3 Memberships

Prof. Wolfram Dötzel

Gesellschaft für Mikroelektronik und Mikrotechnik (VDI/VDE-GMM), Fachausschuß "Trendanalyse"
Member of the Academy of Science of Saxony, Leipzig / Germany
Member of acatech (Council of Technical Sciences of the Union of German Academies of Sciences and Humanities)
ESPRIT III – Network „NEXUS"
DFG-Fachgutachter „Mikro- und Feinwerktechnik"
Prorector for Research of TUC since October, 2003

Prof. Gunter Ebest

Vertrauensdozent „Studienstiftung des Deutschen Volkes"

Prof. Thomas Gessner

Member of „Scientific Advisory Board of the Federal Republic of Germany "
Member of the Academy of Science of Saxony, Leipzig / Germany
Member of acatech (Council of Technical Sciences of the Union of German Academies of Sciences and Humanities)
Member of "Senatsausschuss Evaluierung der Wissenschaftsgemeinschaft Gottfried Wilhelm Leibnitz" (WGL)
Member of the Board of „KoWi", Service Partner for European R&D funding, Bruessel
The Institute of Electrical and Electronics Engineers, Inc. (IEEE) , USA
The Electrochemical Society, USA
„Advisory Professor" of FUDAN University: honorary professor, 1st June 1999
„Advisory Professor" of Chongqing University: honorary professor, 1st July 2003

Prof. Dietmar Müller

Member of the Academy of Science of Saxony, Leipzig / Germany
Member of acatech (Council of Technical Sciences of the Union of German Academies of Sciences and Humanities)

Prof. Christian Radehaus

Optical Society of America (OSA)
The Institute of Electrical and Electronics Engineers, Inc. (IEEE), USA
The American Physical Society (APS)
Deutsche Physikalische Gesellschaft (DPG)

Fraunhofer Institute Reliability and Microintegration
Branchlab Chemnitz
Department: Micro Devices and Equipment

Director: Prof. Thomas Gessner ***Management: Dr. Thomas Otto***

Since 1998 a strong co-operation exists between the Fraunhofer Institute for Reliability and Microintegration (FhG-IZM, Berlin) and the Center for Microtechnologies. Accordingly the department "Micro Devices and Equipment" (MDE) was founded to combine the packaging know-how of the FhG-IZM with the silicon MEMS devices of the Center for Microtechnologies.

The research activities of the department MDE are focused on the following topics:

- *Development of MEMS*: Sensors (kinetic, pressure, force, chemical) and actuators (scanner) are transferred into the system level (e.g. micro spectrometer).

- *Development of advanced technologies* like CMP (chemical mechanical polishing) and 3D-patterning by deep silicon etching as well as increasing the core competence in *MEMS packaging* (chip and wafer bonding including combinations of new materials and bonding at low temperatures)

- *Process and equipment simulation:* The goal is the improvement of deposition and etch rates, uniformity and fill behavior of vias and trenches by optimizing process conditions and reactor design.

- *MEMS design and simulation*:
  - New reduced order modelling features of MEMS provide efficient means for data exchange from component models to circuit and system simulation environment.
  - Novel frequency selective vibration sensor arrays have been successfully integrated into a user programmable vibration measurement unit for wear state monitoring.

One special task of the new assembly technologies development is the combination of silicon micromechanics with down scaled traditional precision mechanics enabling new devices and new low cost fabrication technologies. This is a main challenge in order to push the activities concerning the development and implementation of microsystems for small and medium size enterprises in a short-term period.

In general the strategic alliance between the Fraunhofer Institute for Reliability and Microintegration, department MDE and the Center for Microtechnologies as described ensures strong synergies in the technology and device development.

Nanotechnology Center of Excellence "Ultrathin Functional Films"

The Center of Excellence "Ultrathin Functional Films" (UFF), distinguished by the Federal Ministry of Research (BMBF) as a nation-wide center, is coordinated by Fraunhofer-IWS Dresden. It joins 51 enterprises, 10 university institutes, 22 research institutes, and 6 corporations into a common network. Nanotechnology is one of the key technologies of the 21st century. In order to channel the research results already available at institutes and universities as well as the growing demand from industry, the Nanotechnology Centers of Excellence (CE) had been established in 1998. The Center for Microtechnologies is an active member within this center, especially in the field of microelectronics related topics.

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Activities within the frame of Nano-CE-UFF are subdivided into 6 Working Groups (WG), every one of which is administered and coordinated by one member:

WG 1: Advanced CMOS
WG 2: Novel components
WG 3: Biomolecular films for medical and technological purposes
WG 4: Mechanical and protective film applications
WG 5: Ultrathin films for optics and photonics
WG 6: Nano-size actorics and sensorics

The Working Groups, in which the Center for Microtechnologies is mainly involved, are described shortly in the following:

Advanced CMOS

Structural widths of about 200nm are state-of-the-art in CMOS technology. A reduction down to below 100nm within 10 years, for further miniaturization, is envisaged by the Semiconductor Roadmap (by Semiconductor Industry Association (SIA) and SEMATECH). Along with this trend, higher frequency and reliability are required. This implies novel developments in materials and processes for both the active elements and the interconnect system, including advanced equipment for larger Si-wafer production. Most present-day systems are made of contacts (e.g. titanium or cobalt silicide), barrier layers (TiN, TiW), isolating interlayers (SiO_2), interlayer connections and conducting paths (Al-alloys). Copper with its high conductivity and stability with respect to electromigration is being introduced as conductor material leading to higher frequency and reliability. This requires a precise technology of copper deposition (aspect ratio > 3) and patterning and the availability of suitable barrier layers suppressing interdiffusion and reactions. The barrier layers must not affect the conductivity of the paths remarkably, which requires ultra-thin films. Interfaces and nanometer scale effects become increasingly important.

Head of the Working Group: Prof. Dr. Thomas Gessner
Chemnitz University of Technology

Novel components

The continuing trend towards miniaturization of integrated circuits has given rise to increasing efforts to supplement and gradually replace conventional CMOS-technologies by nanotechnologies and nanoelectronics in near future. The latter include magneto-electronics,

and single electron devices, nanocluster storage elements, and resonant tunneling elements, among others.
There is a new generation of novel components based on the transfer of individual electrons in nanoscale structures. Work centers on memory elements based on the transfer of individual electrons between metal electrodes and on the memory effect of semiconductor nanoclusters in SiO_2 films.

Head of the Working Group: Prof. Dr. Christian Radehaus
Chemnitz University of Technology

4 Research activities of ZfM in cooperation with the FhG-IZM-branchlab Chemnitz

Fields of research

- Design and fabrication of microelectronical and micromechanical elements and arrays
- ULSI metallization
- High temperature stable metallization
- Analysis of micromechanical systems
- Development and application of design tools and methods for micromechanical components and systems & coupled field analysis
- Experimental analysis of microsystems
- Analysis of different interferences on micromechanical systems, reduction or compensation of these interferences
- Coupling of microsystems and instrumentation (mechanical, electrical, thermal and substantial interfaces)
- Function, principles and modelling of electronic devices (test structures, parameter extraction, model building)
- Microelectronic circuit design (read out- and controlling circuits for sensors and actuators)
- MIS – solar cells (manufacturing, analysis, measuring and modelling) & multicristalline solar cells
- Electronics for micro-electromechanical systems (MEMS)
- Design of reusable modules
- Development of infrared measurement systems
- Nanoelectronics
- Integrated Optics
- Colour measurement

Subjects of research

- Microfabricated scanner arrays
- Electostatically driven torsion actuators with one or two DOF
- High temperature applications of MEMS, e.g. gas sensor for exhaust measurement
- Vibration monitoring based on Si-sensor arrays
- Sensor / actuator systems for high precision scanning with a large vertical range
- Transportation systems by using MEMS-actuators