ABSTRACT BOOK

GIGAHERTZ SYMPOSIUM 2008

5-6 MARCH 2008
CHALMERS UNIVERSITY OF TECHNOLOGY
GÖTEBORG
SWEDEN
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### GigaHertz Symposium 5-6 March 2008 at Chalmers

**www.ghz2008.se**  
Chalmers Conference Center, Chalmers University of Technology

**Wednesday 5 March 2008**

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#### Agile Microwave Systems

**Moderator:** Hans-Olof Vickes  
**Ascom/Catella**  
**Saab Microwave Systems**

**A method for switchable rejection filters**  
N. Meissner  
Saab Avitronics

**60 GHz \(\lambda/8\) Phase-Shifter in EFFA Technology**  
X. Rottenberg, P. Ekkels, B. Nauwelaers, W. De Raedt  
Imec, KU Leuven

**Tuneable Filters for Agile Microwave Systems**  
A. Deleniv, S. Gevorgian  
Chalmers, Ericsson

#### RF Power Amplifiers (1)

**Moderator:** Bo G. Berglund  
**Ericsson**

**The Frequency Spectrum of Bandpass Pulse Width Modulated Signals**  
T. Blocher, P. Singerl, A. Wiesbauer, F. Dielacher  
Graz Univ., Infineon

**The potential of active load and source tuning on base station power amplifiers**  
T. Lejon  
Ericsson

**Comparing Polar Transmitter Architectures using GaN HEMT Power Amplifier**  
E. Cijvat, K. Tom, M. Faulkner, H. Sjöland  
Lund Univ., Victoria Univ., Melbourne

#### Microwave Components

**Moderator:** Sven Mattisson  
**Ericsson Mobile Platforms**

**Highly Integrated MMICs for mm-wave system application**  
H. Zirath, S.E. Gunnarsson, M. Ferndahl, R. Kozuharov, C. Kärnfelt  
Chalmers, Ericsson

**An Ultra Wide Band LNA in 90 nm CMOS**  
W. Ahmad, A. Axholt, H. Sjöland  
Lund Univ

#### THz Technology

**Valdemar/Ledning**  
**Moderator:** Staffan Rudner  
**Swedish Defence Research Agency - FOI**

**Invited WS speaker:**  
An introduction to the T4000 terahertz imager  
C. Mann  
Thruvision Ltd., Abingdon, UK

**Novel 220 GHz Slot-Square Substrate Lens Feed Antenna Integrated on MMIC**  
J. Svedin, S. Leijon, N. Wadefalk, S. Cherednichenko, B. Hansson, S. Gunnarsson, I. Kalfass, A. Leather, A. Emrich  
FOI, Chalmers, Fraunhofer-IAF, Omnissys Instruments
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1500-1530 Coffee and Exhibition

**SILVER SPONSORS:** Anritsu Ageto MTT

1530-1730 SESSION II  Runan  Chairman: Piotr Starski, Chalmers

**1530 Invited speaker**
Extremely Low-Noise Amplification with Cryogenic FET’s and HFET’s: 1970-2006 (Where do we go from here?)
Marian W. Pospieszalski
National Radio Astronomy Observatory, Charlottesville, VA

1600

560 GHz \( f_i, f_{max} \) operation of a refractory emitter metal InP DHBT
E. Lind, A.M. Crook, Z. Griffith, M.J. Rodwell
Lund Univ., Univ. California Santa Barbara

Low phase-noise balanced Colpitt InGaP-GaAs HBT VCOs with wide frequency tuning range and small VCO-gain variation
H. Zirath
GHz Centre, Chalmers, Ericsson

Feasibility of Filter-Less RF Receiver Front-End
Linköping University

Small-Size 2-10 GHz Radar Receiver Si-RFIC
H. Berg, H. Thieses, M. Hertz, F. Norling
Saab Microwave Systems

High frequency, current tunable spin torque oscillators: experimental characterization
S. Bonetti, J. Garcia, J. Persson, J. Åkerman
Royal Institute of Technology

N-coupling the capacity of wireless communication using electromagnetic angular momentum
B. Thide
Swedish Institute of Space Physics, Uppsala

1730-1830 Visit (optional) MC2 Cleanroom or Microwave Labs, Chalmers (www.chalmers.se/mc2)

1900 Conference Dinner at Universeum (www.universeum.se)

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Thursday 6 March 2008

0830- 1000 SESSION III  Runan  Chairman: Herbert Zirath, Chalmers

**0830 Plenary invited speaker**
The Next Wireless Wave is a Millimeter Wave
Joy Laskar
GeorgiaTech

**0910 Invited speaker**
High Frequency and Mixed Signal Design for Communication and Remote Sensing applications in advanced technologies
Mehran Mokhtari
Teledyne Scientific

**0940**
MMIC design at G-band (140-220 GHz) including a 220 GHz Single-Chip Receiver MMIC with Integrated Antenna
Chalmers, FOI, Ericsson, Fraunhofer-IAF

A Quad-Core 130-nm CMOS 57-64 GHz VCO
V. P. Goluguri, J. Wernehag, H. Sjöland, N. Troedsson
Cambridge Silicon Radio Sweden, Lund University

**1000-1030 Coffee and Exhibition**

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V
### 1030-1210 SESSION IV

**Runan**

**Chairman:** Niklas Rorsman, Chalmers

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### 1030 Invited speaker

**GaN HEMT development for microwave power applications - Current status and trends**

Masaaki Kuzuhara

Univ. Fukui

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### 1100

**Paving the road for integrated gallium nitride transceivers**


**Demonstrator of Class-S Power Amplifier**

A. Samulak, G. Fischer, R. Weigel

Univ. Erlangen-Nürnberg, Alcatel-Lucent

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### 1210-1300 Lunch and Exhibition

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### 1300-1430 Workshops

#### Thursday 6 March 2008

**Antennas**

Ascom/Catella

**Moderator:** Per Sjöstrand

Saab Avitronics

**Moderator:** Johan Ståhl

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**RF Power Amplifiers (2)**

Runan

**Moderator:** Johan Ståhl

Saab Microwave Systems

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**Measurement - Modeling**

Scania

**Moderator:** Niclas Keskitalo

Ericsson

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**Integrated Antennas for RF MEMS Routes**

A. Rydberg, S. Cheng, P. Hallbjörner, S. Ogden, K. Hjort

Uppsala Univ., SP, Borås

Presented by C. Karlsson, SP

---

**Output Power Density and Breakdown Voltage in Field-Plated Buried Gate Microwave SiC MESFETs**


**Model-Based Predistortion for Signal Generators**

C. Luque, N. Björsell

Univ. Gävle

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**Microstrip patch antenna for wireless applications**

N.A. Touhami, B. Aja, A. Tazón, E. Artal

Univ. Cantabria, Santander

**Silicon-on-SiC hybrid substrate with low RF-losses and improved thermal performance**

J. Olsson, Ø. Vallin, D. Martin, L. Vestling, U. Smith, H. Norström

Uppsala Univ., Infineon

**A Comparison of Antenna Diversity Characterization Methods using Reverberation Chambers and Drive Tests**

D. Nyberg, M. Fränzén, P.S. Kildal

Chalmers, Bluetest AB

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**Small Microstrip Fractal Antenna for RFID Tag**

P. Enoksson, M. Rusu, A. Curutiu, H. Rahimi, C. Rusu

Chalmers, Bucharest Univ., Bonn Univ., Imego

**A review of validation criteria for behavioral power amplifier models**

P. Landin, M. Isaksson, Univ. Gävle

**Measuring Relative Receiver Sensitivity of Wireless Terminals in One Minute in a Reverberation Chamber**

M. Andersson, C. Orenius, M. Fränzén

Bluetest AB

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**The WS provides some personal reflections on doing business from innovations and IP in RF/Microwave from three small companies, one global company and one venture company. The WS is concluded by a discussion**

Mikael Reimers, CEO

Foodradar Systems AB

[www.foodradar.com](http://www.foodradar.com)

Tomas Ornstein, CEO

Ranatec Instrument AB

[www.ranatec.se](http://www.ranatec.se)
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1430-1500 Coffee
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1500-1600 SESSION V Runan Chairman: Arne Alping, Ericsson
1500 Invited speaker
Industrial aspects of 100 Gb/s optical communication Bengt-Erik Olsson Ericsson Research
1530
All-Optical Waveform Sampling with TeraHertz Capacity M. Westlund, P.A. Andrekson, H. Sunnerud Chalmers, Picoseolve Inc.
High Speed 1.3 μm VCSELs for FTTH and RoF P. Westbergh, E. Söderberg, J.S. Gustavsson, P. Modh, A. Larsson, Z.Z. Zhang, J. Berggren, M. Hammar Chalmers, Royal Institute of Technology
1600
Closing Remarks Jan Grahn, Chalmers; General Chairman GHz Symposium 2008 Henrik Sjöland, Lund University: Next GHz Symposium arranger
1630-1730 Visit (optional) MC2 Cleanroom or Microwave Labs, Chalmers (www.chalmers.se/mc2)
560 GHz $f_t$, $f_{\text{max}}$ operation of a refractory emitter metal InP DHBT

Erik Lind*
Solid State Physics, Lund University
Lund University, Sweden
Erik.Lind@ftf.lth.se
* work performed in part while at UCSB

Abstract—We present results of a hybrid dry/wet-etched type I InGaAs/InP DHBT using a refractory emitter metal. Simultaneously high $f_t$ and $f_{\text{max}}$ of 560 GHz is obtained, with a breakdown voltage $BV_{\text{CEO}}$ of 3.4V.

I. INTRODUCTION

Scaling theory [1] of HB Ts indicate that a 2:1 increase in bandwidth requires a 4:1 reduction in emitter and collector widths – for THz operation this requires emitter widths below 125nm. Traditional lift-off techniques and wet etching techniques used for triple-mesa HBTs are difficult to reliable scale below 300 nm emitter widths. We have developed a hybrid dry/wet etch technique that reliable scales to emitter widths below 250nm. First results on a 22nm base thickness, 70 nm collector thickness with ~200 nm emitter width produced record simultaneous $f_t$ and $f_{\text{max}}$ of 560 GHz [2].

II. FABRICATION

The epitaxial material was grown on 4” S.I. InP wafers at commercial vendor IQE. The fabrication starts with a blanket sputtered deposited Ti$_{0.1}$W$_{0.9}$ film, which is subsequently patterned using a SF$_6$/Ar dry etching. Using the emitter metal as mask, the emitter is dry etched in a Cl$_2$/N$_2$ plasma, stopping just short of the base. A InP wet etch is then used to clear the In$_{0.53}$Ga$_{0.47}$As base. The transistors are finished using self aligned base ohmics, forming a triple-mesa transistor. A cross-section SEM image is shown in Fig. 1. Emitter junctions with widths down to 200 nm could controllable be fabricated, showing a substantial improvement over fully wet etched processes.

III. MEASUREMENTS & CONCLUSIONS

The transistors were characterized from DC-67 GHz. The DC current gain was $\sim$ 25. The Breakdown voltages were $BV_{\text{CEO}}$ $\sim$ 3.4V, and $BV_{\text{CEO}}$ $\sim$ 3.6 V, limited by band-to-band tunneling. For devices with emitter widths of 200 nm, a simultaneous extrapolated $f_t$ and $f_{\text{max}}$ of 560 GHz was obtained, which is the first report of a device with both $f_t$ and $f_{\text{max}}$ above 500 GHz. Peak $f_t$ was 600 GHz for a device with lower (430 GHz) $f_{\text{max}}$.

ACKNOWLEDGMENT

This work was supported by the DARPA SWIFT program and a grant from the Swedish Research Council.

REFERENCES