1 Preface

As in preceding years, the Center for Microtechnologies in close cooperation with the "Micro Devices and Equipment" Department Chemnitz of the Fraunhofer Institute for Microintegration and Reliability (FhG-IZM) in Berlin has further consolidated its position as a Center of Excellence in the fields of microelectronics back end technologies and microsystem technologies.

The key to our success was an interdisciplinary cooperation of several chairs within the ZfM. Based on this idea, ZfM's primary mission is to provide an intellectual and working environment that makes possible education through teaching and research in areas that require or may benefit from advanced ULSI-interconnect technologies, Si-nanotechnology and new developments and ideas in the field of MEMS by using microfabrication technologies. ZfM's technology laboratories provide a complex of modern microelectronics laboratories, clean rooms and microfabrication facilities.

Meanwhile the Fraunhofer IZM Department Micro Devices and Equipment Chemnitz exists more than 5 years. The successful integration of MEMS packaging, MEMS system development and equipment as well as process simulation in cooperation with the ZfM has become more and more apparent.
This issue was demonstrated at the Colloquium "Centre of Competence for Micro- & Nanosystems" - 5 years Fraunhofer IZM, Dept. Micro Devices and Equipment, Chemnitz – in August 2004.

We are very pleased that Prof. Dr. Josef Lutz was elected as a new member of the board of directors of the ZfM.

It is my pleasure to summarize some of the scientific highlights of 2004:

- Development of a low-k compatible H_2-based resist stripping process
- Establishing CMP equipment & process for advanced process development and material assessment in Cu / barrier CMP on porous low-k dielectrics
- Development & investigation of ultrathin ternary CVD diffusion barriers (Ti(Si)N, W(Si)N)
- First prototypes of two-axis inclination sensors based on AIM technology successfully fabricated.
- Silicon gyroscope chips from Chemnitz have been sucessfully implemented and tested within a miniaturised LITEF demonstrator for avionic applications.
- A novel 24 kHz scanner with very high optical performance has been developed and successfully tested. It is applicative for horizontal laser deflection in head up displays.
- A micro friction vacuum gauge has been qualified for operation within a temperature range of room temperature up to 350 °C.
- Frequency selective sensors for structure born noise on base of a MEMS chip have been developed. Samples for 2 kHz, 3.5 kHz, 4.5 kHz and 6 kHz are available.
- Development of new software modules for parametric model generation of MEMS based on variational Finite Element techniques.

- System integration of frequency selective sensor arrays for vibration monitoring at cutting tools.

- A new substrate based on SOI technology with buried silicides usable for high performance RF microelectronic devices was developed successfully and is been transferred for industrial application.

- A bulk micromachined ultrasonic transducer is designed and fabricated. Compared with similiar products, this newly developed transducer has the advantages of uniform cavity, consistent elements, and reliable vibration membrane.

- Resonant structure implemental for low pressure measurements inside of hermetically sealed micromechanical devices have been fabricated.

- Tunable infrared filter based on Fabry-Perot-Interferometer suitable for gas analysis systems have been improved.

- Miniaturized dual detector NIR-spectrometer based on micro mechanical scanners with integrated gratings appropriate for substance analysis in gaseous, liquid and solid state has been developed.

- Within the frame of projects NanoCMOS and Skalar the in-house multi-purpose simulation environment T2 has been extended to multi-scale simulation of thin film deposition using advanced PVD and of planarization of oxide films for Shallow Trench Isolation (STI).

The 2004 Annual Report of the Center for Microtechnologies provides an overview of the facilities, staff, faculty and students associated with the ZfM, as well as a description of many of the ongoing research projects which make use of the ZfM facilities.

These developments, which are based on close links with industry and cooperation with German as well as international institutes, contribute to an advanced education for our students. We kindly acknowledge the support of the Federal Ministry of Research, the German Research Foundation, the Saxon Ministry of Science and the European Commission.

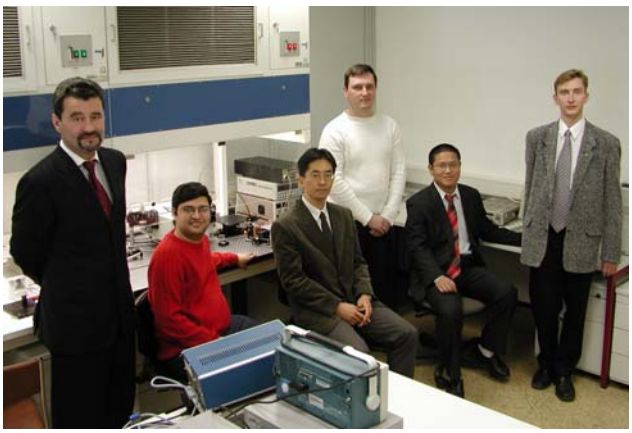
As always, we are driven by our triple aims of excellence in education, scientific and technological research and by providing a comprehensive range of research and development services to industry.

I would like to thank all my colleagues, the scientific fellows and technicians for all their dedicated work.

I look forward to participating in the promising development of new devices and concepts through the use of silicon technology.

Thomas Gessner
President of the Center for Microtechnologies

International cooperations



Prof. Thomas Gessner together with international students and co-workers

From left:
Srihari Sankisa, University of Nevada, Reno, USA – IAESTE program;
Yukito Sato, Ricoh Ltd., Sendai, Japan – Scientist;
Wladimir Kolchuzhin, University of Novosibirsk, Russia – PhD;
Chenping Jia,University of Xian, China – PhD;
Alexej Schaporin, University of Novosibirsk, Russia - PhD

Prof. Gessner – guest of "75th anniversary of Chongqing University", China

Prof. Li Xiaohong, President of Chongqing University

Prof. Zhu Jialin, Chairman of Chongqing Association for Science and Technology

Delegation of Brazil

Mr. Hernan Valenzuela
Brazilian Ministry of Development, Industry and Foreign Trade (SUFRAMA), Coordination of Institutional Relations for Technological Affairs (COART)
meets members of our university and of the FhG

Colloquium
"Centre of Competence for Micro- & Nanosystems"
- 5 Years Fraunhofer IZM, Dept. Micro Devices and Equipment, Chemnitz -

August 10, 2004

Dr. Peter Seifert, Lord mayor of Chemnitz congratulates Prof. Gessner on his birthday

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 100nm are state-of-the-art in CMOS technology. A reduction down to below 50nm within 10 years, for further miniaturization, is envisaged by the International Technology Roadmap for Semiconductors ITRS (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. High k dielectrics will be applied to ensure further scaling of effective gate oxide thickness. Most present-day interconnect systems are made of contacts (e.g. titanium or cobalt silicide), barrier layers (TiN, TiW), isolating interlayers (SiO_2 and low-k dielectrics like FSG, OSG), interlayer connections and conducting paths (Al-alloys and Copper). Copper with its high conductivity and stability with respect to electromigration has been introduced as conductor material leading to higher frequency and reliability. This requires 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.

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