catalogue is available.
Also in the last year the book project "Carbon Dioxide Sensing" finally came to an end, on which we have been working for several years together with scientists of the Kurt-Schwabe-Institut für Meß- und Sensortechnik e.V. Meinsberg, an affiliated institute of the TU Dresden. The recording and monitoring of the concentration of carbon dioxide in gases and liquids is of fundamental importance in many areas of application, from the environment to medicine and industrial manufacturing processes. The manifold application possibilities as well as the large range of the CO_2 concentration to be measured make CO_2 measurement a demanding task, especially since there is an almost unmanageable field of measuring principles. The book now systematically presents all these different measuring principles with their properties as well as their advantages and disadvantages and, thus, offers a decision-making aid for the selection of the most suitable measuring or analysis method for a particular measuring task.
One point is particularly close to my heart again this year: All our results are the result of the tight cooperation of all members of our IFE, to whom I would like to express my sincere thanks. Much is also based on the close cooperation with our partners from other institutes and institutions and has received extensive support from the staff of our university administration and the funding institutions. We would like to thank them all just as much!

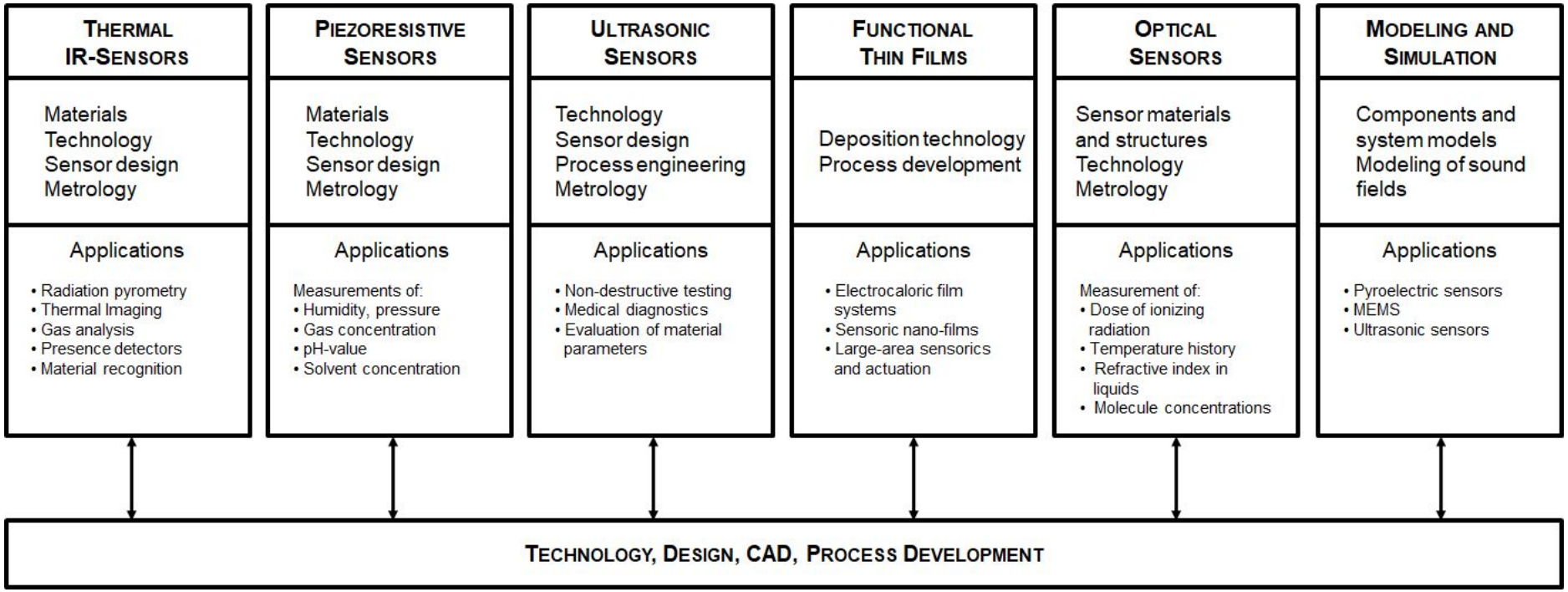
Prof. Dr.-Ing. habil. Gerald Gerlach

1. GENERAL

The Solid-State Electronics Laboratory (Institut für Festkörperelektronik - IFE) is one of 12 laboratories of the Electrical and Computer Engineering Department at Technische Universität Dresden. Together with the Semiconductor Technology and Microsystems Lab and several chairs of the Institute of Circuits and Systems, the Solid-State Electronics Laboratory is responsible for the microelectronics specialization in the Electrical Engineering program. Research and teaching fields of the Institute for Solid-State Electronics are dedicated to the interaction of physics, electronics and (microelectronics) technology in:

- materials research, technology, and solid-state sensor operational principles,
- application of sensors for special measurement problems,
- design of sensors and sensor systems including the simulation of components as well as of complex systems,
- development of thin films and multilayer stacks for sensor applications and other functionalities,
- application of ultrasound for nondestructive evaluation, medical diagnostics and process measurement technology.

For scientific research modern facilities are available (cf. section 4.3) which are located in the Werner Hartmann Building. This building inaugurated in 2013 is operated together with the Institute of Electronic Packaging Technology (IAVT) and the Chair of Microsystem Technology at the Institute of Semiconductors and Microsystems (IHM).


THERMAL IR-SENSORS
Materials
Technology
Sensor design
Metrology
Applications
• Radiation pyrometry
• Thermal Imaging
• Gas analysis
• Presence detectors
• Material recognition
PIEZORESISTIVE SENSORS
Materials
Technology
Sensor design
Metrology
Applications
Measurements of:
• Humidity, pressure
• Gas concentration
• pH-value
• Solvent concentration
ULTRASONIC SENSORS
Technology
Sensor design
Process engineering
Metrology
Applications
• Non-destructive testing
• Medical diagnostics
• Evaluation of material parameters
FUNCTIONAL THIN FILMS
Deposition technology
Process development
Applications
• Electrocaloric film systems
• Sensoric nano-films
• Large-area sensorics and actuation
OPTICAL SENSORS
Sensor materials and structures
Technology
Metrology
Applications
Measurement of:
• Dose of ionizing radiation
• Temperature history
• Refractive index in liquids
• Molecule concentrations
MODELING AND SIMULATION
Components and system models
Modeling of sound fields
Applications
• Pyroelectric sensors
• MEMS
• Ultrasonic sensors
TECHNOLOGY, DESIGN, CAD, PROCESS DEVELOPMENT

2. STAFF

Chair for Solid-State Electronics:

Prof. Dr.-Ing. habil. Gerald Gerlach		Professor and Chair	
Beyer, Julia	Dipl.-Ing.	Research assistant	(since 09/19)
Binder, Simon	Dipl.-Ing.	Research assistant	
Budzier, Helmut	Dr.-Ing.	Senior researcher	
Burkhardt, Anke	Dr. rer. medic.	Research assistant	(until 10/19)
Collasch, Heike		Secretary	
Delan, Annekatrin	Dipl.-Phys.	Research assistant	
Erfkamp Jan	M.Sc.	Research assistant	
Eydam, Agnes	Dipl.-Ing.	Research assistant	
Franke, Daniela	Dr. rer. nat.	Postdoc	
Gulnizkij, Nikolai	Dipl.-Phys.	Research assistant	
Günther, Margarita	PD Dr.-Ing.	Research assistant	
Härtling, Thomas	PD Dr.rer.nat. et Ing. habil.	Research assistant[1]	
Herbst, Sabine		Laboratory assistant	
Juhrig, André	Dipl.-Ing.	Research assistant	(until 12/19)
Junker, Steffen	Dipl.-Ing.	Research assistant	(until 02/19)
Kostka, Siegfried	Dipl.-Ing.	Engineer	
Krause, Volker	Dipl.-Ing.	Engineer	
Kroh, Christoph	M.Sc.	Research assistant	
Kühnicke, Elfgard	extraord. Prof. Dr.rer.nat. et Ing.habil.	Lecturer	
Kuß, Julia	Dr.-Ing.	Research assistant /Course advisor	
Lehmann, Ulrike		Laboratory assistant	
Liebschner, Rocco	M.Sc.	Research assistant	(until 03/19)
Malberg, Insa	Dipl.-Jur.	Officer	
Mieting, Alice	M.Sc.	Research assistant	(since 09/19)
Nizard, Harry	Dr. rer. nat.	Research assistant	
Norkus, Christian		Laboratory assistant	
Norkus, Volkmar	Dr.-Ing.	Senior researcher	
Ott, Tobias	Dipl.-Ing.	Research assistant	(until 09/19)
Pfeil, Sascha	Dipl.-Ing.	Research assistant	
Rath, Katharina	B.A.	Technical employee	
Schmidt, Ulrike	Dipl.-Ing.	Research assistant	(until 10/19)
Schreiber, Stefan, Marco	Dipl.-Ing.	Research assistant	(since 07/19)
Suchaneck, Gunnar	Dr. rer. nat.	Senior researcher	
Wang, Sitao	Dipl.-Ing.	Research assistant	(since 09/19)
Wolf, Mario	Dipl.-Ing.	Research assistant	

Guest Scientists:

Evgenij Artsiukh 13.01.-17.03.2019, 19.07.-16.08.2019

[1] Head of the Research Group for Optical Nanosensorics at Fraunhofer IKTS Dresden

3. TEACHING AND ADVANCED TRAINING

Most of the study courses offered at TU Dresden in engineering sciences are diploma study courses. At the Department of Electrical Enginnering and Information technology, this concerns the graduate study courses Electrical Engineering, Information Systems Technology, Mechatronics and Regenerative Energy Systems. Additionally, master courses are offered to facilitate advanced training of Bachelor graduates from other universities and foreign countries at TU Dresden.

Four semesters of basic studies in Electrical Engineering, that are completed with the so-called “Vordiplom” (Preliminary Diploma), are followed by the main studies of a freely selected branch of study, a course work and a diploma thesis at one of the chairs. As a rule, a total of 10 semesters is necessary to obtain the German academic degree „Diplom-Ingenieur“.

The Chair for Solid-State Electronics is mainly focused on the teaching of design and fabrication technology of electronic components and devices based on solid-state effects. Regarding the basic studies of Electrical Engineering, the Solid-State Electronics Laboratory is involved in lectures related to physical basics of electronics and their use in devices (Sensorics, Solid-State Electronics, Nanotechnology and Nanoelectronics), manufacture and application of electronic components and devices (Infrared Measurement Technology). In the area of ultrasonic sensorics and measurement technology subject-specific lectures are offered to the students.

The huge demand of industry on graduates in engineering sciences, especially in electrical engineering, motivates us to provide a more intensive mentoring of “Fundamentals in Electrical Engineering” freshmen. In order to reduce the dropout without dimishing education requirements, exercise classes are carried out in small groups by experienced mentors taking care in rapid formation of an efficient learning style of our new students. Besides the complete mentoring of two lab works for all students of our Department and complete mentoring of Dynamic Networks for the students for the courses Information Systems Technology and Industrial Engineering, one freshmen exercise class was supervised in summer term 2019 and two classes in the winter term 2019/2020 by IFE personnel.

In particular, the following courses were given during the 2018/19 winter term and the 2019 summer term:

Training course	Lecturer Lecture/ exercise/ laboratory work (Double hours per week)	User
Introduction to Sensorics (Sensorics I)	Prof. Gerlach, PD Dr. Günther Dr. Landgraf 2/1/0	(2, 3) Compulsory course (1, 6, 7, 8) Optional course, PhD students
Sensorics II	Prof. Gerlach, PD Dr. Günther, PD Dr. Härtling 2/0/0	(2) Optional course, PhD students
Sensorics-laboratory work	DI Binder, DI Krause, DI Beyer, Dr. Norkus, Dr. Suchaneck 0/0/1	(2, 6, 8) Optional course
Biochemical Sensors	PD Dr. Günther 2/1/0	(2) Optional course
Solid State Electronics	Prof. Gerlach; Dr. Suchaneck 2/1/0	(2) Optional course
Nanotechnology and Nanoelectronics	PD Dr. Härtling 2/1/0	(2) Optional course
Plasma Technology	Dr. Frach, Prof. Gerlach 4/2/0	(2) Optional course
Lab work supervision of Computer Engineering II course	PD Dr. Budzier, Dr. Suchaneck 0/0/2	(1) Compulsory course
Lab work supervision of Circuitry course 1	DI Juhrig, DI Eydam, DI Kostka Dr. Norkus 0/0/2	(1, 5, 6, 7, 8) Compulsory course
Lab work supervision of Circuitry course 2	DI Krause, DI Juhrig 0/0/2	(1, 5, 6, 7, 8) Compulsory course
Tutor of Basics of Electrical Engineering	Dr. Suchaneck, DI Krause (0/2/0)	(1, 6) Compulsory course
Tutor of Electrical and magnetic fields	Dr. Suchaneck (0/2/0)	(1) Compulsory course
Tutor of Dynamic Networks course exercises for (2)	Prof. Gerlach, PD Dr. Budzier 0/2/0	(5, 8) Compulsory course
Fundamentals of Ultrasound	extraord. Prof. Kühnicke 2/1/0	(2, 3, 4) Optional course, PhD students
Utrasound Sensors and Measurement Techniques	extraord. Prof. Kühnicke 2/0/0	(2, 3, 4) Optional course, PhD students

(1) General study course, Electrical Engineering program; (2) Graduate study course, Microelectronics program; (3) Graduate study course, Equipment, Micro- and Medical Technology program; (4) Graduate study course, Computer Engineering program; (5) Graduate study course, Information Systems Technology program; (6) Graduate Study course, Mechatronics program; (7) General study course, Renewable Energy Systems; (8) General study course, Industrial Engineering.

3.2. Advanced Training Course Noncontact Temperature Measurement and Thermal Imaging Techniques

Date: November 12, 2020

Scientific Chairman: Prof. Dr. Gerald Gerlach, TU Dresden
Lecturer: PD Dr.-Ing. Helmut Budzier, TU Dresden

Target group:
Employees in research, development, manufactoring, and in knowlegde-based customer consulting, including also practitioners developing or using IR technologies or planning to apply this innovative technology, decision-makers and customer consultants intending to get an overview on the capabilities and the limits of IR technology.

Required qualification:
Basic knowlegde of physics and electrical engineering acquired by academic studies of natural or engineering sciences or engineering technician qualification including perennial professional experience in measurement technology and sensorics.

Topics:

Introduction and goal
- Infrared measurement techniques: History and future
- Advantages of IR radiation

Radiometric Fundamentals
- Radiation measurement and radiation laws
- IR properties of solids: Emission, absorption, transmission and reflection
- Fundamental law of photometry

Sensors
- Specific parameters
- Thermal sensors
  - Radiation thermocouples
  - Pyroelectric sensors
  - Bolometers
  - Thermal IR imagers
- Photonic sensors
  - Photoconductors
  - Photodiodes
  - Quantum-well sensors
  - Photonic imagers
  - Cooling
- Comparison of thermal and photonic sensors

Applications
- Thermal imagers
- Pyrometer

Cf.: www.ama-weiterbildung.de

4. RESEARCH TOPICS

4.1. Main research topics

A general scheme of the laboratory including the main research topics is shown in section 1. Here, the following topics are in the focus:

Infrared detectors and infrared measurement technology, pyroelectric infrared sensors:

- Sensor technology and material characterization
- Sensor simulation and design
- Measurement technology for IR single and multi-element detectors
- Sensor applications in radiation pyrometry, thermal imaging, gas analysis and presence detection
- Radiation-absorbing layers
- IR emitters

Piezoresistive sensors:

- Fabrication and characterization of pH-value-, glucose-, ammonia-, ethanol- and urea-sensitive hydrogel films
- Sensor simulation and sensor design
- Measurement technology
- Powerless sensor switches (BIZEPS – Bistable Zero-Power Sensors)

Sensoric polymers:

- Hydrogels with pH-, temperature-, ion- and concentration-dependent swelling behavior
- Imprint and replica plating
- Biocompatibility

Ultrasound technology:

- Simulation of sound fields with complex geometry
- Transducer optimization
- Development of ultrasound measurement techniques using information from the sound field (non-scanning curvature measurement, simultaneous measurements of velocity and distance, enhancement of resolution)
- Array technology

Functional thin films:

- Electrocaloric layer stacks
- Ferromagnetic thin films
- Piezoelectric sensor and actuator layers
- Deposition technology and process development

Modeling and simulation:

- Component and system models
- Network modeling, finite element and finite network modeling
- Coupled simulation
- Application to sensor technology

Optical measurement technology

- Sensoric properties of optical nanostructures and nanomaterials
- Sensoric properties of ceramic phosphors
- Opto-electronic microsystems for sensor readout

Large-area deposition of nanocomposites with defined properties

- Fabrication of nanoparticles by means of gas phase condensation
- Embedding of nanoparticles into thin films by combining of gas phase condensation with other deposition techniques: RF-PECVD, reactive magnetron sputtering
- Nanoparticle materials consisting of metals, alloys and their reactive compounds in matrix materials of inorganic compounds (oxides, nitrides) or functional plasma polymer coatings
- Applications: Optical absorbers, antibacterial coatings of filtration membranes, electrically conducting percolation networks of nanoparticles for sensoric coatings

The chair is involved in the following major projects of the German Research Foundation (Deutsche Forschungsgemeinschaft - DFG):

- Research Training Group (Graduiertenkolleg) 1865 „Hydrogel-based microsystems“ (10/2013-09/2022).

- Research Training Group (Graduiertenkolleg) 2430 „Interactive fiber-rubber-composites“ (since 11/2018)

- Priority Programme SPP 1599: „Caloric effects in ferroic materials: New concepts for cooling“, Project “Electrocaloric multilayer and radial cooling device concepts” (10/2012 – 09/2019).

4.2. Research projects

In the following, only a short summary of objectives and results of our Laboratory´s research projects are presented. For theses and related references, a more comprehensive description is given below (cp. Chapters 5 and 6):

Research Training Group 1865/1 "Hydrogel-based Microsystems"

Spokesman:	Prof. Dr.-Ing. habil. Gerald Gerlach
Project leaders:	PD Dr.-Ing. habil. Margarita Günther Prof. Dr.-Ing. habil. Gerald Gerlach
PhD Students at IFE:	Dipl.-Ing. Julia Beyer Dipl.-Ing. Simon Binder M.Sc. Jan Erfkamp Dipl.-Phys. Nikolai Gulnizkij M.Sc. Christoph Kroh M.Sc. Alice Mieting Dipl.-Ing. Stefan Schreiber Dipl.-Ing. Sitao Wang
Postdoc	Dr. rer. nat. Daniela Franke
Funded by:	DFG (German Research Foundation)
Funding period:	01.04.2018 – 30.09.2022
Topics at IFE:	- Zero-power sensor switch. Hydrogels are used as a material for the switching element in self-sufficient energy systems. Therefore, the switching hysteresis and the kinetics of the hydrogel are important (Dipl.-Phys. Nikolai Gulnizkij). - Force-compensated pH-sensors: A bisensitive hydrogel combines sensor and actuator properties. The thermally controllable actuator function compensates the swelling pressure of the gel after a change in the measured variable. This prevents relaxation and drift effects and shortens the response time (Dipl.-Ing. Simon Binder, Dipl.-Ing. Stefan Schreiber). - Hydrogel-based piezoresistive chemo- and biosensors: By means of a targeted synthesis and functionalization, e.g. with enzymes, novel stimuli-sensitive hydrogels are designed and piezoresistive hydrogel sensors are produced and characterized (M.Sc. Jan Erfkamp). - Plasmonic-based fluid sensor with hydrogel-transducer: Implementation of parallel, optical measurement of temperature, pH and ethanol content in one sensor head with corresponding sensitive hydrogels, immobilized on the plasmonic sensor surface. For this, fundamental principles of the optical readout of hydrogel-based sensors for the application in the food industry are researched (M.Sc. Christoph Kroh, Dipl.-Ing. Julia Beyer). - Smart hydrogels for analyte detection in gases (Dipl.-Ing. Sitao Wang).

- Porous hydrogels with improved response time for application in microsystems (Dr. rer. nat. Daniela Franke)

Objectives:
Stimuli-responsive hydrogels whose reversible swelling process in an aqueous solution depends on the structure and design of the crosslinked polymer, are characterized by a large spectrum of different physical (e.g. temperature, electrical voltage, magnetic field) and chemical parameters (e.g. *pH*-value, analyte concentration in solution), are promising both for sensor as well as for actuator applications, especially since it has been shown that hydrogels can be integrated for corresponding applications in microsystems. Thus, integrated hydrogel-based sensors and actuators enable cost-effective microsystem solutions with a great functional potential. The aim of the Research Training Group is to further investigate the use of hydrogels for sensor and actuator functions in microsystems based on the fundamental knowledge of the synthesis and physicochemical properties and, thus, to lay the scientific basics for future microsystem applications. For this purpose, within the framework of the interdisciplinary research program of the Research Training Group, special materials and procedures based on the requirements of such applications (relevant functionality, high sensitivity, selectivity and long-term stability, short response times) will be developed and investigated numerically and experimentally. On the other hand, selected microsystems comprising these materials and methods are being investigated (e.g. long-term stable pressure-compensated *pH* sensors, biochemical sensors, implantable miniaturized sensor systems, powerless sensor switches, chemical transistors, microfluidic synthesis processors).
Related references: [DISS4], [3-8], [11], [20-21], [23], [31], [33-34], [37], [40-43], [46]

Research Training Group 2430/11865/1 “I-FEV Interactive Fiber-Rubber-Composites”

Spokesman:	Prof. Dr.-Ing. habil. Dipl.-Wirt.-Ing. Chokri Cherif
Project leader at IFE:	Prof. Dr.-Ing. habil. Gerald Gerlach
PhD Students at IFE:	Dipl.-Ing. Sascha Pfeil Dipl.-Ing. Johannes Mersch
Funded by:	DFG (German Research Foundation)
Funding period:	01.11.2018 – 31.04.2023
Topics at IFE:	- TP7: Modeling and metrological evaluation of adaptive components in I-FRCs using electro-mechanical network models. - TP8: Electro-mechanical modeling and metrological evaluation of I-FRCs with material-integrated sensors.

Objectives:
This Research Training Group (RTG) focusses mainly on interactive fiber-rubber composites (I-FRC), including structurally integrated smart actuator and sensor networks

- to specifically adjust component stiffness, and
- to achieve steplessly adjustable, complex deformation patterns with almost unlimited freedom of deformation, long deformation paths, and high actuating power with sensor feedback,

- as well as on in-depth scientific analyses of structural and material behavior on multiple scales.

Due to their high intrinsic deformation capacity, I-FRCs have becoming a promising approach to generate controllably deformable components with specifically adjustable properties. As actutors they can respond to changes in their environment (e.g. temperature and magnetic fields) and ensure precise as well as long-term stable functionalities by means of control circuits that are based on and linked to sensor condition monitoring. However, these functionalities require innovative component designs and cross-scale modelling, simulation, integration into system conceptions, experimental research, and material developments. These I-FRC are a new class of materials offering new properties. For example, the development of I-FRC allows for the reversible and contactless adjustment of geometric degrees of deformation for mechanical components; thus, various environmental requirements can be met in a quick and precise manner. This advantage makes them suitable for numerous fields of application, such as mechanical engineering, vehicle construction, robotics, architecture, orthotics, and prosthetics. Potential applications include their use in systems for precise gripping and transportation processes, such as hand prostheses, automated lids, seals, shapeable membranes, and adaptive flaps for rotor blades of wind turbines as well as trim tabs for ground- and watercraft to effectively reduce flow separation.

The objective of the Research Training Group is the simulation-based development of smart material combinations and gradations for self-sufficient I-FRCs with structurally integrated actuator and sensor networks to actively and locally adjust component stiffness. I-FRCs are also suitable to achieve controlled complex deformation patterns. Of particular interest will be characteristics in terms of large deformation capabilities, high frequencies, and large actuating powers due to sensor feedback in consideration of thermal and mechanical stress, while simultaneously reducing weight and enhancing compactness.

Related references: [24]

DFG Priority Program SPP 1599: Caloric effects in ferroic materials: New concepts for cooling

Project: Electrocaloric multilayer and radial cooling device concepts

Project leader:	Prof. Dr.-Ing. habil. Gerald Gerlach, Dr. rer. nat. Gunnar Suchaneck
Co-workers at IFE:	M.Sc. Rocco Liebschner
Collaboration:	TU Darmstadt, Institute of Materials Science; University of Duisburg-Essen, Institute for Materials Science; Fraunhofer-Institute for Ceramic Technologies and Systems (IKTS), Dresden; Leibnitz University Hannover, Institute of Assembly Technology
Funded by:	DFG (German Research Foundation)
Funding period:	11/2012 – 09/2019

Objectives/results:
- Development of a technology for the fabrication of multilayer electrocaloric elements comprising Ni electrodes by means of reactive sputtering of high-resistive, electrocaloric (Ba,Ca)(Zr,Ti)O_3 thin films at room temperature.
- Evaluation of the expected electrocaloric properties based on determination of the temperature coefficient of the dielectric constant above the Curie temperature.
- Investigation of the electrical breakdown behaviour and degradation in large electric fields.
- Pyroelectric calorimetry of the enthalphy time-dependence during electrical biasing.
- Fabrication and evaluation of the performance of cooling device demonstrators.

Related references: [16], [27]

DFG-Project: Development of advanced imaging techniques and novel segmented high-frequency ultrasound transducers for scanning acoustic microscopes

Project leader:	apl. Prof. Dr. rer. nat. et Ing. habil. Elfgard Kühnicke Dr.-Ing. Sylvia Gebhardt, Fraunhofer-IKTS
Co-workers at IFE:	Dipl.-Ing. André Juhrig, Dipl.-Ing. Mario Wolf Dr. rer. medic. Anke Burkhardt
Collaboration:	Fraunhofer Institute for Ceramic Technologies and Systems (IKTS)
Funded by:	DFG (German Research Foundation)
Funding period:	03/2016 – 01/2020

Objectives/results:
- Improvement of ultrasound imaging in layered structures with variable and unknown sound velocity.
- Expansion of test scenarios (examination under inclined planes and curved structures).
- Simultaneous inspection in multiple depths (determination of inclination angle of surfaces and interfaces).
- Development of a novel multichannel scanning acoustic microscopy system.
- Development of segmented annular array transducers with a frequency of 40 MHz and a better resolution compared to conventional transducers.
- Providing novel measurement methods and techniques as well as special structured ultrasound transducers for focussing the sound field and steering the ultrasound beam.
- Improvement of the soft-mold technique for the fabrication of small-scaled, spherically curved PZT-polymer composite, with an operating frequency of 40MHz.

Related references: [32], [44-45], [58]

DFG-Project: Non-invasive, simultaneous determination of thicknesses and sound velocities by ultrasound

Project leader:	apl. Prof. Dr. rer. nat. et Ing. habil. Elfgard Kühnicke
Co-workers at IFE:	Dr. rer. medic. Anke Burkhardt, Dipl.-Ing. André Juhrig, Dipl.-Ing. Ulrike Schmidt, Dipl.-Ing. Mario Wolf
Funded by:	DFG (German Research Foundation)
Funding period:	07/2017 – 07/2020

Objectives/results:

- Goal: Providing a robust measuring technique to determine simultaneously sound velocities and thicknesses of layered structures (based on the results of a previous project).
- Simultaneous evaluation of material quality and geometry of the specimen.
- Use of single arrays without additional reflectors for examining specimen accessible only on one side.
- Significant improvement of the accuracy especially for structures with three or more layers.
- Development and qualification of a fast simulation algorithm.

Related references: [SA2-4], [22], [30], [57]

DFG-Project: Nanostructured absorber and emitter layers for thermal infrared sensors and radiators (ABSISIS)

Project leader:	Prof. Dr.-Ing. habil. Gerald Gerlach
Co-workers at IFE:	Dr.-Ing. Marco Schossig Dipl.-Ing. Tobias Ott, Dipl.-Ing. Steffen Junker, Christian Norkus
Funded by:	DFG (German Research Foundation)
Funding period:	08/2015 – 09/2019

Objectives/results:

- Deposition of nanostructured absorber and emitter thin films.
- Investigation of the physical (optical, electrical, mechanical, thermal) properties of thin films and particularly the determination of the layer porosity in dependence of the layer thickness.
- Modelling and simulation of the layer and device properties.
- Fabrication and characterisation of infrared sensors and emitters with nanostructured absorber layer.

Related references: [12]

DFG-Project: Mesoporous hydrogels from microemulsions and related structures for hydrogel-based piezoresistive sensors (MESOPOR)

Project leader: Prof. Dr.-Ing. habil. Gerald Gerlach
Co-workers at IFE: Dr. rer. nat. Daniela Franke
Funded by: DFG (German Research Foundation)
Funding period: 01/2018 – 12/2020

Objectives/results:

- Fabrication of porous hydrogel layers to improve the response behavior of hydrogel-based sensors.
- Synthesis of porous, pH-sensitive hydrogels.
- Deposition of pH-sensitive polymer surfactant structures.
- Characterization of the porosity by means of different imaging methods.
- Characterization of the swelling behavior during free swelling.
- Fabrication of hydrogel-based piezoresistive sensors and their characterization.

Related references: [34], [42-43]

EU Project: Physical principles of the creation of novel SPINtronic materials on the base of MULTIlayered metal-oxide FILMs for magnetic sensors and MRAM (SPINMULTIFILM)

Project leader: Prof. Dr.-Ing. habil. Gerald Gerlach
Co-workers at IFE: Dr. rer. nat. Gunnar Suchaneck
Collaboration: University Aveiro, Department of Physics (Portugal); Vrije Universiteit Brussel, Department MACH "Materials in Chemistry" (Belgium); Kaunas University of Technology; Institute of Materials Science (Lithuania); SSPA Scientific and Practical Materials Research Center of NAS of Belarus, Division of Cryogenic Research (Belarus); Institute of Magnetism of the National Academy of Science of Ukraine and the Ministry of Education and Science of Ukraine, Laboratory of Nanocrystalline Structures (Ukraine); WMT Wire Machine Technology (Israel)
Funded by: EU (Horizon 2020) - Marie Skłodowska-Curie Research and Innovation Staff Exchange (MSCA-RISE)
Funding period: 01/2018 – 12/2021

Objectives/results:

- Synthesis of metal-oxide compounds on the base of Sr_2FeMoO_6.
- Creation of nanoheterostructures with dielectric interlayers.
- Characterization and simulation of nanoheterostructures.
- Prototyping of spintronic devices.
- Knowledge exchange and outreach activities.

Related references: [14], [29], [55]

Cooperation project: Submersible refractive index sensor as technology platform for process and environmental monitoring (TauSenT)

Project part: **Transducer development of pH- and ethanol-sensitive hydrogels as sensitive coating for optical transducers**

Project leader: Hon.-Prof. Dr. habil. Thomas Härtling
Collaboration: Fraunhofer-Institute for Ceramic Technologies and Systems (IKTS)
Funded by: BMBF (Federal Ministry of Education and Research)
Funding period: 01/2017 – 12/2019

Objectives/results:

- Development of a multi-sensor platform for detection of parameters in liquids, especially refractive index, pH and ethanol concentration.
- Adaption of the platform to the needs of the brewing industry.
- Proof-of-concept for monitoring of fermentation in large volume fermenters.

Related references: [DISS2], [11], [13], [17], [46]

Cooperation project: High-frequency adjustable, textile-based actuator structures for complex fiber-plastic composite kinematics with high degrees of deformation (HoTexA)

Project leader: Prof. Dr.-Ing. habil. Dipl.-Wirt.-Ing. Chokri Cherif (ITM)
Dr.-Ing. Sven Wießner (IPF)
Prof. Dr.-Ing. habil. Gerald Gerlach (IFE)
Collaboration: Institute of Textile Machinery and High-Performance Materials (ITM), TU Dresden; Leibniz-Institute of Polymer Research Dresden e. V. (IPF);
Funded by: AiF (German Federation of Industrial Research Associations), Forschungskuratorium Textil e.V. (Confederation of the German Textile and Fashion Industry)
Funding period: 10/2019 – 03/2022

Objectives/results:

- Development of functionalized, textile reinforcement structures with structure-integrated, textile-based, high-frequency actuators for geometrically complex fiber-plastic composite applications with fast adaptive adjustment potential.
- Targeted design, development and testing of new textile actuators based on dielectric elastomers.
- Implementation as coaxial conductor in a hybrid construction with highly stretchable, long-term stable, textile-based internal and external electrodes.
- Design and development of a function-specific actuator (e.g. gradient reinforcement structures and multi-matrix systems).

- Automated actuator integration in the area-forming process (e.g. through weaving, or knitting).

Cooperation project: Component-integrated sensors for power transmission elements in wind power stations (BiSWind)

Project part: **Energy harvesting by means of piezoelectric thin films**

Project leader:	Prof. Dr.-Ing. habil. Gerald Gerlach
Co-workers at IFE:	Dipl.-Phys. Annekatrin Delan
Collaboration:	Schaeffler Technologies AG & Co. KG, Herzogenaurach; VTD Vakuumtechnik Dresden GmbH, Dresden; Siegert Thinfilm Technology GmbH, Hermsdorf; Schaeffler Engineering GmbH, Werdohl; Micro Systems Engineering GmbH, Berg; Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology (FEP), Dresden; Fraunhofer-Institute for Ceramic Technologies and Systems (IKTS), Dresden; University Bremen, Bremen Institute for Metrology, Automation and Quality Science (BIMAQ); TU Ilmenau, Micromechanical Systems Group; TU Ilmenau, Electronics Technology Group
Funded by:	BMWi ((Federal Ministry for Economic Affairs and Energy)
Funding period:	12/2015 - 07/2019

Objectives/results:

- Goal: Development of an autonomous measurement system for condition monitoring based on component-integrated sensors.
- Monitored values: Torque, temperature, vibration and rotation speed.
- Robustness against aging and resistance against (aggressive) media, e.g., cooling agents, lubricants, moisture, de-icing agents.
- Investigation of technologies and concepts to integrate the sensors directly, without adhesive bonds, on the surfaces of the rotationally symmetric component by thin-film technology and microstructure technology.
- Focus of this subproject: Development of highly efficient energy harvesters to ensure the power supply of the sensor elements, development of a customized module for energy generation with high stability based on piezoelectric layers, reduction of the defect density of the isolation layers.

Related references: [25-26]

Cooperation project: Advanced free-form coating of flat and 3-dimensional substrates (3D-FF)

Project part: **Model development for simulation, calculation and layer property optimization in free-form coating**

Project leader:	Prof. Dr.-Ing. habil. Gerald Gerlach
Co-workers at IFE:	Dipl.-Phys. Annekatrin Delan
Collaboration:	Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology (FEP), Dresden; AIS Automation Dresden GmbH; LSA GmbH; Von Ardenne GmbH; SeeReal Technologies GmbH; TU Dresden, Institute of Numerical Mathematics (INM)
Funded by:	SAB (Development Bank of Saxony)
Funding period:	08/2019 - 02/2022

Objectives/results:

- Goal: high-precision free-form coating of large substrates, i.e. realization of highly defined layer thickness profiles on 3D surfaces.
- Functional coatings in efficient, automated coating processes.
- Combination of new concepts for coating systems and innovative substrate motion modules, a highly productive precision coating technology and a software platform that provides a continuous data chain from the layer thickness simulation to the coating process and automatic system control.
- Model development for simulation, calculation and optimization of the layer properties in the free-form coating.

Cooperation project: Development of an inline sensor for permanent control and assessment of the development of biofilms in water-bearing piping systems (inline biofilm sensor)

Project part: **Development of the sensor head and deposition of the sensor layers**

Project leader:	Prof. Dr.-Ing. habil. Gerald Gerlach
Co-workers at IFE:	Dipl.-Phys. Annekatrin Delan Dr.-Ing. Harry Nizard
Collaboration:	Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology (FEP), Dresden; -4H-Jena engineering GmbH; 3Faktur GmbH, Jena; Institute for Bioprocessing and Analytical Measurement Techniques e.V., Heiligenstadt
Funded by:	BMWi (Federal Ministry for Economic Affairs and Energy) and AiF (German Federation of Industrial Research Associations)
Funding period:	11/2019 – 10/2021

Objectives/results:
- Goal: Development of an inline biofilm sensor for the detection of bacterial contamination in water-bearing systems for drinking water supply and technical water circuits by means of impedance measurement.
- Enrichment and detection of biofilms on substrate traps.
- Definition of threshold values for the indication of a prohibited bacterial contamination at an early stage.

Cooperation project: Spectral multi-channel pyroelectric high-detectivity sensors in an SMD housing (PYRO-SMD)

Project leader:	Dr.-Ing. Volkmar Norkus
Co-workers at IFE:	Dipl.-Ing. Agnes Eydam, Dipl.-Ing. Siegfried Kostka, Dipl.-Ing. Volker Krause, Sabine Herbst, Ulrike Lehmann, Christian Norkus
Collaboration:	DIAS Infrared GmbH, Dresden
Funded by:	AiF
Funding period:	10/2018 – 09/2020

Objectives/results:
- Concept, sensor layout and design of the micro-optical modul.
- Metrological characterization of interference filters.
- Design and implementation of the filter cage with a chip carrier.
- Design and implementation of micromechanical beam splitters.

Cooperation project: Pilot line for the next generation of high-integratet microelectronics (PIN3S)

Project leader:	Prof. Dr.-Ing. habil. Gerald Gerlach
Mitarbeiter am IFE:	Dr. rer. nat. Gunnar Suchaneck Dipl.-Ing. Simon Binder
Collaboration and funding:	Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology (FEP); Dresden
Funding period:	10/2019 - 12/2020

Objectives/results:
- Fabrication of piezoelectric thin films on predetermined glass substrates.

ESF-Project: Orientation Platform Research & Practice (OFP)

General Project Manager	M.A. Christiane Einmahl, ZiLL (Center for Interdisciplinary Learning and Teaching)
Project leader at IFE:	Prof. Dr.-Ing. habil. Gerald Gerlach
Co-workers at IFE/Faculty:	Dr.-Ing. Julia Kuß Dipl.-Wirt.-Inf. Daniel Knöfel
Funded by:	ESF (European Social Fund)
Funding period:	05/2016 – 12/2023

Objectives/results:

- Increase the intrinsic motivation of students from the first to fourth semester from the participating Faculties of Chemistry and Food Chemistry, Electrical and Computer Engineering, Computer Science, Mechanical Engineering and Mathematics to increase study results.
- Provide insights into subject-related research projects during the basic studies.
- Identification of areas of application of knowledge acquired in the course of studies.
- Formats at the Faculty of Electrical and Computer Engineering: 2019:
  - "Company rallye" / Excursions to Preh Car Connect GmbH (13.10.2019) and Infineon (25.11.2019) for students.
  - BeING Inside – Interdisciplinary engineering practice (together with the Faculties of Chemistry and Mechanical Science and Engineering, as well as BASF Schwarzheide for students and 11th grade pupils (25.-29.3.2019).
  - Workshop „Flow Masters, Cloud Testing“ (22.05.2019).
  - Workshop „Agile Meets Lego“ (24.01.2019).
  - Three workshop for study applicants: “Rookie Becomes an Engineer” with Bertrandt Services, DAS Environmental Expert, Diehl Aviation Gilching, Fraunhofer IPMS, FSD Fahrzeugsystemdaten, Preh Car Connect, SEMPA Systems, SPLU Experts, Sunfire, Von Ardenne and XENON Automatisierungstechnik (28.8.2019), „Expert Workshop“ – Discussion of expected skills of an engineer with regard to interdisciplinary and (inter) national working groups of different sizes (4.9.2019 with Schreibzentrum TUD), and „How to be a Maker“ – Introduction to the organizational structure of the Makerspace. Illustration of the creative process in engineering work based on a practical task and its implementation by means of Arduino-Kit „Uno 1“(11.-13.9.2019).
  - Workshop „Arduino“ with State Chats (02.12.2019).

Further information: https://tu-dresden.de/deinstudienerfolg/ofp

ESF-Project: Development of online self-assessments (OSA) for selected study programs of the TU Dresden with a special focus on STEM subjects.

General Project Manager:	Prof. Dr.-Ing. habil. Hans-Georg Krauthäuser, Vice-Rector for Education M.A. Christiane Einmahl, ZiLL (Center for Interdisciplinary Learning and Teaching)
Project leaders of the partners:	Prof. Dr.-Ing. habil. Gerald Gerlach, Prof. Dr. Thomas Köhler (Media Centre) apl. Prof. Dr. Petra Kemter-Hofmann (Faculty of Psychology)
Co-workers at IFE/Faculty:	Dr.-Ing. Julia Kuß Dr. rer. medic Anja Abdel-Haq
Funded by:	ESF (European Social Fund)
Funding period:	09/2016 – 12/2021

Objectives/results:

- Developing online self-assessment tests for the study program in Electrical Engineering at TU Dresden.
- Accompanying information and counseling offer for the participating students.
- Matching the individual competencies, interests and expectations of prospective and first-year students with the requirements and actual content of the study program.
- Promote a conscious choice of study branch in order to increase the success of the study and to prevent dropouts.
- Testing of prior technical knowledge and expertise on the basis of problem-oriented specialized tasks.
- The first version of the OSA prototype was created and evaluated with first-year students.

Further information: https://tu-dresden.de/deinstudienerfolg/osa

4.3 Facilities and Equipment

The Solid-State Electronics Labratory is equipped with process facilities which allow us to deal with sophisticated scientific tasks and projects. In detail, the following facilities are available in our laboratories:

Sensor technology laboratory:
- Precision crystal treatment by sawing (Struers), grinding, lapping, and polishing (PM2A, Struers)
- Photolithography
- Wire bonding (type 1419 and 4126, K&S)

Vacuum engineering laboratory:
- Multi-target sputtering system (LS703S, von Ardenne Anlagentechnik)
- Sputter equipment
- Ion beam etching equipment (scia Mill 150, scia Systems GmbH, Microetch 301A, Veeco)
- PECVD/RIE double chamber tool (Plasmalab 60Plus, Oxford Plasma Technology)

Plasma technology laboratory:
- Vacuum system for fabrication of nanoparticles and nanocomposite layers
- 60 MHz plasma source for deposition of plasma polymers and inorganic composite layers
- Gas flow sputter source for creation of anorganic nanoparticles
- Vacuum deposition system Pfeiffer PLS570 comprising puls sputtering
- RF-Sputter system Perkin Elmer 2400
- Plasma cleaner (RF and microwave) Plasma Electronics MR300D

Process measurement instruments:
- Scanning surface profile measuring system (Profiler Dektak)
- FT-IR spectrometer (Spectrum 2000, Perkin Elmer)
- Laser interferometer (SP 120, SIOS)
- Dual-beam laser vibrometer (Polytec)
- Ellipsometer Plasmos SD2000,
- Optical contact angle instrumentation DataPhysics OCA20/6

PC-controlled measurement equipment:
- Dielectric and pyroelectric properties of ferroelectric materials
- LIMM (Laser intensity modulation method) setup for the depth-resolved non-invasive determination of polarization in piezo-, pyro- and ferroelectrics
- Characteristic parameters of infrared detectors (single-element and line detectors, focal plane arrays)
- Sample response to pressure changes
- Sample response to humidity and temperature changes
- High temperature system (Novotherm HT1200) for characterization of electrical properties
- Measurement of amplitude and frequency for resonance frequency determination

- Evaluation of the dynamic behavior of MEMS devices
- Analysis of the thermal and temporal influence on sensors
- Measurement set-up for gas sensor evaluation

IR applications laboratory:
- Blackbody radiators (Mikron M300, DIAS, HGH RCN 300)
- Pyrometer (Heimann, infra sensor, Raytek)
- Line scanner and 2D infrared cameras (DIAS GmbH)
- Thermal vision camera (Inframetrics)
- Climatic exposure test cabinet (mytron WB80KH)

Ultrasound technology:
- Scanning ultrasonic microscope D6000 (10 to 230 MHz)
- One-channel ultrasonic test instrument for non-destructive examination
- Ultrasound field measuring station with x-y-z positioning system
- 8-channel ultrasonic sending-receiving system comprising ADC (125 MS/s sampling rate per channel) for signal analysis
- 10-channel ultrasonic sending-receiving system comprising ADC (500 MS/s sampling rate per channel) for microscopy application (up to 200 MHz)
- Measuring set-up for sound velocity determination in fluids without reference reflectors (one-channel, x-y positioning system, thermostat)
- Ultrasonic annular arrays (3...19 MHz), focussing transducers (8...100 MHz)

CAE laboratory:
- Software: ANSYS, PSpice, Matlab, LabView, Testpoint

5. THESES AND CERTIFICATES

5.1. PhD theses

In 2019, 15 doctoral students (including 6 external ones) were supervised by the Chair of Solid-State Electronics. The following PhD theses were successfully defended:

[DISS 1] Marisa Rio: **Microfluidic Biochip for Studying Electrotaxis of Cells under Direct Current Electric Fields.**

Supervisors: Prof. Dr.-Ing. habil. Gerald Gerlach

Day of defence: February 26, 2019

Endogenous electric fields (EFs) are fundamental in biological processes such as embryonic development, regeneration, and wound healing. However, lack of a deeper understanding of their role and action mechanisms halts advances in bioengineering, regenerative medicine, and synthetic morphology. In order to gain an insight into these biological phenomena, researchers apply electric fields to cells in vitro and study the subsequent cellular responses. Until now, the phenomenon of electrotaxis has only been studied in homogeneous electric fields. This dissertation introduces a microfluidic biochip that allows stimulation of cells with stationary, non-homogeneous electric fields, e.g. to simulate the electrical environment during repair processes such as wound healing. The fabrication process used for this research focuses on photolithography and soft lithography techniques that enable the construction of a biocompatible, compact and transparent device. The special electrode arrangement at the end of each microfluidic channel spatially separates the non-polarizable electrodes from the cell surface, enabling long-term stimulation.
A numerical simulation was used to elucidate the EF distribution over the cell chamber. This confirmed the applicability of non-homogenous EFs within physiological strengths. Furthermore, biocompatibility was confirmed by viability assay and immunofluorescence staining on the photoreceptor-derived 661W cell line. Electrotaxis experiments have confirmed the DC EF-induced, cathodal-directed motility of the studied cell line.
In addition, a “scratch assay” monitored the wound dynamics upon stimulation with different electric fields strengths. The experimental results showed that wound healing response is highly regulated by field strength and exposure time to non-homogeneous EFs.

Publication:
M. Rio: Microfluidic biochip for studying electrotaxis of cells under direct current electric fields. Dresdner Beiträge zur Sensorik, Band 73. Dresden: TUDpress 2019. ISBN: 978-3-95908-167-2

[DISS 2] Roland Wuchrer: **Compact Interrogation Unit Based on a Double Photodiode for Spectral-optical Sensors**

Supervisors: Prof. Dr.-Ing. habil. Gerald Gerlach
Hon.-Prof. Dr. rer. nat. et Ing. habil. Thomas Härtling

Day of defence: March 8, 2019

Spectral-optical sensors determine physical or (bio-) chemical measurands on the basis of specific spectral property changes of the transducer. This relatively young sensor technology is characterized, besides the spectral adjustability and compact size, by high sensitivity, electrical passivity and applicability under extreme conditions (temperature, humidity, …). It offers a wide range of industrial applications, where established electronic sensors either cannot be used, or are used only to a limited extent. This work starts with an introduction to plasmonic principles for refractive index measurement and inorganic phosphors as thermographic sensor material. Their spectral operation is based either on a defined wavelength shift or a change in the intensity ratio of two spectral lines. It turned out that in these two examples the cost-intensive and bulky readout hardware limits their range of applications.
This thesis aims at contributing to the development of a novel miniaturized optoelectronic read-out unit. The key component of the assembly is a double-layer photodiode (also referred to as wavelength-sensitive photodiode), which unites a spectral-selective element and detector through its vertical stack design of two photodiodes with different spectral sensitivity. The measured photocurrent ratio of the two photodiodes allows an intensity-independent, real-time and position tolerant signal detection. The robust measurement behavior of the double-layered photodiode opens up completely new setup concepts for spectral-optical sensors. The capability of the readout unit is demonstrated with a dual-channel fluid sensor system for the refractive index measurement with a three-dimensional nanostructured plasmonic gold layer. The second sensor setup is a fiber-optical surface temperature detector with the upconversion material $NaYF_4$: Yb^{3+}, Er^{3+}. Both setups will be characterized under well-defined laboratory conditions in terms of resolution and stability. In that regard, the measurement behavior of the DPD will be verified with calculations based on reference spectra.
This approach combines the simplicity of an intensity measurement setup with the robustness of spectral readout and, hence, enables the application of the interrogation unit for all kinds of spectral-optical sensors.

Publication:
R. Wuchrer: Kompakte Abfrageeinheit auf Basis einer Doppelphotodiode für die spektraloptische Sensorik. Dresdner Beiträge zur Sensorik, Band 72. Dresden: TUDpress 2019. ISBN: 978-3-95908-184-9

[DISS 3] Anna Schröter **Impedimetric Sensor for Wound Monitoring**

Supervisor: Prof. Dr.-Ing. habil. Gerald Gerlach

Day of defence: October 2, 2019

For almost 40 years, measuring principles have been investigated to assess the condition of a wound. Systems that have been commercially available so far require the opening of the dressing. The risk of an undiscovered infection during prolonged use of modern, hydroactive wound dressings speaks in favour of online monitoring. Larger dressing change intervals significantly increase the chance that the wound will heal. So far, there are only a few practicable approaches for integrated monitoring solutions. The measurement of the electrical parameter impedance can be easily miniaturised and the susceptibility to failure can be reduced by simple measures. Being independent from a transducer makes this method more energy-efficient and thus enables mobile applications. To the author's knowledge, this work deals for the first time with the impedimetric characterization of the immunologically important NETs (Neutrophil Extracellular Traps) and investigates the potential of this measurement method for a wound infection sensor.
The immune response was examined using impedance spectroscopy in an artificial wound environment. Typical parameters for NET formation, such as time course, distinctive spectra and characteristic frequencies, were determined. The method was verified with quantification methods for NETs commonly used in the literature. The impedimetric NET detection proved to be reliable and robust. With both chemical stimulants and microbes, an amplitude was clearly measurable. The large signal changes of more than 100 % on average increase the chance that this method also works reliably in the natural wound environment and with less precise measurement equipment.

[DISS 4] Christoph Kroh **Hydrogel-based Plasmonic Sensor for Inline Monitoring of Liquid Parameters**

Supervisors: Prof. Dr.-Ing. habil. Gerald Gerlach
Hon.-Prof. Dr. rer. nat. et Ing. habil. Thomas Härtling

Day of defence: December 10, 2019

In many industries, the need for efficient, cost-effective and inline-capable sensors for detecting chemical and physical properties in liquids is steadily increasing. Due to their biocompatibility and their comparatively simple manufacturing process, responsive hydrogels are especially suitable for the detection of these parameters. Hydrogels are hydrophilic, water-insoluble polymers that respond to an external stimulus by swelling or deswelling. Thick hydrogel layers are usually necessary for previously developed piezoresistive, hydrogel-based sensors, causing their response time to reach a range of several minutes up to several hours. By using optical sensors these response times are becoming independent of the hydrogel layer thickness and can be reduced to a few seconds, thus enabling real-time applications.

This work is dedicated to the study and application of micrometer-thin hydrogel layers for different liquid parameters. To begin with, the properties of a nanostructured plasmonic sensor substrate are presented. The substrate serves as a transducer that is sensitive to the refractive index, with which the swelling of the hydrogel can be optically detected. The core of this work is the development of sensors for the detection of ethanol concentrations in liquids based on a polyacrylamide hydrogel. This work demonstrates that, by combining the plasmonic sensor and the hydrogel, ethanol concentrations can be detected and evaluated with sufficient accuracy. Furthermore, the properties, cross sensitivities and sterilizability of the sensor are presented. An additional focus of this work is on the preparation of thin hydrogel layers on the plasmonic sensor substrates and for this, a method for microstructuring the gel layer is presented. It is shown that with this method the response time of the sensors can be reduced to only a few seconds. Finally, the use of a pH-sensitive hydrogel demonstrates the simple applicability of the measurement principle to additional liquid parameters, allowing the development of multi-parameter measurement systems.

5.2. Diploma theses

(Supervisors in brackets)

[DA 1] Stefan Schreiber:
Entwurf und Aufbau einer Ansteuerelektronik für einen Sensor zur Bestimmung der thermophysikalischen Eigenschaften von Fluiden (Design and realization of the control electronics for a sensor to determine thermophysical properties of fluids)
(Prof. Dr.-Ing. habil. G. Gerlach / PD Dr.-Ing. habil. H. Budzier, Dr. M. Seilmayer [HZDR, Rossendorf])

5.3. Master theses

[MA 1] Anirhudda Sathyadharma Prasad:
Simulation and experimental investigations on coupled micro- and non-mechanical oscillating beams
(Prof. Dr.-Ing. habil. G. Gerlach, Prof. I. De Wolf [KU Leuven, Belgien], Prof. Dr. rer. nat. B. Büchner [IFW Dresden])

5.4. Study Projects

[SA 1] Gerrit Bücken:
Systemtheoretische Modellierung von ko-resonanten Cantilever-Sensoren (System theory-based modeling of co-resonant cantilever sensors)
(Prof. Dr.-Ing. habil. G. Gerlach, Prof. Dr.-Ing. J. Körner)

[SA 2] Emanuel Leipner:
Bestimmung geeigneter Versuchsparameter zur Messung der Transversalwellengeschwindigkeit in Gewebephantomen aus PAA (Determination of suitable test parameters for measuring the transverse wave velocity in tissue phantoms made of PAA)
(apl. Prof. Dr. rer. nat. et Ing. habil. Kühnicke, Dipl.-Ing. M. Wolf)

[SA 3] Ronja Schramm:
Aufbau eines Experimentierstandes zur gezielten Erwärmung eines Gewebephantoms mittels hochintensivem Ultraschall (Assembly of an experiment setup for the targeted heating of a tissue phantom using high-intensity ultrasound)
(apl. Prof. Dr. rer. nat. et Ing. habil. Kühnicke, Dipl.-Ing. M. Wolf, Dipl.-Ing. A. Juhrig)

[SA 4] Victoria Constance Köst:
Untersuchung zum Denaturierungsverhalten von PAA-Eiweiß-Phantomen (Investigation of the denaturing behavior of PAA protein phantoms)
(apl. Prof. Dr. rer. nat. et Ing. habil. Kühnicke, Dipl.-Ing. M. Wolf)

6. PUBLICATIONS

6.1. Book series: Dresden to Sensor Technology Contributions

Since 1996 the book series „Dresdner Beiträge zur Sensorik“ edited by G. GERLACH has been published. The aim of this series is the publication of outstanding scientific contributions of TU Dresden, especially of those produced at the Solid-State Electronics Laboratory. The 71 volumes published earlier were continued by two new ones in 2019.

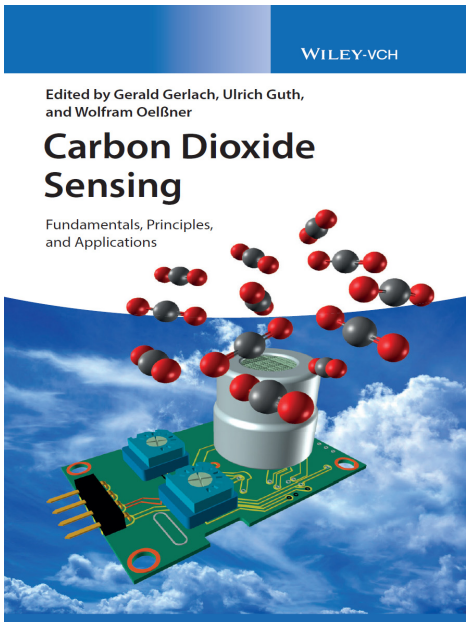
R. Wuchrer: Kompakte Abfrageeinheit auf Basis einer Doppelphotodiode für die spektraloptische Sensorik (Compact interrogation unit for spectral-optical sensors based on double photodiodes). Dresdner Beiträge zur Sensorik, Band 72. Dresden: TUDpress 2019. ISBN: 978-3-95908-184-9

M. Rio: Microfluidic biochip for studying electrotaxis of cells under direct current electric fields. Dresdner Beiträge zur Sensorik, Band 73. Dresden: TUDpress 2019. ISBN: 978-3-95908-167-2

6.2. Books

1. G. Gerlach, U. Guth, W. Oelßner (Eds.): Carbon Dioxide Sensing – Fundamentals, Principles, and Applications. Weinheim: Wiley-VCH 2019.

2. G. Gerlach (Hrsg.): Spicken erlaubt – Einfach schöne Spickzettel. Cribbing allowed – Simply beautiful crib sheets (zweisprachig). Katalog zur Ausstellung, 80 Seiten, Dresden: TUDpress 2019 (to order via www.jpc.de).



6.3. Papers in Journals

3. S. Binder, G. Gerlach: Intramolecular force-compensated hydrogel-based sensors with reduced response times. Technisches Messen 86 (2019) 4, 227-236.

4. J. Erfkamp, M. Günther, G. Gerlach: Piezoresistive hydrogel-based sensors for the detection of ammonia. Sensors 19 (2019), 971 (13 pp.).

5. J. Erfkamp, M. Günther, G. Gerlach: Hydrogel-based sensors for the ethanol detection in alcoholic beverages. Sensors 19 (2019), 1199 (14 pp.).

6. J. Erfkamp, M. Guenther, G. Gerlach: Enzyme-functionalized piezoresistive hydrogel biosensors for the detection of urea. Sensors 19 (2019), 2858 (15 pp.)

7. G. Gerlach: Hydrogel-based chemical and biochemical sensors. Zeszyty Naukowe Wydziału Elektrotechniki i Automatyki Politechniki Gdańskiej (Scientific Papers of the Faculty of Electrical Engineering and Automation, Gdansk University of Technology) 66 (2019), 15-19.

8. N. Gulnizkij, G. Gerlach: Modelling and model verification of an autonomous threshold sensor for humidity measurements. Journal of Sensors and Sensor System 8 (2019).

9. M. Guenther, F. Altenkirch, K. Ostermann, G. Rödel, I. Tobehn-Steinhäuser, S. Herbst, S. Görlandt, G. Gerlach: Optical and impedimetric study of genetically modified cells for diclofenac sensing. Journal of Sensors and Sensor Systems 8 (2019), 215-222.

10. K. Hohlfeld, S. Eßlinger, A. Eydam, A. Winkler, T. Weber, M. Gude, N. Modler, G. Gerlach, G. Suchaneck, A. Michaelis, A. Schönecker, S. Gebhardt, P. Neumeister: Integration of piezoceramic composites into structural components: Effect on the polarisation state and polarizability. Journal of Ceramic Science and Technology 10 (2019) 1, 19-26.

11. C. Kroh, R. Wuchrer, N. Steinke, M. Guenther, G. Gerlach, T. Härtling: Hydrogel-based plasmonic sensor substrate for the detection of ethanol. Sensors 19 (2019), 1264 (10 pp.).

12. T. Ott, D. Roldán, C. Redenbach, K. Schladitz, M. Godehardt, S. Höhn: Three-dimensional structural comparison of tantalum glancing angle deposition thin films by FIB-SEM. Journal of Sensors and Sensor System 8 (2019), 305–315.

13. N. Steinke, S. Döring, R. Wuchrer, C. Kroh, G. Gerlach, T. Härtling: Plasmonic sensor for on-site detection of diclofenac molecules. Sensors and Actuators B 288 (2019), 594-600.

14. G. Suchaneck, N. Kalanda, E. Artsiukh, G. Gerlach: Challenges in $Sr_2FeMoO_{6-\delta}$ thin film deposition. Physica Status Solidi B 2019, DOI: 10.1002/pssb. 201900312.

15. G. Suchaneck, U.V. Yakhnevych, A. Eydam, D.Yu. Sugak, I.I. Syvorotka, V.G. Haiduchok, S.B. Ubizskii, G. Gerlach: Depth profiling of dopant concentration and pyroelectric properties of $LiNbO_3$ single crystals treated at high-temperature in the presence of metal ions. Ferroelectrics 539 (2019), 151-157.

16. G. Suchaneck, L. Felsberg, G. Gerlach: Materials issues in thermal modeling of thin film electrocaloric solid-state refrigerators. Modern Electronic Materials 4 (2018) 59-69.

17. R. Wuchrer, T. Härtling, G. Gerlach: Onlinefähige Signalauswertung für spektral-optische Sensoren mit einer Doppelphotodiode. Technisches Messen 86 (S1) (2019), S37-S41.

18. R. Unger, A. Nocke, G. Gerlach, C. Cherif: Evaluation of a novel test method for the determination of strain rate-dependent material properties of high-performance fibres. Procedia Structural Integrity 17 (2019), 942-948.

19. U.V. Yakhnevych, G. Suchaneck, A. Eydam, D.Yu. Sugak, I.I. Syvorotka, V.G. Haiduchok, O.A. Buryy, S.B. Ubizskii, G. Gerlach: Investigation of optical and pyroelectric properties of lithium niobate single crystals caused by metal ions diffusion. Journal of Nano- and Electronic Physics 11 (2019) 1, 01017 (5 pp).

6.4. Conference and Workshop Contributions

20. N. Gulnizkij, G. Gerlach: Realisierung eines bistabilen Feuchtesensorschalters mit Schalthysterese. In: Sensoren und Messsysteme 2019, 20. GMA/ITG-Fachtagung, Nürnberg, 25.-26.06.2019. Wunstorf: AMA Service GmbH, 177-182.

21. M. Gulnizkij, G. Gerlach: Bistable hydrogel-based sensor switch for monitoring relative humidity. In: IEEE Sensors Conference, Montreal, Canada, 27.-30.10.2019.

22. A. Juhrig, U. Schmidt, M. Wolf, E. Kühnicke: Schallfeldcharakterisierung an neu entwickeltem mehrkanaligem 20 MHz Annular-Array für die Ultraschallmikroskopie. In: 45. Deutsche Jahrestagung für Akustik – DAGA 2019, 18.-21.03.2019, Rostock, Proceedings, 1069-1072.

23. C. Kroh, R. Wuchrer, N. Steinke, M. Guenther, G. Gerlach, T. Härtling: Fast response hydrogel-based plasmonic sensor substrate for the detection of ethanol. In: IEEE Sensors, Conference, Montreal, Canada, 27.-30.10.2019.

24. J. Mersch, S. Pfeil, F. Lohse, H. Probst, C. Cherif, G. Gerlach: Textile-amplified elastomer actuators for soft robotics. In: AUTEX2019 – 19th World Textile Conference on Textiles at the Crossroads, 11-15 June 2019, Ghent, Belgium (6 pages).

25. R. Petrich, H. Bartsch, K. Tonisch, K. Jaekel, S. Barth, H. Bartzsch, D. Glöß, A. Delan, S. Krischok, S. Strehle, M. Hoffmann, J. Müller: Investigation of ScAlN for piezoelectric and ferroelectric applications. In: 22nd Microelectronics and Packaging Conference (EMPC), 16.-19.09.2019, Pisa.

26. R. Petrich, H. Bartsch, K. Tonisch, K. Jaekel, S. Barth, H. Bartzsch, D. Glöß, A. Delan, S. Krischok, S. Strehle, M. Hoffmann, J. Müller: Untersuchung von ScAlN für piezoelektrische und ferroelektrische Anwendungen. In: MikroSystemTechnik Kongress 2019; 28.-30.10.2019, Berlin, P1.2.

27. I.A. Starkov, G. Suchaneck, A. S. Starkov, G. Gerlach: Modeling of hybrid relaxor-ferroelectric $Ba(Zr_{0.2}Ti_{0.8})O_3$ ceramics. IEEE F2cπ^2 Joint Conference, July14-19, 2019, Lausanne (Switzerland), Electronic Abstracts, Oral contribution TuORii4A.3.

28. M. Stoehr, G. Gerlach, T. Härtling, S. Schoenfelder: Analysis of photoelastic properties of monocrystalline silicon. In: Sensoren und Messsysteme 2019, 20. GMA/ITG-Fachtagung, Nürnberg, 25.-26.06.2019. Wunstorf: AMA Service GmbH, 695-699.

29. G. Suchaneck, E. Artsiukh, R. Liebschner, M. Kalanda, G. Gerlach: Multi-target reactive sputter deposition of strontium ferromolybdate - Challenges and approaches. In: IWAMO 2019 – International Workshop on Advanced Magnetic Oxides. April 15-19, 2019, Aveiro (Portugal), Invited talk, Workshop Book, p. 29.

30. M. Wolf, E. Kühnicke: Schallfeldbasierte Ultraschallmessverfahren zur gleichzeitigen Messung von Schallgeschwindigkeiten und Abständen. In: 45. Deutsche Jahrestagung für Akustik – DAGA 2019, 18.-21.03.2019, Rostock, Proceedings, 1041-1044.

6.5. Guest Lectures (if not included in section 6.3)

31. S. Binder, T. Hanus, S. Zschoche, G. Gerlach: A force compensation sensor based on a bisensitive semi-interpenetrating polymer network. APMM 2019, Active Polymeric Materials and Microsystems, Dresden, 16.-19.09.2019. Book of Abstracts, 78-79.

32. A. Burkhardt, A. Juhrig, M. Wolf, E. Kühnicke: Sensitive sound field parameters fort he characterization of viscous fluids. IEEE IUS, 06.-09.10.2019, Glasgow, Scotland, UK.

33. J. Erfkamp, M. Guenther, G. Gerlach: Piezoresistive chemical and biochemical sensors based on stimuli-responsive hydrogels. APMM 2019, Active Polymeric Materials and Microsystems, Dresden, 16.-19.09.2019. Book of Abstracts, 18-19.

34. D. Franke, G. Gerlach: Porous hydrogels from surfactant-based template solutions. APMM 2019, Active Polymeric Materials and Microsystems, Dresden, 16.-19.09.2019. Book of Abstracts, 21-22.

35. G. Gerlach: Sensoren als Schlüssel zur Zukunft – Warum dauert es 20 Jahre von der Idee zum Massenprodukt? Annual Membership Meeting 2019 of the VDI Dresdner Bezirksvereins e.V, 08.03.2019.

36. G. Gerlach: Anforderungen an Sensoren – Warum dauerte es von der Idee bis zum Massenprodukt 20 Jahre? Institute Colloquium of the Institute of Electromechanical and Elektronic Design, TU Dresden, 05.04.2019.

37. G. Gerlach: Hydrogel-based sensors. German-New Zealand Summer School on Soft Robotics, Biomechanics and Advanced Human Machine Interaction. Dresden, 10.-14.06.2019.

38. G. Gerlach: Hydrogel-based chemical and biochemical sensors. 4th International Conference on Advanced Materials and Nanotechnology ICAMN 2019. Hanoi University of Science and Technology, International Training Institute for Material Science, Hanoi, Vietnam, 13.-16.10.2019. Abstract Book, Bach Khoa Publishing House, 25-26.

39. G. Gerlach: Sensoren als Schlüssel zur Zunkunft – Warum dauert es aber 20 Jahre von der Idee zum Massenprodukt? 627. Elektrotechnical Colloquium of VDE Dresden, 13.11.2019.

40. N. Gulnizkij, G. Gerlach: Design and verification of a bistable humidity sensor switch. APMM 2019, Active Polymeric Materials and Microsystems, Dresden, 16.-19.09.2019. Book of Abstracts, 83-84.

41. N. Gulnizkij, G. Gerlach: Development and mathematical description of a bistable hydrogel-based sensor switch for monitoring of the relative humidity. SEIA'19, 5th International Conference on Sensors and Electronic Instrumentation Advances & 1st IFSA Frequency and Time Conference. Adeje, Tenerife, Spain, 25.-27.09.2019.

42. D. Franke, G. Gerlach: Porous hydrogels from surfactant-based template solutions. APMM 2019 – Active Polymeric Materials and Microsystems, 16.-19.09. 2019, Dresden.

43. D. Franke, G. Gerlach: Poröse Hydrogele für piezoresistive Sensoren mit schnellem Ansprechverhalten. 14. Dresden Sensor Symposium 2019, 02.-04.12.2019, Dresden.

44. A. Juhrig, U. Schmidt, M. Wolf, E. Kühnicke: Development of a 20 MHz annular-array — a first step to a multichannel microscope. ICU, 03.-06.09.2019, Brügge, Belgien.

45. A. Juhrig, U. Schmidt, M. Wolf, E. Kühnicke: Development of a 20 MHz annular-array — a balancing act between optimized design and technological opportunities. IEEE IUS, 06.-09.10.2019, Glasgow, Scotland, UK.

46. C. Kroh, R. Wuchrer, N. Steinke, M. Guenther, G. Gerlach, T. Härtling: Hydrogel-based plasmonic sensor substrate. APMM 2019, Active Polymeric Materials and Microsystems, Dresden, 16.-19.09.2019. Book of Abstracts, 95-96.

47. J. Kuß: Online-Self-Assessments (OSAs) für Studieninteressierte: Entwicklung von OSAs für ausgewählte Studiengänge der TU Dresden mit besonderem Fokus auf MINT-Fächern. 13th Meeting of the Netzwork for Mathematics/Physics + E-Learning. 11.09.2019, HTW Dresden.

48. H. Nizard, M. Maicu, T. Modes, D. Gloess, P. Frach, G. Gerlach: Large-area nanoparticle deposition using dynamic vacuum with plane jet geometry. 9th International Workshop on Polymer-Metal NanoComposites, Espoo, Finnland, 22-24.07.2019.

49. H. Nizard: Wide area nanoparticle deposition using dynamic vacuum with plane jet geometry. 9th International Workshop on Polymer-Metal Nanocomposites, 22-24.07.2019, Espoo, Finnland.

50. H. Nizard: Modeling of the gas flow in a nanoparticle gas phase aggregation reactor. Comsol User Day, 24.10.2019, Dresden.

51. V. Norkus, V. Krause: Sensoren – Schlüssel zur Umwelt. UNI LIVE, Dresden, 10.01.2019.

52. V. Norkus, V. Krause: Sensoren – Schlüssel zur Umwelt. Student Seminar, Dresden, 22.11.2019.

53. K.-D. Sommer, G. Gerlach, T. Simmons: Sensor technology in Germany – Linking innovations in sensor and measurement technology. NIST National Institute of Standards and Technology, Gaithersburg, 10.04.2019.

54. G. Suchaneck: Reactive multi-target sputtering of PZT thin films onto Si-wafers. ECSEL-Project Meeting, 26.02.2019, Dresden.

55. G. Suchaneck: Thin film synthesis of complex oxides by reactive magnetron sputtering. Scientific and Practical Materials Research Center of the National Academy of Sciences of Belarus, Minsk, 09.09.2019.

56. S. Tobehn-Steinhäuser, A.T. Winzer, S. Görlandt, S. Herbst, M. Günther, U. Pliquett, G. Gerlach, T. Ortlepp: Impedance spectroscopy in biology and health science. BIOMINXV, 15th International Symposium on Biomineralization. München, 9.-13.09.2019.

57. M. Wolf, L. Timmermann, A. Juhrig, K. Rath, E. Leipner, F. Krujatz, E. Kühnicke: Ultrasonic temperature monitoring in tissue phantoms by locally resolved measurement of longitudinal and transverse wave speed. ICU, 03.-06.09.2019, Brügge, Belgien.

58. M. Wolf, E. Kühnicke: Transient approximated green's function of a circular line source on a half space for fast simulation of axisymmetric problems. IEEE IUS, 06.-09.10.2019, Glasgow, Scotland, UK.

7. GUEST LECTURES

Also in the last year we could welcome numerous guest speakers at our Laboratory. For that, significant financial assistance was provided by the Research Training Group „Hydrogel-based microsystems“ (GRK 1865) enabling in most cases the financement of the travel costs and lectures.

14.03.2019	Prof. Dr. Joachim Wagner IAF Freiburg, IPMS Dresden	Quantum cascade lasers for spectroscopy: Concepts and applications
14.03.2019	Dipl.-Ing. E. Artsiukh National Academy of Sciences, Minsk, Belarus	Multitarget reactive sputtering of Sr_2FeMoO_6 thin films
16.-19.09.2019	Prof. Iain Anderson University of Auckland, NZ	Capacitive strain sensors for robotics and humans
16.-19.09.2019	Prof. Thomas Hellweg Universität Bielefeld	Smart microgel based surfaces and free standing membranes
16.-19.09.2019	Prof. Dirk Kuckling Universität Paderborn	Tayloring of hydrogels for targeted sensor properties
16.-19.09.2019	Dr. Marko Mailand IDT Europe, Dresden	An integrated microfluorimeter interface to fluorescent hydrogel-based analyte sensors
16.-19.09.2019	Prof. Martin Möller RWTH Aachen	Can a material perform as an engine?
16.-19.09.2019	Prof. John Madden University of Columbia, CAN	Ion transport in gels and the effect of pressure
16.-19.09.2019	Prof. Maurizio Porfiri New York University, USA	Modeling actuation and sensing of ionic polymer metal composites
16.-19.09.2019	Prof. Helmut Schlaak Technische Universität Darmstadt	Maturity of dielectric elastomer transducers – technology, properties and applications
16.-19.09.2019	Prof. Sebastian Seiffert Universität Mainz	Dynamics and relaxation of supramolecular polymer-network gels in view of their microstructure
16.-19.09.2019	Prof. Carmen Scholz University of Alabama, USA	Poly(amino acid)s as active polymeric materials in sensing and chromat. applications
16.-19.09.2019	Prof. Julius Vancso University of Twente, NL	Smart, non-ergodic hydrogels

Dipl.-Ing. Sascha Pfeil (Middle of the photo):

Diploma Award 2018 of the Institute for Solid-State Electronics, sponsored by InfraTec GmbH Dresden, for his Diploma thesis „Bionic robots based on dielectric elastomers“.

Markus Stöhr, Gerald Gerlach, Thomas Härtling, Stephan Schönfelder (HTWK Leipzig, TU Dresden):

Best Poster Award at the 20. GMA/ITG-Fachtagung Sensoren und Messsysteme 2019, 25./26.06.2019, Nuremberg, for the contribution „Analysis of photoelastic properties of monocrystalline silicon“.

Prof. Dr.-Ing. habil. G. Gerlach:

- Spokesman of the DFG Research Training Group “Hydrogel-based Microsystems”.
- Member of the Council of the Electrical and Computer Engineering Department.
- Dean of Educational Affairs of the Electrical and Computer Engineering Department.
- Member of the Senate Council of the Graduate Academy at TU Dresden.
- Member of the Advisory Council of the TUDIAS Study College.
- Member of the Executive Committee of Dresden International University (DIU).
- Member of the Advisory Council of the Electrical and Computer Engineering Department at TU Ilmenau.
- Member of the Excecutive Board of the DTV – the German Association of Technical-Scientific Societies.
- Member of the VDE Committee „VDE-Ehrenring“.
- Chief Editor, JSSS Journal of Sensors and Sensor Systems.
- Associated Editor-in-Chief, IEEE Sensors Journal.
- Member of the Scientific Board of the Journal „Technisches Messen“.
- Member of the Scientific Board of the Journal „Measurement Automation Monitoring”, Poland.
- Member of the Advisory Board of the Fraunhofer Institutes for Electron Beam and Plasma Technology (FEP) and for Photonic Microsystems (IPMS), Dresden (until 05/2019).
- Member of the Advisory Board of the Kurt-Schwabe-Institute for Measuring and Sensor Technology Meinsberg e. V.
- Member of the Advisory Board of the Kurt-Schwabe Foundation.
- Member of the Scientific Advisory Board of the CiS Research Institute for Microsensor Systems and Photovoltaics, Erfurt.
- Chairman of the Working Group “Microelectronics”, VDE Dresden Branch.
- Godfather of TU Dresden at the Martin-Andersen-Nexö Secondary School (MANOS), Dresden.

apl. Prof. Dr. rer. nat. et Ing.habil. E. Kühnicke

- Member of IEEE, German Society for Non-destructive Testing (DGZfP). Technology in Medicine and Health Care (TIMUG), German Acoustical Society (DEGA), and the German Association of University Professors.
- Vice-chairman of the Working Group “University Professors” of the DGZfP.
- Member of the Working Group “Ultrasound” of the DGZfP, Member of the sub-committtees "Models and Theories for Ultrasound Testing" and "Phased Array".
- Referee for “Journal of the Acoustical Society of America (JASA)” and “Journal of Wave Motion”.

- Referee of the Alexander von Humboldt Foundation and the German Research Foundation (DFG).

Hon.-Prof. Dr.-Ing. Thomas Härtling:

- Member of the AMA Science Board.
- Member of the Working Group of University Professors for Measurement Technology (AHMT).

PD Dr.-Ing. habil. H. Budzier

- Person in charge for literature of the IFE.
- Network administrator of the institute
- Referee for „IEEE Sensors Journal“ and „Journal of Sensors and Sensor Systems (JSSS)“.

PD Dr.-Ing. Margarita Günther:

- Member of the Council of the Research Training Group “Hydrogel-based Micro-systems”.

Dr. rer. nat. G. Suchaneck

- Member of the Center of Applied Photonics at the Institute of Applied Photophysics at Dresden University of Technology.
- Member of the Working Group “Plasma Technology” of the Association of German Engineers (VDI), http://www.akplasma.org.
- Member of the Council of the National Centre of Competence for Materials, Advanced Technologies, Coatings and their Applications (Prague).
- Project referee of the Horizon 2020 program of the European Union.
- Project referee of the German Aerospace Center e. V. (DLR).
- Project referee of the Southeast European Research Area Network (SEE-ERA.NET).
- Project referee for the subject "Thin film technology" of the Grant Agency, Academy of Science of the Czech Republic.
- Referee for “Applied Physics Letters”, “Journal of Applied Physics”, “Thin Solid Films”, “Physica Status Solidi (RRL)”, “Physica Status Solidi A”, “Physica Status Solidi B”, “Journal of Materials Chemistry C”, “Materials Chemistry and Physics”, “Journal Alloys and Compounds”, “Kosove Mater. (Bratislava)”.
- Deputy member of the Employee Committee of the TU Dresden.

10.1. Sensors & Measuring Systems 2018

Place: Congress Center Nuremberg, Germany

Date: June 25-26, 2018

Chairmen: Rainer Tutsch, TU Braunschweig
Andreas Schütze, Saarland University es

Organization: VDI/VDE-Society Measurement and Automatic Control (GMA) and AMA - Association for Sensors and Measurement e. V.

Sessions:

Focus topics:
A Sensors
B Measurement systems
C Applications

Further information: www.ama-science.org

10.2. APMM 2019 – Active Polymeric Materials and Microsystems

Place: Dresden, Penck-Hotel

Date: September 16-19, 2019

Chairman: Gerald Gerlach, TU Dresden

International Steering Committee:

- Iain Anderson, University of Auckland, NZ
- Thomas Hellweg, University of Bielefeld, DE
- Dirk Kuckling, University of Paderborn, DE
- Angel Licea-Claverie, University of Tijuana, MX
- John Madden University of British Columbia, CA
- Jules J. Magda, University of Utah, US
- Martin Moeller, DWI Aachen, DE
- Maurizio Porfiri, New York University, US
- Walter Richtering, RWTH Aachen, DE
- Sebastian Seiffert, University of Mainz, DE
- Carmen Scholz, University of Huntsville, US
- Luisa Torsi, Università degli Studi di Bari, IT
- Marek Urban, Clemson University, US

- Regine von Klitzing, TU Darmstadt, DE
- Andreas Walter, University of Freiburg, DE

Topics:
- Electro-active Materials
- Hydrogels and Microgels
- Synthesis and Characterization, Material Properties
- Responsive and Adaptive Systems
- Hydrogel-based Sensors, Actuators, Devices and Microsystems
- Soft Robotics
- Microfluidics
- System Integration, Additive Manufacturing
- Modeling and Simulation

Information and Contact:

https://tu-dresden.de/ing/elektrotechnik/ife/graduiertenkolleg/apmm-2019

10.3. 14. Dresden Sensor Symposium

Place: Westin Bellevue, Dresden

Date: Dezember 2-4, 2019

Organization: DECHEMA e. V.

Topics:
- Sensor technology
- Process measurement
- Environmental sensorics
- Biomedical sensorics

Further information: www.dechema.de/DSS14.html; www.ama-science.org

11.1. 5th German-Czech Workshop on Nanomaterials

Place: Dresden, Fraunhofer FEP

Date: Mai 18-19, 2020

Organizing committee:
Co-Chairs: Peter Frach, Fraunhofer FEP
Gerald Gerlach, TU Dresden
Secretary: Harry Nizard

Scope and Topics:

The German-Czech Workshop on Nanomaterials is organized every two years Previous editions took place in Sankt Peter-Ording (2012), Prague (2014), Lübeck (2016) and České Budějovice (2018). The 5th edition will take place in Dresden and will be co-chaired by the Fraunhofer FEP and the Technical University Dresden.

The scope of the German-Czech Workshop on Nanomaterials covers
- cluster and nanoparticle growth,
- aggregation sources,
- related sputtering processes and their applications.

It aims at supporting the collaboration between active groups on both sides of the German-Czech border, but researchers from all over are naturally welcomed as well.

Abstract submission deadline:
06.03.2020

Information:
https://www.fep.fraunhofer.de/en/events/Nanoworkshop.html

11.2. SMSI 2020 – Sensor and Measurement Science International

Place: Congress Center Nuremberg

Date: Juni 22-25, 2020

General Chair: Gerald Gerlach, TU Dresden, Germany
General-Co-Chair: Klaus-Dieter Sommer, TU Ilmenau, Germany

Organizer: AMA Service GmbH

Topics:

1. Sensors and Instrumentation

Topical Chairs:
- Prof. Dr. Gerald Gerlach, TU Dresden, Germany
- Prof. Dr. Reinhard Lerch, Friedrich-Alexander-University Erlangen-Nuremberg, Germany
- Prof. Dr. Ulrich Schmid, TU Wien, Austria

- Sensor Principles and Quantities
- Sensor Materials and Technology
- Sensor Interface Electronics
- Applications

Satellite Conference: IRS² 2020 - Infrared Sensors and Systems

- IR Thermal Detectors
- IR Photon Detectors
- IR System Components
- Thermal Imaging
- Pyrometry
- Gas Analysis
- IR Spectroscopy
- Applications

2. Measurement Science

Topical Chairs:
- Prof. Dr. Klaus-Dieter Sommer, TU Ilmenau, Germany
- Prof. Dr. Luca Mari, Università Cattaneo - LIUC Castellana, Italy
- Prof. Dr. Fernando Puente León, Karlsruhe Institute of Technology, Germany

- Measurement Foundations
- Advanced Methods and Measurement Systems
- Networked and IoT-related Measurement Systems
- AI Approaches in Measurement
- Applications

3. System of Units and Metrological Infrastructure

Topical Chairs:
- Dr. Beat Jeckelmann, METAS Bern, Switzerland
- Dr. Matthias Bartholmai, BAM Berlin, Germany
- Dir. u. Prof. Dr. Peter Ulbig, PTB Braunschweig, Germany

- Revised SI and its Opportunities
- Metrology and Traceability
- Calibration Methods
- Advanced Testing Methods
- Regulations and Standards in Metrology

Deadline for short paper submission (2 pages):
31 January 2020

Information:
https://www.smsi-conference.com

12. VDE WORKING GROUP MICROELECTRONICS

12.1. Mission

Since 2003, there is the Working Group “Microelectronics”. It provides a panel of experience exchange focused on the area of microelectronics to engineers, technical staff, scientists and students.

The settlement of the world leading suppliers of computer processors, random access memories, and silicon wafers in the Dresden region, and the advanced development of the traditional microelectronics companies made Saxony with the center of Dresden to one of the World leaders in microelectronics.

The Working Group meetings are arranged mostly directly at enterprises or research institutes. Thereby, the objectives of the work group are:

- to establish by interesting lectures a panel of free of charge education by interesting presentations which mirror new developments in all areas of microelectronics.
- to open possibilities to get to know colleagues and enterprises of the Dresden Microelectronics environment.
- to arrange contacts industrial employees to universities and their students.

The topics of the Working Group are spread over all areas of microelectronics:

- Wafer fabrication,
- Technology,
- Installation engineering,
- Electronic components and their design,
- Applications (for instance, sensorics, automotives, biotech, medical engineering).

Prof. Dr.-Ing. habil. G. Gerlach is chairman of the working group „Microelectronics“.

12.2. Meetings 2019

March 13, 2019	„Automotive Sensors from Dresden: A visit at IDT Europe GmbH (formerly ZMDI)“ IDT Europe GmbH, Dresden
August 28, 2019	„Sputtertargets from Brand-Erbisdorf: A visit at GfE Fremat GmbH“ GfE Fremat GmbH, Brand-Erbisdorf
October 23, 2019	„Vacuum Deposition Technology: A visit at VTD Vakuumtechnik Dresden GmbH“ VTD Vakuumtechnik Dresden GmbH, Dresden
December 5, 2019	„Wet Process Equipment for Microelectronics: A visit at AP&S International GmbH“ AP&S International GmbH, Dresden