

40th Chemnitz Seminar  
December 3 – 4, 2024

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## »Sensor Systems for One Health«



# Sensor Systems for One Health – Welcome!

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**Dr. Mario Baum**  
Fraunhofer ENAS  
Health Systems

**40<sup>th</sup> Chemnitzer Seminar “One Health”**  
Chemnitz, 3<sup>rd</sup> & 4<sup>th</sup> December 2024



# Welcome to Chemnitz

Home of Fraunhofer ENAS and European Capital of Culture in 2025



# Fraunhofer Institute for Electronic Nano Systems ENAS

At a glance



Around **250 experts** along the **entire value chain** of intelligent systems



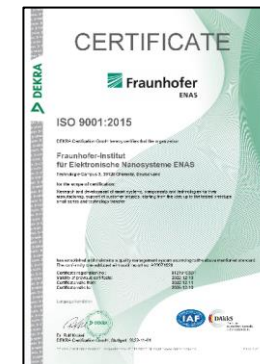
**Leading edge equipment** for wafer, package as well as for characterization, test and reliability



**218 patents** in 70 families  
ISO 9001:2015 **certified**

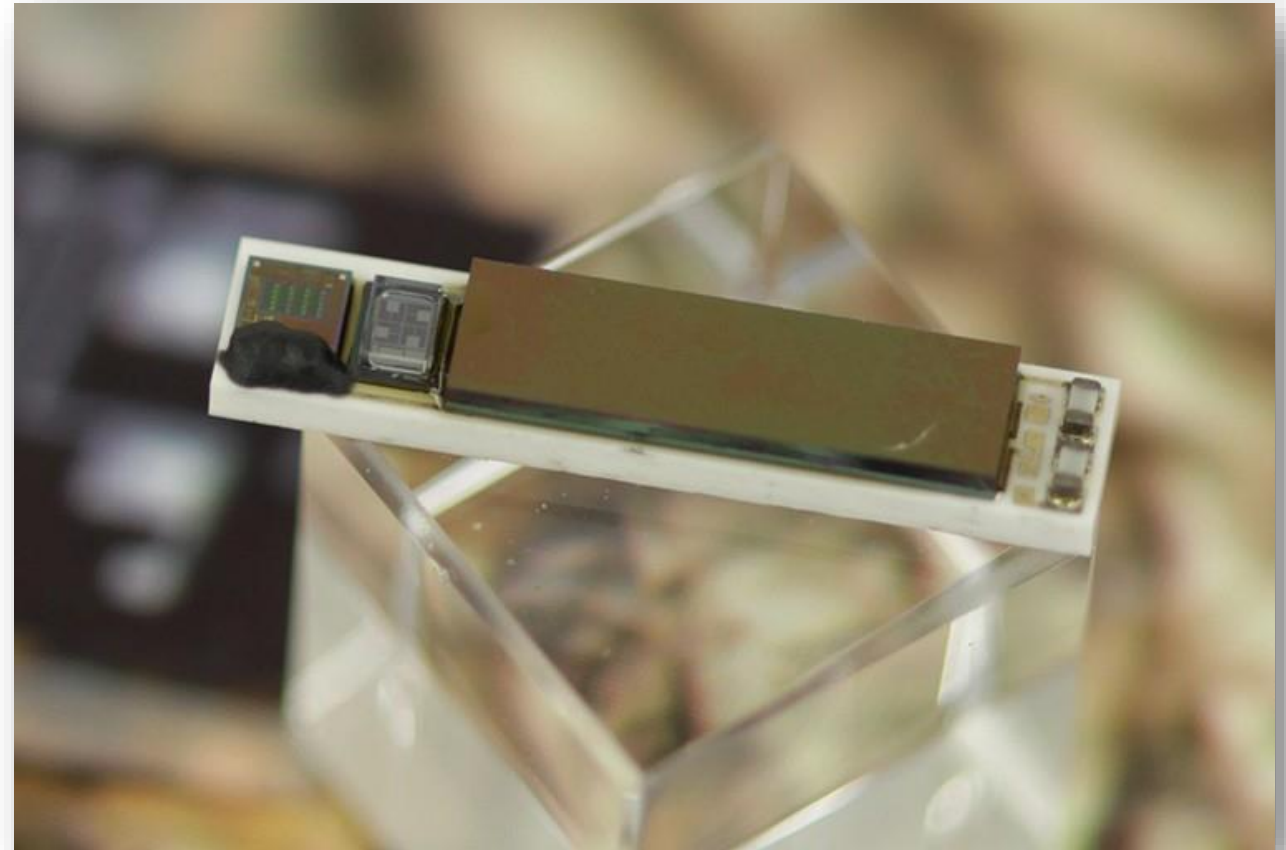
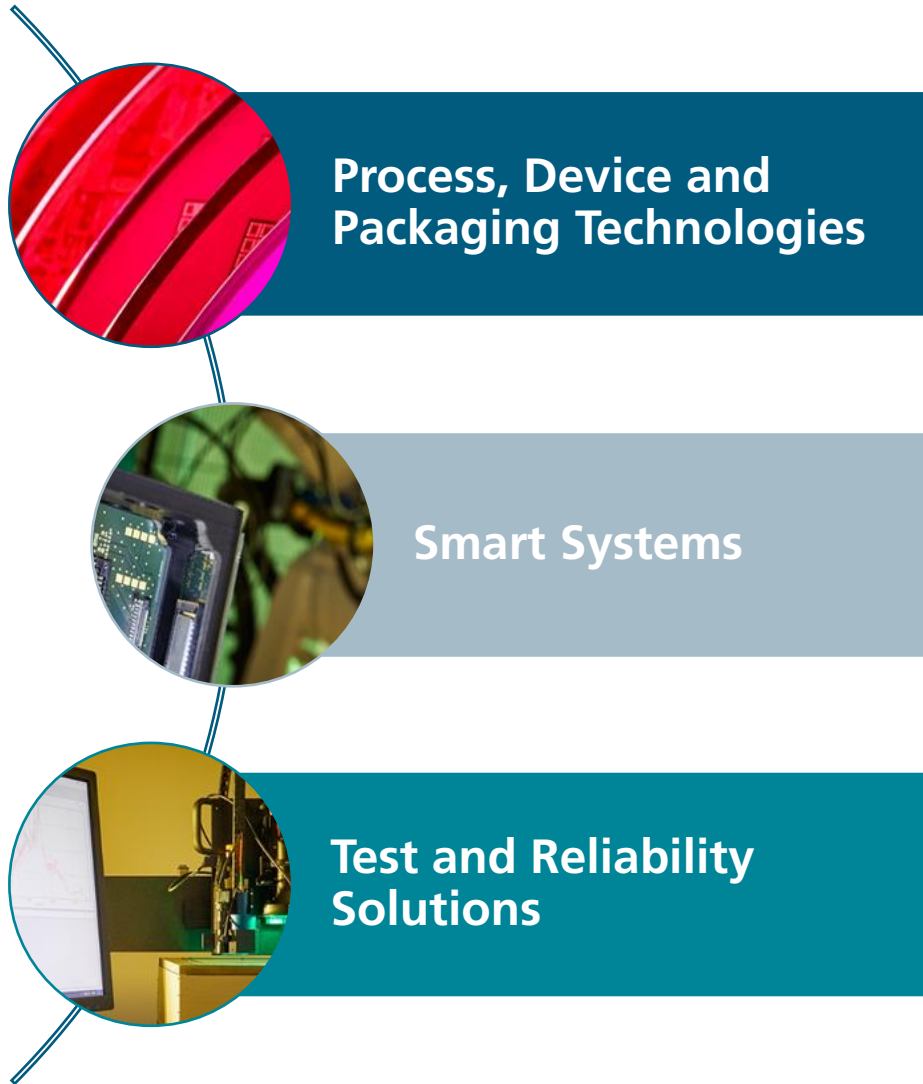


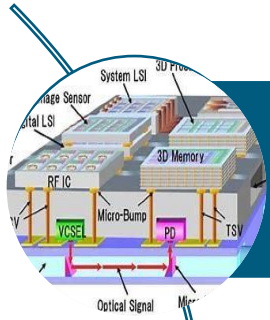
Strong Cooperation **Fraunhofer ENAS** and **Chemnitz University of Technology** (ZfM, SSI)  
**Fraunhofer ENAS is part of FMD**



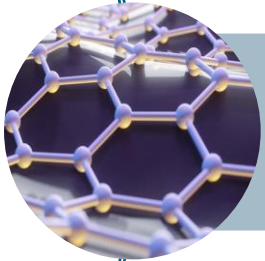


# Fraunhofer ENAS - Value chain

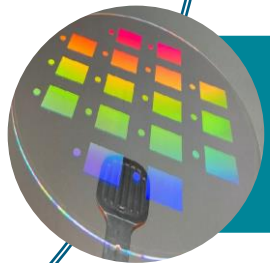




### Heterointegration



### New materials

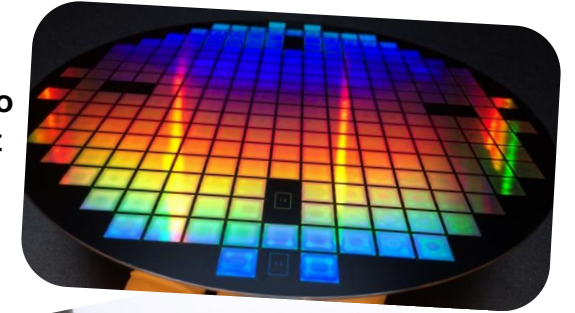


### Technology development

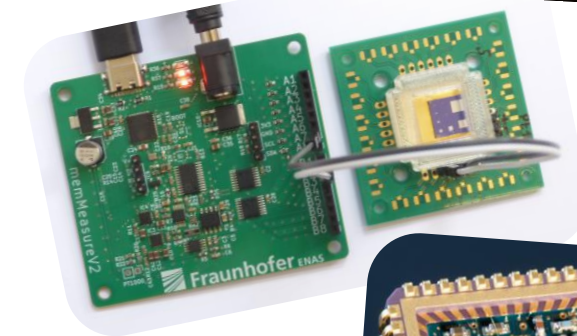
## Process, Device and Packaging Technologies

- Wafer-2-wafer bonding
  - Chemical-mechanical polishing (CMP)
  - Chiplet technologies
- 
- New functionalities
  - Higher precision of MEMS
  - Completely new components
- 
- Sensors
  - Molecular electronics
  - Next generation technology

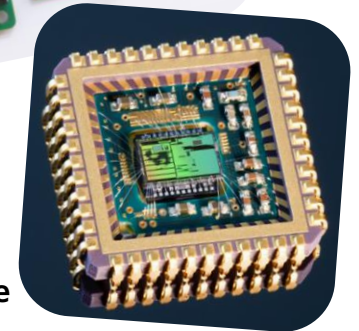
8" Nano  
imprint  
master



Memristor



Gyroscope





### Intelligent medical technology



### Hydrogen

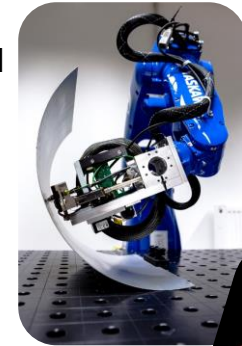


### IoT

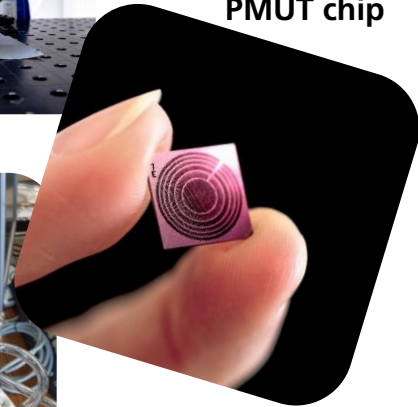
## Smart Systems

- Miniaturization
  - Ultrasonic
  - Precise medical diagnostics and analysis
- 
- Gas sensors for detecting H<sub>2</sub>
  - Structural H<sub>2</sub> tank monitoring
  - MEA printing process
- 
- Intelligent sensor systems for specific applications (agriculture/food, production machines, monitoring, ...)

Printed hybrid electronics



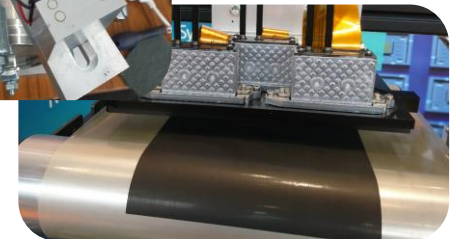
PMUT chip

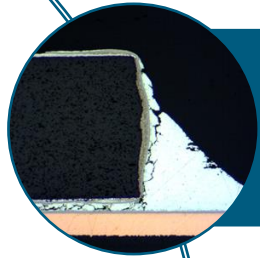


Thermal voltage sensor

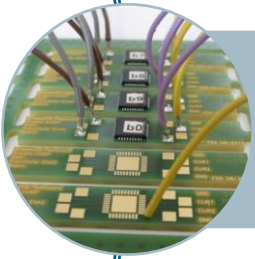


Membrane for MEA

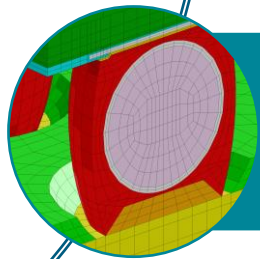




**Reliability: Leading edge in “end of life”**



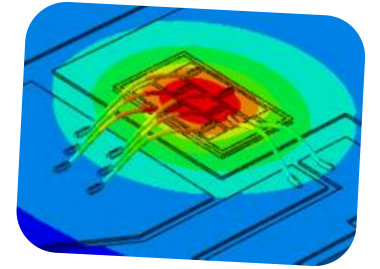
**Extension: Electrical reliability**



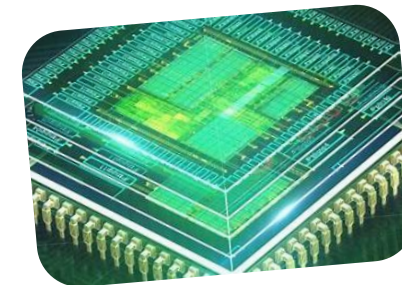
**Functional test (wafer, module and system level)**

## Test and Reliability Solutions

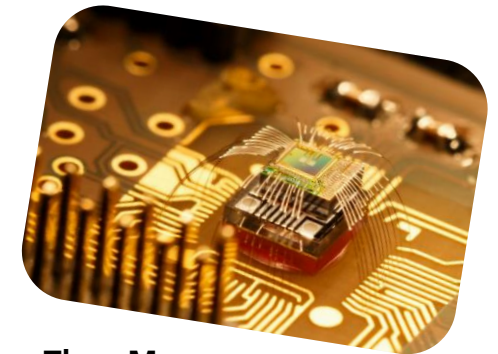
- Thermomechanical reliability
- Modeling and predictions (health model)
- Burn-In and electrical stress test
- Error models and simulation
- Design and verification
- Focus 1: High power (SiC and GaN) test
- Focus 2: Chiplet testing



**Digital Twin**



**Advanced CMOS**



**More Than Moore**



# A holistic approach to global health:

How the well-being of people and nature keeps our world in balance

The concept “One Health” describes the interactions and interdependencies between and among the elements of the various ecosystems found on our planet, where animals, humans and plants live closely together in harmonious balance.

We focus on monitoring systems based on sensors and actuators, so called smart systems for:

- Human medical & consumer technology
- Animal welfare and food safety
- Environmental Health

Keeping global health  
in balance with smart  
sensor solutions



# Department Health Systems

## Facts & Figures



Established on 1<sup>st</sup> January 2024 by the unification of **Fluidic Integration** group (MDI) and **Systems Engineering**



**Leading edge equipment** for prototyping, micro fluidics and X-Ray analysis, soon: Ultrasound diagnostics



**10** scientific staff members and technicians,  
up to **10** students in different projects and topics



Strong Cooperation **Fraunhofer ENAS** and **Chemnitz University of Technology** (MAIN, ZfM, SSI) and  
Klinikum Chemnitz





# Our Approach: Systems Engineering

as a multi core discipline of medical engineering

Project  
Leadership

Business

Science

Engineering

Risk  
Management

Requirements

Integration

Project  
Management

Human  
Factors

Verification &  
Validation

Software

Medicine,  
Health &  
Fitness

Hardware

# Sensor and Actuator Systems for One Health

Working Fields in Health related Research and Development at Fraunhofer ENAS

## Regulatory Issues for Research and Development

Implant  
Technolo-  
gies

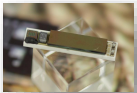
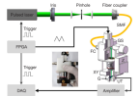
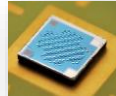


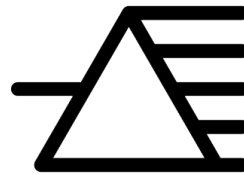
Photo-  
acoustic  
Imaging



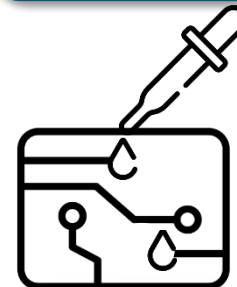
Ultrasound  
&  
Wearables



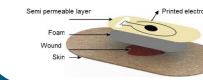
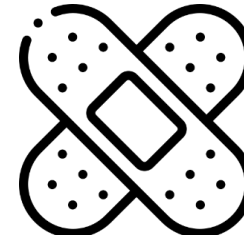
Optics &  
Spectro-  
scopy



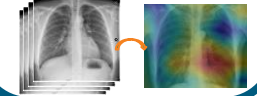
Micro-  
fluidics



Wound  
healing



Mobile and  
spectral  
X-Ray

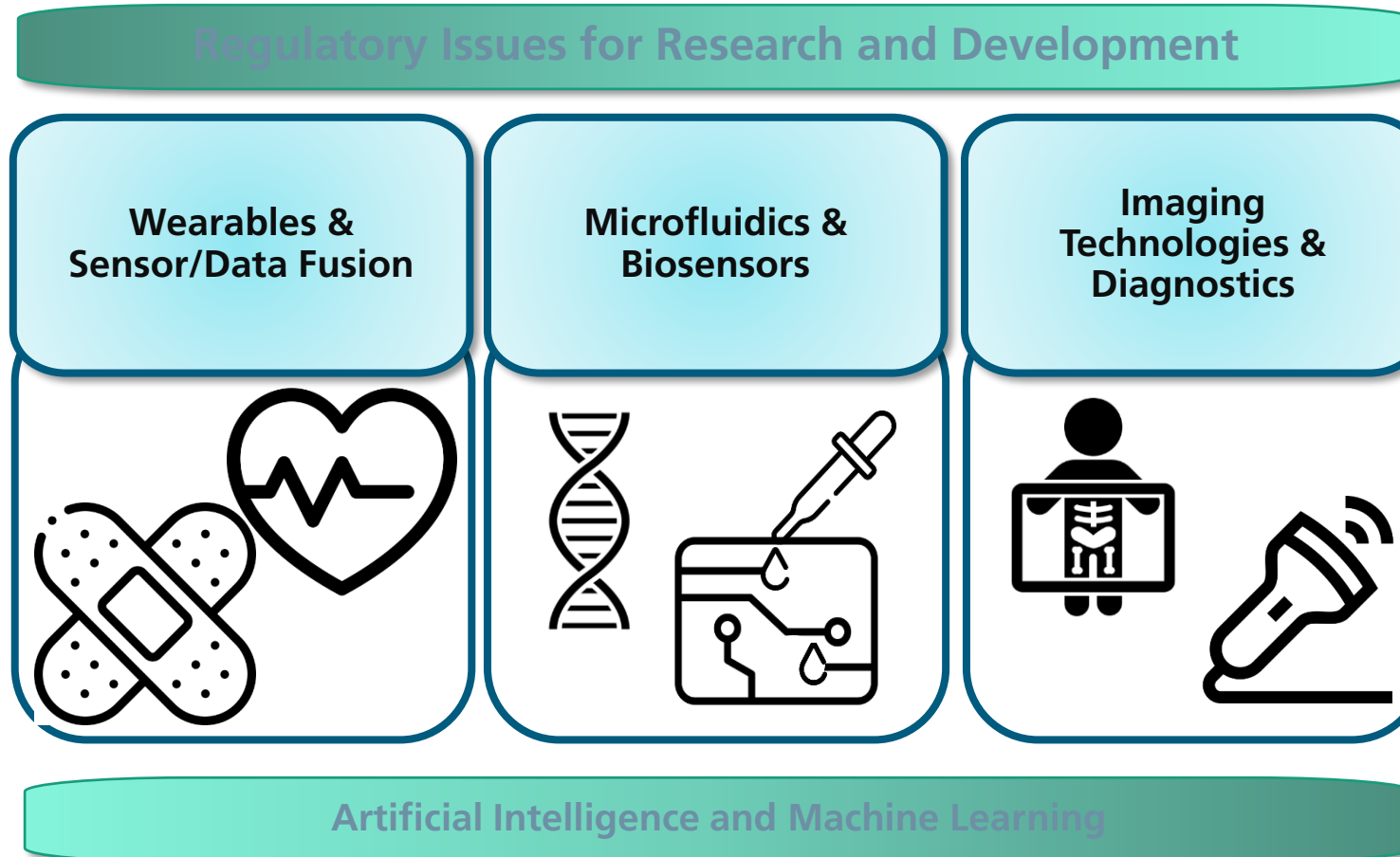


## Artificial Intelligence and Machine Learning



# Sensor and Actuator Systems for One Health

Working Fields in Health related Research and Development at Health Systems Department



### 3 Main Topics based on Competencies and scientific Experiences

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- The figure illustrates the ECG system architecture and components, divided into four parts:
- (a) Patient and ECG System:** A diagram of a patient wearing an ECG system. Labels include "ECG", "Arterie", "Patient", and "Herzschlag".
  - (b) ECG System Layers:** A cross-section diagram showing the layers of the ECG system: "Semi permeable layer", "Printed electrodes", "Foam", "Wound", and "Skin".
  - (c) IT-Infrastruktur (IT Infrastructure):** A diagram showing the IT infrastructure components: "Basisstation", "Integrative Datenbank", "Klinisches IT-System", and "Arztin/Arzt PC/Tablet".
  - (d) ECG System Components:** A photograph of the ECG system components, including the ECG system board, ECG system board, and ECG system board.

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**Das Fraunhofer ENAS ist ein Teil der**



**Forschungsfabrik  
Mikroelektronik**  
Deutschland

**Fraunhofer-Verbund Mikroelektronik in Kooperation mit  
Leibniz FBH und IHP**

# Kontakt

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**Further Information and Program of the Year:**  
**[Chemnitz 2025: Kulturhauptstadt Europas](#)**