TECHNISCHE UNIVERSITÄT DRESDEN

FACULTY OF ELECTRICAL AND COMPUTER ENGINEERING
INSTITUTE OF SOLID-STATE ELECTRONICS
HEAD: PROF. DR.-ING. HABIL. G. GERLACH

2023 ANNUAL REPORT

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Institute of Solid-State Electronics:

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

Dear friends and partners of our Institute,

There are only a few days left in the old year 2023 before the new year 2024 begins. As with every new year, this is a good opportunity to look back on the past, but also to look forward to important changes that await us in the coming year.

In 2023, our IFE continued to grow. On October 1, the newly established professorship "System Integration and Scientific Instrumentation" was filled at our faculty, which was affiliated with our institute. This professorship is linked to the position of Deputy Director of the Kurt-Schwabe-Institut für Mess- und Sensortechnik Meinsberg e.V. The KSI is a non-profit Saxon state institute for basic and application-oriented research in the fields of physical chemistry and electrochemistry, sensor technology and the associated development of novel sensor materials and scientific instrumentation. We are delighted that Prof. Dr.-Ing. Andreas Arndt has joined our IFE. He studied electrical engineering at the University of Rostock, where he also completed his doctorate in the field of control engineering with a focus on medical technology applications. Even before his doctorate, he moved into industry and worked in leading R&D positions for the companies Berlin Heart GmbH and Biotronik, most recently as Head of Sensor Technology Research. We are very pleased about this reinforcement and wish Mr. Arndt all the best and much success for his two challenging positions in the KSI institute management and at our IFE!

Further major changes await us in the coming year 2024. After more than 28 years as Director of the IFE, I will officially retire in April 2024. However, this does not mean that I will turn my back on the institute, but I will continue to supervise various research projects as a Senior Professor, e.g. the IFE projects in the Research Training Group "Interactive Fiber-Elastomer Composites", and a number of doctoral students. It is also planned that the professorship will be filled from April, with the slightly modified dedication "Biomedical Sensor Technology". With this reallocation, the faculty is supporting the Biomedical Engineering degree course, which was newly established in 2022 and had 36 new students last year and almost 50 this year. The "Biomedical Sensor Technology" professorship will form the core team of the course together with the "Biomedical Engineering" professorship (Prof. Hagen Malberg) and the "Biomedical Electrical Engineering" professorship, which is also yet to be filled.

Another important change awaits us in the spring of next year. After a nine-year "stopover" in the Günther Landgraf Building in the former “Old Rectorate” on Mommsenstraße, we will then move into a newly constructed office building on Nöthnitzer Straße, directly opposite our laboratory building, Werner-Hartmann-Bau. We will certainly miss the beautiful view of the Bärengarten, the inner courtyard of the Alte Mensa, but we will certainly not miss the omnipresent smells of food.

We are certain that the Institute of Solid-State Electronics is well equipped for the future with the developments mentioned, so that we can continue and further develop our work in teaching and research. A look back at the year that has just ended shows that our IFE team has achieved outstanding results. Never before have we recorded more than 30 publications in scientific journals within a calendar year. Although "only" two dissertations were defended in 2023, five more are about to be submitted. We are pleased that, despite many (and increasing) bureaucratic obstacles, we are still able to offer our young academics sufficiently

good conditions for successful academic work. An important success factor for this continues to be the extraordinarily dedicated work of all our employees at the IFE, whether in the scientific, technical or administrative areas. My special thanks go to all of them.

Once again this year, we would like to thank all our partners and colleagues in the research facilities and institutes that work with us, in the university administration and in the funding institutions. We at IFE owe them all a great debt of gratitude. We hope that we can continue to have you at our side as reliable partners and friends of our institute in the coming year.

Prof. Dr.-Ing. habil. Gerald Gerlach

1. GENERAL

The Institute of Solid-State Electronics (Institut für Festkörperelektronik - IFE) is one of 12 laboratories of the Faculty of Electrical and Computer Engineering at Technische Universität Dresden. Together with the Institute of Semiconductor Technology and Microsystems 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 the investigation of materials, technologies and solid-state physics principles for sensors,
- in the development of thin films and multilayer stacks for sensor applications and other functionalities,
- for the design of sensors and sensor systems including modeling and simulation of individual sensor components, but also complex systems
- in the coupling of sensors, information technologies and artificial intelligence including intelligent data analysis systems and modern energy management methods, and
- in the application of sensors for special measurement tasks in a wide variety of technical fields, in particular biomedical technology.

For the coming year 2024, the reappointment of the Professorship for Solid-State Electronics is planned, but with the dedication Biomedical Sensor Technology. This professorship as well as the Professorship for Systems Integration and Scientific Instrumentation will then primarily take over courses in the “Biomedical Engineering” diploma programm, which were newly established in 2022.

For our 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 Microsystems at the Institute of Semiconductors and Microsystems (IHM).

2. STAFF

Chair for Solid-State Electronics:

Prof. Dr.-Ing. Andreas Arndt[1]	Chair of systems integration and scientific instrumentation
Prof. Dr.-Ing. habil. Gerald Gerlach	Chair of Solid-State Electronics
Prof. Dr. rer. nat. habil. Elizabeth von Hauff[2]	Chair of Coating Technologies for Electronics
Dr.rer.nat. et Ing. habil. Thomas Härtling[3]	Honorary professor

Budzier, Helmut	PD Dr.-Ing.habil.	Senior researcher
Begyi, Fatemeh	B. Sc.	Coordinator (until 03/23)
Collasch, Heike		Secretary
Eydam, Agnes	Dr.-Ing.	Scientific assistant
Franke, Daniela	Dr. rer. nat.	Postdoc
Günther, Margarita	PD Dr.-Ing.	Scientific assistant
Herbst, Sabine		Laboratory assistant
Herzog, Julia	Dipl.-Ing.	Scientific assistant (until 12/23)
Hinz, Alexander Martin	Dr. rer. nat.	Scientific assistant
Koenigsdorff, Markus	Dipl.-Ing.	Scientific assistant
Krause, Volker	Dipl.-Ing.	Engineer for teaching/research
Kuß, Julia	Dr.-Ing.	Scientific assistant /Course advisor
Lehmann, Ulrike		Laboratory assistant
Liebscher, Hans	Dipl.-Ing.	Scientific assistant
Malberg, Insa	Dipl.-Jur.	Hourly employee (until 02/23)
Mieting, Alice	M.Sc.	Scientific assistant (until 05/23)
Norkus, Volkmar	Dr.-Ing.	Senior researcher
Schreiber, Stefan	Dipl.-Ing.	Scientific assistant (until 03/23)
Suchaneck, Gunnar	Dr. rer. nat.	Senior researcher
Uhlig, Gregor	M. Sc.	Scientific assistant
Ullmann, Christian	Dipl.-Ing.	Lab engineer (until 03/23)
Wang, Sitao	Dipl.-Ing.	Scientific assistant
Wolf, Mario	Dipl.-Ing.	Scientific assistant
Žukauskaitė, Agnė[4]	Ph.D.	Senior researcher

[1] Deputy Director of the Kurt Schwabe Institute for Measurement and Sensor Technology Meinsberg e.V. (KSI Meinsberg)
[2] Head of Fraunhofer FEP Dresden
[3] Group leader for Optical nanosensorics at Fraunhofer IKTS Dresden
[4] also research associate at Fraunhofer FEP Dresden

Guest Scientists:

31.05.-21.06. 2023
M.Sc. Ignas Bitinaitis, Center for Physical Sciences and Technology, Vilnius (Litauen)

19.06.-14.07.2023
Prof. Dr. Sławomir Gryś, Politechnika Częstochowska (Poland)

26.06.-. 28.06.2023
Dr. Alexandr Belosludtsev, Center for Physical Sciences and Technology, Vilnius (Litauen)

3. TEACHING AND ADVANCED TRAINING

Most of the study programs offered at TU Dresden in enginerring sciences are still diploma study courses. At the Department of Electrical and Computer Engineering this concerns the Diploma programs Electrical Engineering, Information Systems Technology, Mechatronics, and Regenerative Energy Systems. Bachelor graduates from other universities or from abroad can enter the diploma programs after recognition of academic achievements in order to continue their studies at the TU Dresden. In addition, an English-language master's degree in Nanoelectronic Systems is offered.

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 chosen branch of study, a course work and a diploma thesis at one of the chairs. The standard period of study for the program is 10 semesters 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 Institute of Solid-State Electronics is involved in lectures related to physical basics of electronics and their use in devices (Sensorics, Solid-State Electronics), manufacture (Plasma Technology) and application of electronic components and devices (Microtechnology, and Infrared Measurement Technology).

In particular, the following courses were given during the 2023 summer term and the 2023/2023 winter term:

Training course	Lecturer Lecture/ exercise/ laboratory work (Double hours per week)	User
"Introduction to Sensorics (Sensorics I)"	Prof. Härtling 2/1/0	(2, 3) Compulsory course (6, 7, 8) Optional course, PhD students
Supervision of practical experiments in "Sensorics"	DI Krause, DI Liebscher, DI Bischoff, DI Herzog 0/0/1	(8) Optional course
„Plasma Technology"	Prof. von Hauff, Dr. Hinz, Dr. Žukauskaitė, and others 4/2/0	(2, 10) Optional course
"Cardiac Assistance Systems" (module: Autonomous and Cooperative Medical Technology)	Prof. Arndt	(3, 6, 8, 11) Optional course

Supervision of practical experiments in “Computer Engineering 1”	Dr. Eydam, DI Liebscher, DI Koenigsdorff 0/0/2	(1, 5, 6, 7, 8) Compulsory course
Supervision of practical experiments in “Computer Engineering 2”	DI Krause, DI Eydam, DI Liebscher 0/0/2	(1, 5, 6, 7, 8) Compulsory course
“Dynamic Networks” (exercises supervision)	PD Dr. Budzier/Prof. Gerlach 0/2/0	(5) Compulsory course

(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.
(9) General study course, Biomedical Technology.
(10) Master study course Nanoelectronic systems.
(11) General study course, mechanical engineering

4. RESEARCH TOPICS

4.1. Main research topics

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

Piezoresistive sensors:

- Fabrication and characterization of pH-value-, glucose-, ethanol- and aceton-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
- biodegradable hydrogels

Elastomer-based actuators:

- Soft robotics
- Fiber-elastomer composites
- Electroactive polymers (EAP)
- Function generation by means of integrated textile materials
- Textile EAPs

Functional thin films

- 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
- Application in the field of sensor technology

Optical Measurement Technology

- Sensor properties of optical nanostructures and nanomaterials
- Sensor 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 combination 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 was and is involved in the following major projects of the German Research Foundation (Deutsche Forschungsgemeinschaft - DFG):

- Research Training Group (Graduiertenkolleg) 1865 „Hydrogel-based microsystems“ (10/2013-02/2023).

- Research Training Group (Graduiertenkolleg) 2430 „Interactive fiber-elastomer-composites“ (11/2018-10/2027)

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 at IFE:	PD Dr.-Ing. habil. Margarita Günther Prof. Dr.-Ing. habil. Gerald Gerlach
PhD Students at IFE:	Dipl.-Ing. Julia Herzog 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 – 28.02.2023
Topics at IFE:	- Force-compensated pH-sensors: A bisenitive hydrogel combines sensory and actuator properties. The thermally controllable actuator function compensates the source pressure of the gel after a change in the measured variable. This prevents relaxation and drift effects and shortens the response time. (Dipl-Ing. Stefan Schreiber) - Plasmonic-based fluid sensor with hydrogel-transducer: Application of different stimuli-responsive hydrogels in an optical sensor system for the simultaneous detection of different fluid parameters (e.g. ethanol or glucose concentration, pH value, etc.). (Dipl.-Ing. Julia Herzog) - Hydrogel composites for the detection of heavy metals in aquatic systems: Hydrogels are specifically functionalized with iron oxide particles and tested in piezoresistive sensors. The characterization of the magnetic and electrical properties of the hydrogel composites enables their application for other sensor and actuator principles. (M.Sc. Alice Mieting) - Smart hydrogels for analyte detection in gases: Investigation of the gas absorption capabilities of different hydrogels. Modification of hydrogels with additional nanofillers, e.g. graphene oxide and Mxene to further improve the gas absorption ability. This also includes the development of a suitable detection option for the swelling degree of of the hydrogel, so that finally there is a complete sensor concept for the analyte detection in gases. (Dipl.-Ing. Sitao Wang)

- Porous hydrogels with improved response time for application in microsystems.
  (Dr. Daniela Franke)
- Glucose-sensitive, hyaluronic acid-based, biodegradable hydrogels
  (M. Sc. Gregor Uhlig, Dr. 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 sensory and actoric 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: [DISS2], [10], [23], [31-32], [40], [70-71], [74]

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

Spokesman:	Prof. Dr.-Ing. habil. Dipl.-Wirt.-Ing. Chokri Cherif (Institute for Textile Machinery and High-Performance Textile Materials Technology)
Project leader at IFE:	Prof. Dr.-Ing. habil. Gerald Gerlach
PhD Students at IFE:	Dipl.-Ing. Hans Liebscher, Dipl.-Ing. Markus Koenigsdorff
Postdoc:	Dr.-Ing. Johannes Mersch
Funded by:	DFG (German Research Foundation)
Funding period:	01.11.2018 – 31.10.2027
Topics at IFE:	- Modeling and metrological evaluation of of structurally integrated actuator-sensor systems based on alternative electroactive polymers using electromechanical equivalent models. (Dipl.-Ing. Liebscher)

- Electromechanical modeling and metrological investigation of helical actuators with material-integrated sensors. (Dipl.-Ing. Markus Koenigsdorff)
- Electro-mechanical modeling and metrological evaluation of I-FRCs with material-integrated sensors. (Dipl.-Ing. Johannes Mersch)

Objectives:
This Research Training Group (RTG) mainly focusses 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 sensorial 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-FRC have become 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 regulation and control circuits that are based on and linked to sensorial 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 (e.g. hand prostheses, automated lids, seals, shapeable membranes) and components (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 proposed Research Training Group is the simulation-based development of smart material combinations and gradations for self-sufficient I-FRC with structurally integrated actuator and sensor networks to actively and locally adjust component stiffness. I-FRC 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 sensorial feedback in consideration of thermal and mechanical stress, while simultaneously reducing weight and enhancing compactness.
Related references: [DA1], [SA1, SA2], [3], [13, 14], [16-18], [37], [41-47], [67], [69]

Project: Synthesis and characterization of biocompatible, biodegradable glucose-sensitive hydrogels for sensor applications

Project leader:	Prof. Dr.-Ing. habil. Gerald Gerlach
Co-workers at IFE:	Dr. rer. nat. Daniela Franke, M.Sc. Gregor Uhlig
Funded by:	Sentiomed Inc., Salt Lake City, USA via GWT - Society for Knowledge and Technology Tranfer, Dresden
Funding period:	04/2023 – 07/2023

- **Objectives/results:**
- Development of a synthesis concept and synthesis planning.
- Synthesis of biocompatible hydrogels.
- Evaluation of glucose sensitivity using free swelling.
- Implementation and characterization of the decomposition of the hydrogel using the body's own structures.
- Use of the hydrogel as transducer in a piezoresistive microsensor and its metrological characterization.

Related references: [75]

Cooperation project: 3D printing of structured piezoelectric polyvinylidene difluoride-trifluoroethylene copolymers

Project leader:	Prof. Dr. rer. nat. habil. Elizabeth von Hauff
Co-workers at IFE:	M.Sc. Gregor Uhlig, Dipl.-Ing. Christian Ullmann
Funded by:	Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology (FEP), Dresden
Funding period:	10/2023 – 09/2025

Objectives/results:
- Establishment and technical optimization of a novel process for printing flexible, structured piezoelectric polymer layers,
- Chemical optimization of the polymer matrix with regard to mechanical stability and piezoelectric function.
- Application of the printing process to other technically and scientifically relevant (co-)polymers.

DFG-Project: Quartz oscillator sensors for high-resolution detection of infrared radiation

Project leader:	Prof. Dr.-Ing. habil. Gerald Gerlach Dr.-Ing. Volkmar Norkus

Co-workers at IFE:	Dr.-Ing. Agnes Eydam, Dipl.-Ing. Volker Krause, Sabine Herbst, Ulrike Lehmann
Funded by:	DFG (German Research Foundation)
Funding period:	10/2020 – 09/2024

Objectives/results:
- Thinning of quartz crystal wafers.
- Fabrication of self-supporting, thermally insulated quartz with electrode and IR absorption layer.
- Modeling and simulation of the sensor geometry, the thermal properties and the damping behavior of the sensor.
- Assembly of an oscillator system for vibration excitation and measurement.
- Measurement of sensitivity and noise.

Related references: [38]

DFG-Project: Doubly cross-linked supramolecular hydrogels for sensing applications

Project leader:	Prof. Dr.-Ing. habil. Gerald Gerlach, Prof. Dr. rer. nat. habil. Dirk Kuckling
Co-workers at IFE:	PD Dr.-Ing. habil. Margarita Günther
Collaboration:	University of Paderborn
Funded by:	DFG
Funding period:	05/2022 – 04/2025

Objectives/results:
- Goal: Sensors with double-crosslinked, supramolecular gels for the detection of special biomarkers, doping substances and fungicides.
- Synthesis and characterization of such gels with incorporated host/guest structures.
- Novel sensors using these gels with sufficiently short response time and high detection sensitivity.

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 – 06/2023

Objectives/results:
- Synthesis of metal-oxide compounds on the base of Sr_2FeMoO_6.
- Novel nanoheterostructures with dielectric interlayers.
- Characterization and simulation of nanoheterostructures.
- Prototypes of spintronic devices.

Related references: [11], [19], [25 - 36], [52 - 58]

Orientation program MINT (OSM)

Project leader:	Dr. Christiane Einmahl (TU Dresden/Center for interdisciplinary learning and teaching)
Patron:	Prof. Dr.-Ing. habil. Gerald Gerlach
Co-workers:	Dr. rer. medic Anja Abdel-Haq, Dipl.-Wirt.-Inf. Daniel Knöfel, Dr.-Ing. Julia Kuß
Funded by:	Higher education pact and future contract
Funding period:	04/2021 - 12/2024

Objectives/results:
The aim of the project is to design, test and evaluate an Orientation Program for future first-year students at the TU Dresden (German abbreviation: OSM) of STEM (German abbreviation: MINT) subjects. This orientation program (i) enables prospective students to make an independent, reflective and sustainable choice of course of study, (ii) supports the acquisition of (possibly missing) professional skills, (iii) promotes knowledge of university structures, working techniques and specialist cultures, (iv) offers insights into future practical career fields and (v) enables the acquisition of key skills. The Orientation Program thus helps to permanently reduce the number of early dropouts and changes of the study subject in the STEM area. The results and formats of the student success projects “Online Self-Assessment” and “Orientation Platform for Research and Practice” are also continued in the orientation program.
Building blocks of the orientation program:

A: Study orientation
B: Qualification
C: Key competencies and career field exploration
D: Project work

4.3 Facilities and Equipment

The Institute of Solid-State Electronics is equipped with process facilities which allow 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*^{80Plus}, 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)
- Pressure measurement station
- Humidity and temperature measurement station
- High temperature system (Novotherm HT1200) for characterization of electrical properties
- Measurement of resonance properties
- 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)

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

5. THESES AND CERTIFICATES

5.1. PhD theses

[DISS 1] Rene Landgraf: **Polymer-optical Waveguides for Biosensing**

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

Day of defence: July 3rd, 2023

The reliable quantitative detection of biomarkers and pathogens at picomolar or even lower concentration is yet not readily available outside medical labs but would be a great help for point-of-need/point-of-care testing (POCT). Therefore, such detection technologies are subject to extensive research. Microdevices based on integrated optical waveguides are candidates for the detection of such ultra-low biochemical concentrations.
In this work, sensors in the shape of microring or microracetrack resonators, manufactured by UV-assisted nanoimprint lithography (UV-NIL) as a promising but challenging replication technology, are investigated. Analytical and numeric models are developed and the main influence factors that allow a low limit of detection, such as the coupling gap width, the material shrinkage and the residual layer thickness, are identified and quantified. Potential biosensor applications are evaluated and general design rules as well as resulting designs are derived. The UV-NIL polymer and the more established silicon-based microresonators are compared in terms of technological parameters such as lithography resolution, integration level as well as the dynamic measurement range.
High quality factors of more than 25,000 were reached for free spectral ranges of 1.3 nm and of more than 20,000 for 2.0 nm, allowing both a high resolution of the resonance shift detection and a sufficient dynamic range. The bulk refractive-index sensitivity was measured to be (60 ± 4) nm/RIU (refractive index units) which was very close to the theoretical simulation of 63 nm/RIU.
When comparing the results of this work to literature results, a very good sensor performance was accomplished: A high dynamic range together with a good bulk refractive index sensitivity was achieved for a technology with a fast throughput time. Regarding the possibility to further increase the sensitivities by one to two orders of magnitude through layout optimization and the fact that only two main manufacturing steps were necessary, the UV-NIL polymer waveguide technology of this work has a high potential for miniaturized, high-sensitivity biosensing. Methods how to functionalize the microresonator sensors are tested and an alternative biosensor characterization assay is suggested. Ideas how to integrate the microresonators into a biosensor system are investigated.

Publication:
René Landgraf: Polymer-optical Waveguides for Biosensing. Dresdner Beiträge zur Sensorik, Band 89. Dresden: TUDpress 2023.

[DISS 2] Nikolai Gulnizkij: **Hydrogel-based, bistable sensor switches for energy-autonomous monitoring and control of humidity**

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

Day of defence: November 30th, 2023

The present work deals with the concept and evaluation of power-free, moisture-sensitive threshold switches based on the BIZEPS (Binary ZEro-Power Sensor) concept. For the sensory function of the threshold switch, a moisture-sensitive hydrogel is applied in a structured manner to beams made of spring sheet metal or to bending silicon plates. The hydrogel swells or deswells when the surrounding humidity changes and, through the change in volume, provides mechanical energy to deflect beams or plates using the bimorph effect. Sensors currently detect influencing variables continuously and require evaluation and control electronics. With an energy-autonomous sensor switch that shows binary switching behavior, evaluation and control electronics can be dispensed with. The sensor switch should assume one of two possible stable switching states.
The focus of this work is the realization of the sensor with its switching function, its miniaturization and modeling based on beam and plate theory. The aim of the mechanical model based on beam theory was to describe the switching behavior of the sensor switches depending on the geometric dimensions and material parameters and to derive basic design guidelines from this. The switching hysteresis of the sensor switch is generated by an axial force, which is achieved either by a corresponding compressive force (macrodemonstrator) or by depositing a thin layer on top of the bending plate (MEMS demonstrator). By expanding the mechanical models to include this axial force component, the characteristic switching behavior of a bistable threshold switch can be modeled. In order to realize bar-like (macro demonstrator) and plate-like (MEMS demonstrator) threshold switches, both classic manufacturing techniques and MEMS technologies were used. The switching points of the bar- and plate-type threshold switches can be adjusted by the size of the axial force. For the MEMS threshold switches, this was specifically achieved by structuring (i.e. the coverage ratio) of a silicon dioxide layer on the silicon bending plate.
A commercial application of such humidity threshold switches is conceivable in a wide variety of industries, e.g. in food industry, building monitoring and electronics. The threshold switches can be adapted to the desired requirements using the developed mechanical models by varying geometric dimensions and selecting the appropriate materials.

5.2. Diploma theses

(Supervisors in brackets)

[DA 1] Haojie Li:
Anwendung der Impedanzspektroskopie zur Charakterisierung von dielektrischen und elektrisch leitfähigen Elastomeren (Application of impedance spectroscopy for characterization of dielectric and electrically conductive elastomers).
(Prof. Dr.-Ing. habil. Gerald Gerlach, Dr. rer. nat. Gunnar Suchaneck / Dipl.-Ing. Hans Liebscher)

[DA 2] Markus Schmidt:
Entwicklung eines Verfahrens zur Funktionsprüfung von Beschleunigungssensoren im Blattwerk und Aufbau eines mobilen Testgerätes (Development of a method for testing the functionality of acceleration sensors in the foliage and construction of a mobile test device).
(Prof. Dr.-Ing. habil. Gerald Gerlach, Prof. Dr. Niels Modler [TUD, Institute of Lightweight Engineering and Polymer Technology ILK] / Dr. Anja Winkler (TUD, Institute of Lightweight Engineering and Polymer Technology ILK), Dr. Beate Bergk (Weidmüller Monitoring Systems GmbH))

[DA 3] Helen Merkel:
Plasma induced damage in CVD dielectrics and at the substrate interface.
(Prof. Dr. rer. nat. habil. Elizabeth von Hauff, Prof. Dr.-Ing. habil. Gerald Gerlach / Helmut Schönherr [Infineon, Österreich])

5.3. Study Projects

[SA 1] Dustin Hanusch:
Entwicklung eines Versuchstandes zur Herstellung künstlicher Muskelfasern und Sensorgarne durch thermisches Faserziehen (Development of a test setup for the production of artificial muscle fibers and sensor yarns by thermal fiber drawing).
(Prof. Dr.-Ing. habil. G. Gerlach, Dipl.-Ing.Markus Koenigsdorff)

[SA 2] Justus Krenkel:
Entwicklung eines Versuchstandes zur Charakterisierung bistabiler Elemente für die Anwendung in biomimetischen Soft-Robots (Development of a test setup for characterizing bistable elements for use in biomimetic soft robots).
(Prof. Dr.-Ing. habil. G. Gerlach, Dipl.-Ing.Markus Koenigsdorff)

6. PUBLICATIONS

6.1. Book series: Dresden Sensorics Contributions

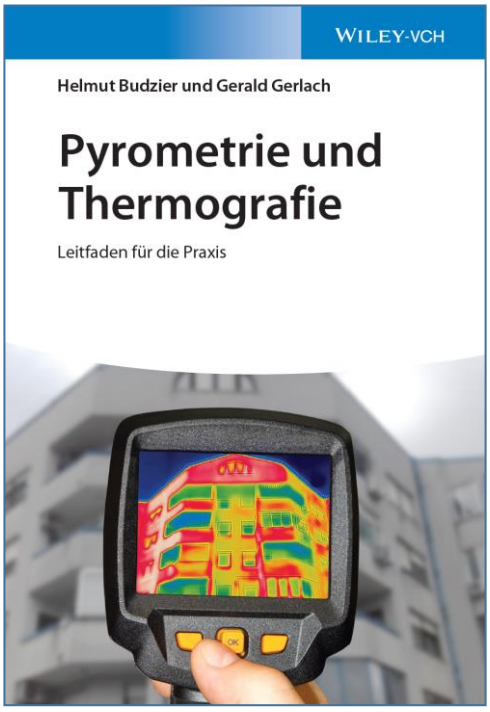
Since 1996 the book series „Dresdner Beiträge zur Sensorik“ edited by G. GERLACH has been published. The aim of this series is the publication of outstanding scientific contributions of TU Dresden, especially of those produced at the Solid-State Electronics Laboratory. The 8 volumes published earlier were continued by one new one in 2023.

René Landgraf: Polymer-optical Waveguides for Biosensing. Dresdner Beiträge zur Sensorik, Band 89. Dresden: TUDpress 2023.

6.2. Book chapters

1. H. Budzier, G. Gerlach: Pyrometrie und Thermografie: Leitfaden für die Praxis (Pyrometry and Thermography: Practical Guide). WILEY-VCH GmbH, Weinheim. 2023.

hat formatiert: Englisch (Vereinigte Staaten)



6.3. Papers in journals

2. S. Abdulazhanov, Q.H. Le, D.K. Huynh, D.F. Wang, D. Lehninger, T. Kaempfe, **G. Gerlach**: THz thin film varactor based on integrated ferroelectric $HfZrO_2$. ACS Applied Electronic Materials 5 (2023) 1, 189–195.

3. A.I. Acevedo-Velazquez, N. Keshtkar, **J. Mersch**, K. Katzer, C. Cherif, M. Zimmermann, **G. Gerlach**, K. Röbenack (2023). Construction, modeling, and control of a three-beam prototype using interactive fiber rubber composites. Proceedings in Applied Mathematics and Mechanics (2023), e202300198.

4. M. Andrulevičius, E. Artiukh, **G. Suchaneck**, **S. Wang**, N. A. Sobolev, **G. Gerlach**, A. Tamuleviciene, B. Abakevičienė, S. Tamulevičius: Multi-target reactive magnetron sputtering towards the production of strontium molybdate thin films. Materials 16 (2023), 2175 (10 pages).

5. J. Brüning, P. Yevtushenko, A. Schlief, T. Jochum, L. van Gijzen, S. Meine, J. Romberg, T. Kuehne, **A. Arndt**, L. Goubergrits: In-silico enhanced animal study of pulmonary artery pressure sensors: assessing hemodynamics using computational fluid dynamics. Frontiers in Cardiovascular Medicine 10 (2023), 1193209 (15 pages).

6. P. Bischoff, A. V. Carreiro, C. Schuster, **T. Härtling**: Quantifying the displacement of data matrix code modules: A comparative study of different approximation approaches for predictive maintenance of drop-on-demand printing systems. Journal of Imaging, 9 (2023), 125 (12 pages).

7. P. Bischoff, A. Kaas, C. Schuster, **T. Härtling**, U. Peuker: Fast and efficient evaluation of the mass composition of shredded electrodes from lithium-ion batteries using 2D imaging. Journal of Imaging, 9 (2023), 135 (11 pages).

8. R. Dauth, **G. Gerlach**, S. Fella: Inductive coupled-coils angle encoders with improved performance and linearity. Technisches Messen 90 (2023), S2–S7.

9. S. Ghosh, **A. Hinz**, M. Frentrup, S. Alam, D. Wallis, R. Oliver: Design of step-graded AlGaN buffers for GaN-on-Si heterostructures grown by MOCVD. Semiconductor Science and Technology 38 (2023) 4, 044001 (16 pages).

10. **J. Herzog**, M. Rio, C. Schuster, **T. Härtling**, **G. Gerlach**: Hydrogelbasierte plasmonische Sensoren zur Ethanoldetektion: Einfluss des Quellverhaltens auf das optische Signal. Technisches Messen 90 (2023). (akzeptiert) https://doi.org/10.1515/teme-2023-0081

11. A.E. Ieshkin, T.S. Ilina, D.A. Kiselev, B.R. Senatulin, E.A. Skryleva, **G. Suchaneck**, Yu.N. Parkhomenko: Sputtering and ripples formation by gas cluster ions on $LiNbO_3$ crystal. Physics of the Solid State, 64(10), (2022) 1465-1476. Russian version: Fisika Tverdogo Tela (2022), 64 (10) 1489-1501.

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12. A. Kazemi, F. Müller, M.M. Sharifi, H. Errahmouni, **G. Gerlach**, T. Kämpfe, M. Imani, X. Hu, M. Niemier: Achieving software-equivalent accuracy for hyperdimensional computing with ferroelectric-based in-memory computing. Scientific Reports 12 (2022) 119201.

13. N. Keshtkar, **J. Mersch**, K. Katzer, K. Röbenack, C. Cherif, **G. Gerlach**, M. Zimmermann: Construction, modeling, and control of a three-beam prototype using interactive fiber rubber composites. Proceedings in Applied Mathematics and Mechanics (2023), e202300198 (8 pages).

14. **H. Liebscher**, **M. Koenigsdorff**, A. Endesfelder, **J. Mersch**, M. Zimmermann, **G. Gerlach**: Understanding the impact of active-to-passive area ratio on deformation in one-dimensional dielectric elastomer actuators with uniaxial strain state. Materials 16 (2023), 6897 (15 pages).

15. P. Li, S. H. C. Askes, E. del Pino Rosendo, F. Ariese, C. Ramanan, **E. von Hauff**, A. Baldi: Nanoscale thermometry of plasmonic structures via Raman shifts in copper phthalocyanine. Journal of Physical Chemistry C 127 (2023) 20, 9690-9698.

16. **J. Mersch**, N. Witham, F. Solzbacher, **G. Gerlach**: Continuous textile manufacturing method for twisted coiled polymer artificial muscles. Textile Research Journal 93 (2023) 19-20, 4623-4638.

17. **J. Mersch**, **G. Gerlach**: Properties and special phenomena of strain sensors made of carbon particle-filled elastomers. Technisches Messen 90 (2023) 11, 715-724.

18. K.K. Meena, I. Arief, A.K. Ghosh, **H. Liebscher**, S. Hait, J. Nagel, G. Heinrich, A. Fery, A. Das: 3D-printed stretchable hybrid piezoelectric-triboelectric nanogenerator for smart tire: Onboard real-time tread wear monitoring system. Nano Energy. 115 (2023), 108707.

19. A. Mindaugas, E. Artiukh, **G. Suchaneck**, S. Wang, N. A. Sobolev, **G. Gerlach**, A. Tamulevičiene. B. Abakevičiene, S. Tamulevičius: XPS analysis of strontium molybdate thin films obtained by multi-target reactive magnetron sputtering. Materials 16(6) (2022) 2175 (10pp).

20. F. Müller, S. De, R. Olivo, M. Lederer, A. Altawil, R. Hoffmann, T. Kämpfe, T. Ali, S. Dünkel, H. Mulaosmanovic, J. Müller, S. Beyer, K. Seidel, **G. Gerlach**: Multilevel operation of ferroelectric FET memory arrays considering current percolation paths impacting switching behavior. IEEE Electron Device Letters 44 (2023) 5, 757-760.

21. S. Oster, N. Scheuschner, K. Chand, S.J. Altenburg, **G. Gerlach**: Potentials and challenges of deep-learningassisted porosity prediction based on thermographic in situ monitoring in laser powder bed fusion. Technisches Messen 90 (2023), S85–S96.

22. K. Pingen, S. Neuhaus, N. Wolff, L. Kienle, **A. Žukauskaitė**, **E. von Hauff**, **A.M. Hinz**: Influence of Si(111) substrate off-cut on AlN film crystallinity grown by magnetron sputter epitaxy. Journal of Applied Physics 134 (2023), 025304.

23. **S. Schreiber**, N. Steinke, **G. Gerlach**: Chemical hydrogel sensors based on the bimorph effect with short response time. Journal of Sensors and Sensor Systems 12 (2023), 141-146.

24. C. Schwinge, R. Hoffmann, J. Hertel, M. Wislicenus, L. Gerlich, F. Völklein, **G. Gerlach**, M. Wagner-Reetz: Thermoelectric transport properties of Si, SiGe and Silicide CMOS-compatible thin films. Review of Scientific Instruments 94 (2023) 10. (DOI: 10.1063/5.0164172).

25. **G. Suchaneck**: Tunnel magnetoresistance of granular superparamagnetic and ferrimagnetic structures. Nanomaterials Science & Engineering 4 (2022) 1, 10-20.

26. **G. Suchaneck**, E. Artiukh: Nonstoichiometric strontium ferromolybdate as an electrode material for solid oxide fuel cells. Inorganics 10 (2022) 12, 230 (28pp).

27. **G. Suchaneck**, E. Artiukh: Absence of weak localization effects in strontium ferromolybdate. Applied Sciences 13 (2023) 7096 (12pp).

28. K. Thomschke, N. Steinke, M. Rio, **T. Härtling**, C. Schuster: Antibody binding to plasmonic nanostructure: A validation study using experiment and simulation. Sensors and Actuators B 397 (2023), 134624.

29. D.Q. Tran, F. Tasnadi, **A. Žukauskaitė**, J. Birch, V. Darakchieva, P.P. Paskov: Thermal conductivity of $Sc_xAl_{1-x}N$ and $Y_xAl_{1-x}N$ alloys. Applied Physic Letters 122 (2023) 18, 182107.

30. T. Tulus, J. Wang, Y. Galagan, **E. von Hauff**: Quantifying electrochemical losses in perovskite solar cells. Journal of Materials Chemistry C 8 (2023), 1-10.

31. **S. Wang**, **G. Gerlach**, J. Körner: A study of smart hydrogels as sensing elements in gaseous environment for VOC detection. Polymer 278 (2023), 126009.

32. **S. Wang**, C. Jiao, **G. Gerlach**, J. Körner: Porosity engineering of dried smart poly(N-isopropylacrylamide) hydrogels for gas sensing. Biomacromolecules 24 (2023) (akzeptiert).

33. **A. Žukauskaitė**, S. Barth: Nitrides for piezoelectric energy harvesting. Chapter. 3.4. In: V. Pecunia et al.: Roadmap on energy harvesting materials. Journal of Physics and Materials 6 (2023), 63-67.

6.4. Conference and Workshop Contributions

34. M. Andrulevičius, E. Artiukh, **G. Suchaneck**, **S. Wang**, N. A. Sobolev, **G. Gerla**ch, A. Tamuleviciene, B. Abakevičienė, S. Tamulevičius: Multi-target reactive magnetron sputtering towards the production of strontium molybdate thin films. E-MRS Fall Meeting. Warsaw, 18.-21.09.2023.

35. M. Andrulevičius, E. Artiukh, **G. Suchaneck**, **S. Wang**, N. A. Sobolev, **G. Gerlach**, A. Tamuleviciene, B. Abakevičienė, S. Tamulevičius: Multi-target reactive magnetron sputtering towards the production of strontium molybdate thin films. In: Open Readings Conference for Students of Physics and Natural Sciences. Annual Abstract Book 2023. Vilnius University Press 2023. S. 273.

36. E. Artiukh, **G. Suchaneck**, Ermakova E.A.: Magnetic tunnel junctions based on Sr_2FeMoO_6. In: Applied Problems of Optics, Informatics, Radiophysics and Solid-State Physics. Seventh International Scientific and Practical Conference. Proceedings. Minsk, 18.-19. 05.2023, p. 247-250.

37. A. Endesfelder, **M. Koenigsdorff**, M. Ullmann, M. Zimmermann, **G. Gerlach**, **J. Mersch**: Investigation of the prestretch-dependent stability and force output of carbon-fiber-reinforced dielectric elastomer actuator. In: Electroactive Polymer Actuators and Devices (EAPAD) XXV. Proc. SPIE 12482, 2023, 124820O (9 pages).

38. **A. Eydam**, **V. Norkus**, **G. Gerlach**: Thin quartz resonators as detector element for thermal infrared sensors. In: SMSI 2023 Conference – Sensor and Measurement Science International, Proceedings, Wunstorf: AMA, 2021. 340-341.

39. **G. Gerlach**: The long and rocky road from academic sensor research to industrial mass production. Invited talk, MKM 2023 Międzyuczelniana Konferencja Metrologów, Wroclaw, 20.-22.09.2023. In: M.R. Rzasy (Ed.): Metrologia. Opole: Poltechnika Opolsk 2023. 99-106.

40. **J. Herzog**, M. Sobczyk, M. Rio, C. Schuster, **T. Härtling**, **G. Gerlach**: Swelling behavior of an ethanol-sensitive hydrogel immobilized on a plasmonic sensor substrate. In: Proceedings Eurosensors XXXV Conference, Lecce, 10.-13.09.2023.

41. N. Keshtkar, **J. Mersch**, K. Katzer, K. Röbenack, C. Cherif, **G. Gerlach**, M. Zimmermann: Construction, modeling, and control of a three-beam prototype using interactive fiber rubber composites. In: 93rd Annual Meeting of the International Association of Applied Mathematics and Mechanics. Book of Abstracts. Dresden, 20.05.-02.06.2023. 174-175.

42. **M. Koenigsdorff**, **J. Mersch**, **G. Gerlach**: Free-standing tubular DEAs for multi-directional bending. In: Electroactive Polymer Actuators and Devices (EAPAD) XXV. Proc. SPIE 12482, 2023, 124820N (8 pages).

43. **M. Koenigsdorff**, Z. Wang, A. Winkler, N. Modler, **G. Gerlach**: Dielectric elastomer unimorphs with anisotropic bending stiffness: a simple and cost-effective manufacturing approach using thermoplastic dielectric and 3d-printed electrodes. In: EuroEAP 2023 – 11th International Conference on Soft Transducers and Electromechanically Active Polymers. Bristol, UK, 06.-08.06.2023.

44. **M. Koenigsdorff**, A.I. Acevedo Velazquez, **J. Mersch**, K. Röbenack, **G. Gerlach**: Investigating pre-stretch dependent blocked force and capacitive self-sensing in strip DEAs with anisotropic carbon fiber-reinforced electrodes. In: EuroEAP 2023 – 11th International Conference on Soft Transducers and Electromechanically Active Polymers. Bristol, UK, 06.-08.06.2023.

45. **H. Liebscher**, A. Endesfelder, **M. Koenigsdorff**, **J. Mersch**, M. Zimmermann, **G. Gerlach**: Influence of the active-to-passive area ratio on the electrically induced strain of a fiber-reinforced dielectric elastomer actuator. In: Electroactive Polymer Actuators and Devices (EAPAD) XXV. Proc. SPIE 12482, 2023, 124820S (8 pages).

46. **H. Liebscher**, **M. Koenigsdorff**, **J. Mersch**, **G. Gerlach**: Influence of the active-to-passive coverage ratio on electro-active strain in dot actuators. In: EuroEAP 2023 – 11th International Conference on Soft Transducers and Electromechanically Active Polymers. Bristol, UK, 06.-08.06.2023.

47. **H. Liebscher**, J. Nirmala Suresh, H. Li, **J. Mersch**, S. Wießner, **G. Gerlach**: Humidity dependence of the dielectric constant of a thermosetting polyurethane. In: Proceedings of 2023 International Workshop on Impedance Spectroscopy, 26.-29.09.2023, Chemnitz.

48. F. Müller, S. De, M. Lederer, R. Hoffmann, R. Olivo, T. Kämpfe, K. Seidel, T. Ali, H. Mulaosmanovic, S. Dünkel, J. Müller, S. Beyer, **G. Gerlach**: Multi-level operation of ferroelectric FET memory arrays for compute-in-memory applications. In: 2023 IEEE International Memory Workshop (IMW), Monterey, CA, USA, 21-24 May 2023. IEEE 2023.

49. H. Nizard, S. Rauer, D. Glöß, A. Delan, T. Modes, J. Neidhardt, **A. Žukauskaitė**, **G. Gerlach**, **E. von Hauff**: Homogeneity of nanoparticle layers as deposited by gas phase condensation (GPC) and PE-CVD processes. In: SSRN Social Science Research Network. 2023, 4496149. https://ssrn.com/abstract=4496149 or http://dx.doi.org/10.2139/ssrn.4496149.

50. C. Schwinge, M. Czernohorsky, **G. Gerlach**, M. Wagner-Reetz, W. Weinreich: 300mm wafer level fabrication of CMOS-compatible thermoelectric energy-harvester and cooler devices. In: ECT 2023 – 19th European Conference on Thermoelectrics. Praha, 17.-21.09.2023. Book of Abstracts, S. 108.

51. A. Seeger, I. Stade, J. Romberg, J. Brüning, L. Goubergrits, M. Rolf-Pissarczyk, M. Terzano, G.A. Holzapfel, **A. Arndt**: Designing and testing an implantable

sensor with in silico techniques. In: 18th International Symposium on Computer Methods in Biomechanics and Biomedical Engineering. Abstract Book - Oral Presentations. 03.-05.05.2023, Paris, France. S. 53.

52. **G. Suchaneck**, E. Artiukh, N. Kalanda, M. Yarmolich, **G. Gerlach**: Strontium ferromolybdate/strontium molybdate core-shell ceramics - A nanogranular magnetic material possessing a natural core-shell structure. Preprints 2023, 2023111103. DOI: 10.20944/preprints202311.1103.v1.

53. **G. Suchaneck**, E. Artiukh, **G. Gerlach**: Strontium ferromolybdate-based magnetic tunnel junctions. In: X International Scientific Conference: Actual Problems in Solid-State Physics (APSSP-2023), Minsk, Belarus, 22.-26.05.2023, Book of Abstracts, p.57, Online contribution.

54. **G. Suchaneck**, E. Artiukh: Nonstoichiometric strontium ferromolybdate as an electrode material for solid oxide fuel cells. In: Materials World 2023, Virtual Conference on Materials Science & Engineering, 29.-30.05.2023, Book of Abstracts, p.41, Online talk.

55. **G. Suchaneck**, E. Artiukh: Nonstoichiometric strontium ferromolybdate - a new electrode material for solid oxide fuel cells. In: 2nd International Meet & Expo on Materials Science and Nanomaterials, Webinar, 18.09.2023, Invited talk.

56. **G. Suchaneck**, E. Artiukh: Nonstoichiometric strontium ferromolybdate - a new electrode material for solid oxide fuel cells. In: 3rd World Conference On Advanced Materials, Nanoscience and Nanotechnology. 19.-20.10.2023, Paris(France), Book of Abstracts, p. 31, Invited keynote talk.

57. **G. Suchaneck**, E. Artiukh: Solid oxide fuel cells based on nonstoichiometric strontium ferromolybdate electrodes. In: 1st International Workshop on Modern Trends in Energy Research, 20.11.2023, Aveiro (Portugal), Plenary lecture, Book of Abstracts, p. 170.

58. **G. Suchaneck**, **G. Gerlach**: Perspectives of strontium ferromolybdate-based magnetic tunnel junctions. In: International Conference on Nanotechnology Research and Innovation 2023 (ICNTRI-2023), 20.-24.11.2023, Aveiro (Portugal), Book of Abstracts, p. 34.

6.6. Guest lectures (if not included in section 6.3)

59. S. Abdulazhanov, D.K. Huynh, Q.H. Le, T. Kaempfe, **G. Gerlach**: A novel reconfigurable RF Switch based on ferroelectric hafnium oxide FeFET fabricated in 22 nm FDSOI technology. EuMW 2023 – European Microwave Week. Berlin, 17.-22.09.2023. Vortrag EuMIC11-4. Conference Program. S. 51.

60. M. Andrulevičius, E. Artiukh, **G. Suchaneck**, **S. Wang**, N. A. Sobolev, **G. Gerlach**, A. Tamuleviciene, B. Abakevičienė, S. Tamulevičius: Multi-target reactive magnetron sputtering towards the production of strontium molybdate thin films. E-MRS Fall Meeting. Warsaw, 18.-21.09.2023.

61. **A. Arndt**: From engineering metrics to clinical endpoints. 28th Congress of the European Society of Biomechanics. Maastricht, 09.07.2023. Invited Talk.

62. **G. Gerlach**: Der lange und steinige Weg von der akademischen Sensorforschung zur industriellen Massenproduktion (The long and rocky road from academic sensor research to industrial mass production). XXXVII. Messtechnisches Symposium, AHMT, 27.–28.09.2023, Freiburg.

63. **E. von Hauff**: Kolloquium at Justus-Liebig-Universität Gießen, Physikalisch-Chemisches Institut. 05/2023.

64. **E. von Hauff**: Kolloquium Helmholtz-Zentrum Dresden-Rossendorf HZDR 03/2023.

65. **E. von Hauff**: Plasma & surface technologies for energy applications & sustainability. Keynote-Vortrag. V2023 – Vacuum & Plasma International Conference, Dresden, 18.09.2023.

66. **A.M. Hinz**: Reaktives Magnetronsputtern: Ein unterschätzter Prozess für die Halbleiterfertigung (Reactive magnetron sputtering: an underestimated process for semiconductor production). 656. Elektrotechnisches Kolloquium des VDE Dresden e.V., 01.11.2023

67. **J. Mersch**: Fibre-based materials in soft actuators and sensor systems. Keynote speech. Mitgliederversammlung des DFG-Schwerpunktprogramms 2100 “Soft Material Robotic Systems“. Dresden, 20.03.2023.

68. F. Müller, **G. Gerlach**: Multi-level operation of ferroelectric FET memory arrays for compute-in-memory applications. IMW 2023 – 15th International Memory Workshop. Dresden, 21.-24.05.2023.

69. N. S. Witham, **J. Mersch**, **G. Gerlach**, C. F. Reiche, F. Solzbacher: Helical geometry’s effect on the energy conversion efficiency of twisted coiled polymer artificial muscles. UBEC – Utah Biomedical Enginieering Conference. University of Utah, 09.09.2023.

70. **S. Wang**, **G. Gerlach**, J. Körner: Tailored smart hydrogels as a potential sensing material for exhaled breath analyses. 2023 MRS Spring Meeting and Exhibition, San Francisco, 10.-14.04.2023.

71. **S. Wang**, **G. Gerlach**, J. Körner: Synthesis and characteriszation of MXene-modified PNIPAAm hydrogel for VOC gas sensing. 2023 MRS Spring Meeting and Exhibition, San Francisco, 10.-14.04.2023.

72. S. Yang, M. Lederer, **G. Gerlach**: Interplay of n-/p-type regions and ferroelectric switching in ferroelectric FETs. SISC 2023, 54th IEEE Semiconductor Interface Specialists Conference, San Diego, 13.-16.12. 2023.

hat formatiert: Englisch (Vereinigte Staaten)

6.6. Associate Guest Editorships

73. **A. Žukauskaitė**: Editorial for Special Issue “Piezoelectric Aluminium Scandium Nitride (AlScN) Thin Films: Material Development and Applications in Microdevices”. Micromachines 14 (2023) 5, 1067.

6.7. Patents

74. A. Ehrenhofer, T. Wallmersperger, **G. Gerlach**: Sensor und Sicherungsvorrichtung. DE OS 10 2022 104 027 A1 vom 24.08.2023.

75. **D. Franke**, **G. Gerlach**, L. Laurentius: Sensormaterial für die kontinuierliche Bestimmung des Gewebezuckergehaltes. 2022; Lizenz verkauft an die Firma Sentiomed, Inc., Salt Lake City, Utah, USA.

76. C. Moss, A. Seidelt, **A. Arndt**, O. Skerl, T. Finnberg: Implantierbare medizinische Vorrichtung mit Aufweckvorrichtung. EP 4125552 A1, 08.02.2023.

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Dipl.-Ing. Richard Wolff
Diploma Award 2022 of the Institute for Solid-State Electronics, sponsored by InfraTec GmbH Dresden and Heimann Sensors GmbH, for his Diploma thesis „Development of algorithms for stationary and adaptive identification of defective pixels in cooled IR detector arrays“.
29.06.2023

Poster prize of the 16th Dresden Sensor Symposium for the contribution: J. Herzog, N. Steinke, M. Rio, T. Härtling, C. Schuster, G. Gerlach: “Ethanol-sensitive Hydrogele auf plasmonischen Sensorsubstraten: Einfluss des Quellvorgangs auf die Brechzahländerung (Ethanol-sensitive hydrogels on plasmonic sensor substrates: Influence of the swelling process on the change in refractive index)”.
07.12.2022.

Dr. rer. nat. et Ing. habil. Thomas Kämpfe
Dresden Excellence Award 2022 – City of Dresden Science Prize for his habilitation thesis „Electron devices based on ferroelectric hafnium oxide thin films“.
11.03.2023.

Dr.-Ing. Johannes Mersch
Measurement Technology University Prize of the Gisela and Erwin Sick Foundation 2023 for his thesis „Kraftkompensierte chemische Sensoren auf der Basis bisensitiver Hydrogele (Force-compensated chemical sensors based on bisensitive hydrogels)“.
05.05.2023

M.Sc. Simon Oster (external PhD student at the Federal Institute for Materials Research and Testing (BAM))
Student Prize 2023 from the DGZfP – German Society for Non-Destructive Testing e.V.

Publication of the month at the Federal Institute for Materials Research and Testing (BAM):
S. Oster, N. Scheuschner, K. Chand, S.J. Altenburg, G. Gerlach: Potentials and challenges of deep-learningassisted porosity prediction based on thermographic in situ monitoring in laser powder bed fusion. Technisches Messen 90 (2023), S85–S96.

Dr. rer. nat. Gunnar Suchaneck
Recognition as “Top Downloaded Article” by Wiley publishing company for the contribution “Magnetoresistance of antiphase boundaries in $Sr_2FeMoO_{6-\delta}$" in Physica Status Solidi B.

29.06.2023 Prof. Dr. Waldemar Minkina (Politechnika Częstochowska): How infrared radiation was discovered – Range of this discovery and detailed, unknown information.

29.06.2023 Prof. Dr. Sławomir Gryś (Politechnika Częstochowska): Active thermography in non-destructive testing/evaluation.

8. BOARD MEMBERSHIPS

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- Referee of the scientific journals: “Journal of Physics: Condensed Matter”, “Frontiers in Energy”, “Frontiers in Electronic Materials”, “Applied Physics Letters”, “MRS Advances”, “AIP Advances”, “Thin Solid Films”, “Phase Transitions”, “Coatings (MDPI)”, “Materials (MDPI), “Nanomaterials (MDPI)”.