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Fraunhofer ENAS is participant of the

Forschungsfabrik Mikroelektronik
Deutschland
The particular strength of the Fraunhofer Institute for Electronic Nano Systems ENAS lies in the development of smart systems for various applications. These systems combine electronic components with nano and micro sensors as well as actuators, communication units and self-sufficient power supply. Furthermore, smart systems are equipped with the ability to respond to each other, to identify one another and work in consortia. Hence, they form the base for the internet of things.

The research and product portfolio covers single components, manufacturing technologies and system concepts, system integration technologies and transfers them into production. Fraunhofer ENAS offers research and development services from the idea, via design and technology development or realization based on established technologies up to tested prototypes. If standard components do not meet the requirements, Fraunhofer ENAS provides prompt help in the realization of innovative and marketable products and helps to transfer them into production.

Application areas are i. a. semiconductor industry, aeronautics, automotive industry, logistics, medical engineering and life sciences, agriculture, mechanical engineering and manufacturing, as well as Internet of Things.

Fraunhofer ENAS focusses its technology portfolio and market activities on five business units:

- Micro and Nanoelectronics
- Sensor and Actuator Systems
- Technologies and Systems for Smart Power and Mobility
- Technologies and Systems for Smart Health
- Technologies and Systems for Smart Production
MICRO AND NANOELECTRONICS

- Processes and technologies for micro and nanoelectronics with the focus on back-end of line and interconnects
  » Development of individual processes (metal ALD, CVD, ULK processes, dry etching)
  » Diffusion barriers
  » Alternative interconnect architectures (air gaps, alternative ULK integration)

- Modeling and simulation of technological processes, equipment and devices
  » Simulation of processes (PVD, CVD, ALD, ECD), equipment and devices
  » Device simulation and modeling of CMOS and nano devices (i.e. CNT FETs)
  » Blackbox modeling and event-driven modeling and simulation

- Beyond CMOS and RF devices, integrated circuits and technologies
  » RF MEMS switches, CNT FETs
  » Memristive devices and circuits

- Packaging and (heterogeneous) integration (2D, 2.5D, 3D) for electronic devices
  » Development of wafer level packaging (joining and contacting processes)
  » Thin film encapsulation and screen printing for metallization and solder

- Electromagnetic and thermomechanical characterization and reliability evaluation
  » Back-end of line components, chip-package interaction and reliability assessment of board and system level
  » Thermomechanical reliability analysis
  » Optimal layout for electronic components, devices and systems
  » Simulative thermoelectrical reliability on a system (PCB) and package level
SENSOR AND ACTUATOR SYSTEMS

- **Inertial sensors**
  - High precision silicon-based sensors for measuring acceleration, vibration, inclination and angular rate
  - Full value chain accessible (design, development of technologies, manufacturing of prototypes, characterization, test)

- **Optical systems/MOEMS**
  - Variable frequency optical filters and shutters
  - Optical gratings
  - Controllable detectors and sources
  - Spectral sensors
  - Quantum dot-based

- **Electromagnetic sensors**
  - Magnetic field sensors (TMR, GMR)
  - Sensors for near field measurements of electromagnetic fields

- **Pressure and power transducer**
  - Silicon-based ultrasonic transducer
  - Ambient pressure-sensitive resonators
  - MEMS loudspeaker

- **Material and structure sensors**
  - Silicon-based sensors for mechanical strain, stress and overload (detection of cracks)
  - Nano composite-based overload and humidity sensors
  - Sensors based on carbon nanotubes
TECHNOLOGIES AND SYSTEMS FOR SMART POWER AND MOBILITY

- Energy supply of mobile devices and vehicles (electromobility)
  » Wireless power supply (low and high power)
  » Flexible, low-cost batteries
  » Reliability of battery management systems with integrated sensors (electromobility)

- Reduction of the power consumption of vehicles by integration of actuators and sensors into lightweight structures
  » Power saving with focus on active flow control
  » Integration of sensors for Structural Health Monitoring (SHM) into light weight structures

- Electric grid monitoring
  » Monitoring of high-voltage and medium-voltage lines including the transmission of data into the grid control center
  » Increase of the ampacity of existing power lines
  » Detection of ice load on the power lines
  » Monitoring the distance of the conductor to ground
  » Conductor slip for detection and localization of ground faults

TECHNOLOGIES AND SYSTEMS FOR SMART HEALTH

- Medical implants
  » Miniaturized sensor and actuator systems including system integration and biocompatible encapsulation for replacement, restoration and improvement of human senses

- Medical devices
  » Integrated sensors and actuators for the monitoring of patients
  » Biocompatible materials for the interface between biological tissue and technical devices
  » MRI-compatible materials
  » Wireless data and energy transfer

- Analytics
  » Integrated sensor and actuator systems for microfluidic and spectroscopic analysis systems
  » Wireless data and energy transfer
TECHNOLOGIES AND SYSTEMS FOR SMART PRODUCTION

- Smart digital production
  » Providing technologies for flexibilization and sensor-based monitoring of production
  » Resource-efficient mass production of intelligent and individualized products down to batch size 1 (inkjet and aerosol jet printing processes)

- Sensor systems for supporting production
  » Sensor solutions for monitoring of machine conditions and processes during production
  » Sensor systems for harsh environments
  » Sensors for monitoring production resources (grease, oil, air)

HOW TO REACH US

Bus and tram stop:
1 »Fraunhoferstraße Süd«
2 »Am Technologie-Campus« and »Technopark«
3 »TU Campus«
4 »Rosenbergstraße«
5 »Fraunhoferstraße Nord«
6 »Stadlerplatz«

Directions:
www.enas.fraunhofer.de/en/contact