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Seminar on “SiGe BiCMOS Technologies for Microwave and Terahertz Applications”

锗硅 BiCMOS 技术的微波和太赫兹应用研讨会

March 17 - 18, 2016 | SHANGHAI, CHINA

Why Participate:

In the past decade there has been increased interest in utilizing the frequency spectrum within the THz gap (30GHz to 30 THz) for different applications in the mm-and sub-mm-wave range like industrial sensors and imagers, point-to-point wireless communications, extremely broadband ADCs, 400Gb/s optical (backbone) transmission, high-resolution 150 GHz automotive radar, as well as highly linear amplifiers for mobile communications. Moreover there is a large variety of application areas for these circuits and systems such as health (medical equipment, skin and genetic screening), material science (safety inspection and research), mass transit (security screening, in-seat communications), industrial automation (sensors), communications (terrestrial, satellites), and space exploration. Nevertheless the deployment of these high-performance circuits and systems in commercial markets is driven mainly by cost-, form-factor-, and energy-efficiency and several applications in the mm- and sub-mm-wave range cannot be addressed by digital CMOS technology due to the impact of parasitics to the high-frequency (HF) performance of the CMOS transistors and limitations for achievable cutoff-frequencies. Moreover, the diversity of the commercial (sub)mm-wave market results in segments that are too small to justify the extremely expensive fabrication of advanced (digital) CMOS including the addition of the necessary passives. A much more cost-efficient solution is the modular integration of high-performance silicon-germanium (SiGe) heterojunction bipolar transistors (HBTs) and special passive devices for HF-applications into a depreciated CMOS process. The resulting BiCMOS technology has already become a mainstream manufacturing platform for a large variety of existing HF products offered by different worldwide operating foundries and research institutes like IBM/Globalfoundries, ST-Microelectronics with a 55 nm SiGeC BiCMOS process and IHP with the world fastest SiGe-BiCMOS process (130nm) exceeding cutoff-frequencies of 0.5 THz.

The short course will provide a detailed introduction in physical principals of SiGe HBTs and process integration schemes for integration in existing CMOS platforms. A comparison of technology features of SiGe HBTs with RFCMOS and III/V technologies will be given.

For circuit designer a good design environment in state of the art CAD Tools is important. Details on SiGe HBT modeling and reliability aspects will be presented together with special supported RF components in Process Design Kits for RF design.

Lecture 3 will focus on advanced technology modules in SiGe BiCMOS technologies for RF applications followed by a presentation of design examples from 10GHz to 500 GHz in Lecture 4. Here a comparison of SiGe design features with competitive RFCMOS and III/V technologies will be given as well.

In Lecture 5 three design examples relevant for recent industrial applications will be presented more in detail. Design concepts in SiGe BiCMOS environment will be explained from schematic level to



simulation and layout.

A German design company Silicon Radar (spin off of IHP) will present radar products based on SiGe BiCMOS technologies at 24 GHz and 120 GHz. For 120 GHz a radar chipset will be presented in an onsite demo. In the presentation there will be a focus on RF packaging concepts and RF testing problems for product development.

Beside its importance for Microwave Applications, SiGe technologies opens a door to develop Terahertz products in near future. This is a recent research topic worldwide, which will be touched in our lectures beside Microwave applications. Especially in lecture 7 research topics in this field will be presented from a Chinese Research Institute which is using IHP's SiGe technologies for many years already.

Finally IHP's in MPW and foundry service offerings will be presented, which will show a convenient way to access SiGe BiCMOS technologies.

Who Should Attend:

This course is suitable for foundry process engineer, manager and also for designer who wants to design high frequency application from SiGe BiCMOS, such as high speed communications, radar applications, mmWave THz imaging and sensing. In addition, different product example from SiGe BiCMOS process will be attractive and good example for customers who want to develop similar product. This course also welcomes high level management of Chinese foundries to discuss possible cooperation between IHP and local Chinese foundries with BiCMOS process.

Why Lynne Consulting:

Lynne Consulting is offering advanced engineering courses in the field of analog, RF and mixed-signal IC design targeting the audience of electrical engineers, company managers and marketing engineers working in the semiconductor industry. The lecturers are leading practitioners and top experts in the area from high-technology companies and universities, who teach the most up-to-date information available at the time of the course.

Course Details:

- ◆ **Duration:** 2 days (17th-18th March 2016)
- ◆ **Venue:** Building 21, No 1388, Zhangdong Road, Pudong New District, Shanghai, China
- ◆ **Registration Fee:** ¥2500/person (Included in the fee are lecturing fee, lecture notes, daily lunches and coffee breaks.)
- ◆ A discount applies for groups before **11th March 2016** (3 persons (Total: ¥7000); 4 persons (Total: ¥8800); 5 persons or more (negotiation))
- ◆ ¥1800/person for students
- ◆ The above discount can not apply simultaneously
- ◆ **Deadline for registration: 11th Mar. 2016**

Registration Method:

Free registration: Please fill out the registration form (in the attachment) and send the completed form to:

Email: steven.yu@lynneconsulting.com

Fax: 021-3327-5892

Seminar Program:

Day 1-March 17, 2016 (Thursday) :

Lecture 1: SiGe HBTs integrated in a CMOS platform - By Dr. A. Mai

- Physics of SiGe HBT
- Detailed Technology flow of SiGe HBT in a CMOS platform
- Process comparison RF-CMOS, SiGe BiCMOS, III/V Technologies

Lecture 2: Circuit Design platform for SiGe HBTs – By Dr. R.F. Scholz

- Modelling and Reliability of SiGe HBTs
- Process Design Kit for RF Design

Lecture 3: High end RF Technology Modules on CMOS/BiCMOS a More than Moore strategy- By Dr. M. Kaynak

- BiCMOS embedded RF-MEMS
- BiCMOS embedded Through Silicon Vias
- Microfluidics for THz bio-sensing applications
- Fan out wafer level packaging (eWLB) for RF applications

Lecture 4 : Overview SiGe Circuit Design – By Dr. M. Kaynak

- Application comparison RF-CMOS, SiGe BiCMOS, III/V Technologies
- Selected SiGe Design Examples from 10 GHz to 500 GHz

Day 2-March 18, 2016 (Friday) :

Lecture 5: Wireless Applications: From research to product - By Dr. Y. Sun

- 60 GHz for communication
- 120 GHz Radar on chip solution
- 77 GHz Radar for Automotive: front-end solution chipsets pre-release

Lecture 6: Silicon Radar – Experts on MMICs Radar Products - By D. Genschow

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- 24 GHz Radar Frontend Chips
 - Packaging Concept and RF Testing on 120 GHz Radar reference product
 - 120 GHz Demonstration Board – on site demo

Lecture 7: TMillimetre-wave and THz Applications – SiGe Design Research in China –By Prof. Y.Z. Xiong

- W-band transceiver
- D-band transceiver
- 340 GHz transceiver

Lecture 8: MPW and Foundry Service from IHP - By Dr. R.F. Scholz

Lecturer's Biography:

Dr. Andreas Mai



Dr. rer. Nat. Andreas Mai studied physics at the Technical University of Brandenburg and made his diploma with AMD Dresden in 2006. Subsequent he joined the IHP Technology department. He worked in the Process Integration group on the development of a 130nm SiGe-BiCMOS technology with focus on the integration of RF-LDMOS transistors. He received his PhD in 2010 and became the project leader for the technical coordination, yield enhancement and technology stabilization of IHPs MPW-technologies. In 2013 he got the position as group leader of the “Process Integration” group in IHPs technology department with the responsibility for service and certain research activities of

IHPs technology developments. Since the beginning of 2015 he acts as the “Technology-Department Head” in IHP with the main responsibilities for operation of IHPs 200mm-SiGe-BiCMOS pilot line and technology service activities of IHP.

Dr. Mehmet Kaynak



Dr. –Ing Mehmet Kaynak received his B.S degree from Electronics and Communication Engineering Department of Istanbul Technical University (ITU) in 2004, took the M.S degree from Microelectronic program of Sabanci University, Istanbul, Turkey in 2006 and received the PhD degree from Technical University of Berlin, Berlin Germany in 2014. He joined the technology group of IHP Microelectronics, Frankfurt (Oder), Germany in 2008. From 2008 to 2015, he has led the MEMS development at IHP. Since 2015, he is the department head of technology group at IHP. Dr. Kaynak is being affiliated as Adjunct Professor at Sabanci University, Turkey and he is coordinating the joint-lab between IHP and

Sabanci University.

Dr. Kaynak has spent 5+ years on RF-MEMS switch development in a BiCMOS process for mm-wave applications. He has also experience on RF and mm-wave silicon based circuits. His other research interests are integrated CMOS-MEMS technologies, development of RFMEMS passive components and thermal and thermal-mechanical properties of thin film structures and modeling of these with finite-element analysis. Recently, he initiated the research activities at IHP on 3D heterogeneous integration and microfluidics technologies.

Dr. Kaynak has published over 100 peer-reviewed journal and conference publications as an author or co-author. He has granted 7 patents on RF-MEMS technologies. He has involved in many different BMBF and EU supported projects and has act as the work package leader of EU funded FLEXWIN and NANOTEC projects. He currently serves on several steering and technical committees of international conferences and journals as member and reviewer, such as IEEE NEMS, IEEE IMS, IEEE Radio Wireless Week, IEEE SiRF, EuMW, GeMiC, MEMSWAVE, IEEE Transactions on Microwave Theory and Techniques, IEEE Microwave and Wireless Components Letters, IEEE Transactions on Antenna and Propagation, Elsevier Microelectronics Engineering. He act as the general chair of MEMSWAVE conference in 2013 and TPC chair of IEEE SiRF in 2013. He is the member of European Space Agencies (ESA) Micro Nano Technologies (MNT) group, EuMAs Topical Group on RF MEMS, IEEE Technical Committee MTT-21 (MEMS Components and Technologies) and MTT-10 (Biological Effect and Medical Applications of RF and Microwave). Dr. Kaynak has received the Young Scientist Award of Leibniz institute for the year of 2014.

Prof. Yong-Zhong Xiong



Yong-Zhong Xiong received the Ph.D. degree in electrical and electronic engineering at the Nanyang Technological University (NTU), Singapore. He was with the Institute of Microelectronics (IME) of Singapore as a Principal Investigator (PI) more than ten years, He currently is a professor and director of Semiconductor Device and Integrated Circuits, Terahertz Research Centre, China Academy of Engineering Physics, Chengdu, China. he is leading a group working on monolithic silicon based microwave/millimeter wave/THz integrated circuit design, and device modeling & characterization. He holds several issued patents and has authored or co-authored over 200 technical papers.

Dr. Yaoming Sun



Yaoming Sun received his B. Eng. Degree from Xidian University, Xi'an, China, in 1997, the M. S. degree from Katholieke Universiteit Leuven, Leuven, Belgium in 2003, and the Ph.D . degree from Brandenburgische Technische Universität Cottbus, Cottbus, Germany in 2009.

Dr. Sun worked in the field of mobile communication, RF transceivers from 1997 to 2002. At 2002, he was involved in Ku-band transceiver design based on MCM-D technology with IMEC, Belgium. From 2003 to 2013, he was with IHP Microelectronics, Frankfurt Oder, Germany, as a scientist. During this period, he has designed and co-designed the first 60-GHz transceiver SoC chipset in Europe. From 2010, he coordinated the European project 'SUCCESS', where highly integrated 122GHz radar chipsets are

developed and successfully demonstrated. At 2013, Dr. Sun found a company 'HK Microsystem' to promote SiGe BiCMOS technologies in Asia and providing design service and consultancy.

D. Genschow



Dieter Genschow graduated from Reading University (UK) and University of Applied Sciences in Berlin, Germany in 2006.

He started working in the industry as a design engineer for capacitive sensing technologies in a German Tier 1 company for the automotive industry.

He joined the IHP as a research associate in 2009 and worked in the field of Radar system design for 6 years.

In 2015 he joined Silicon Radar and is responsible for embedded Radar System design and product management now.

Dr. René Scholz



René Scholz is group leader of IHP's MPW and Foundry Service since 2004. His group is also responsible for development of Process Design Kits for IHP's BiCMOS technologies.

From 2001 -2004 he was responsible for RF characterization and SiGe-HBT modeling at IHP.

In 2008 he got an MBA – Management for Central and Eastern Europe at European University Viadrina Frankfurt (Oder).

1991 to 1996 he did his Ph.D. at the Max Plank Institute of Microstructure Physics in Halle.

Topic: Investigation of diffusion of point defects in silicon and gallium arsenide.

Organizers (listed at random) :



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