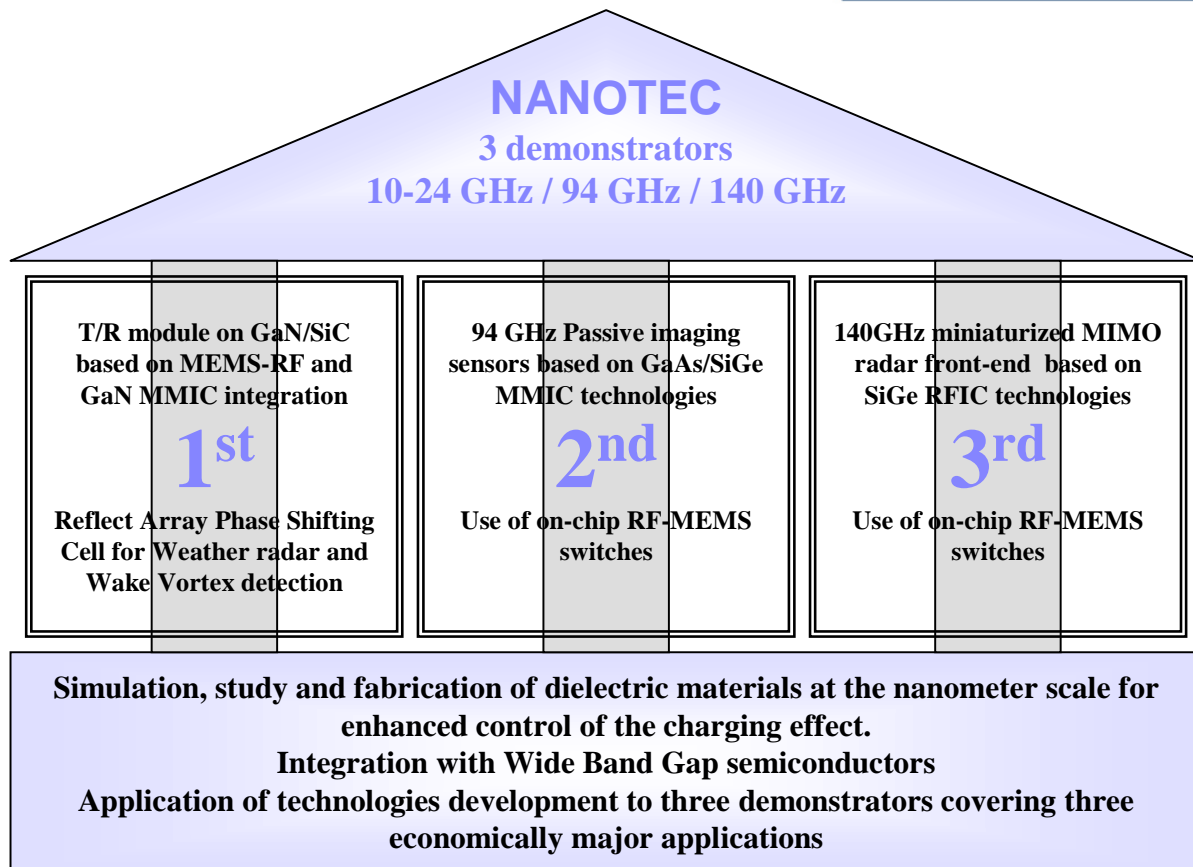


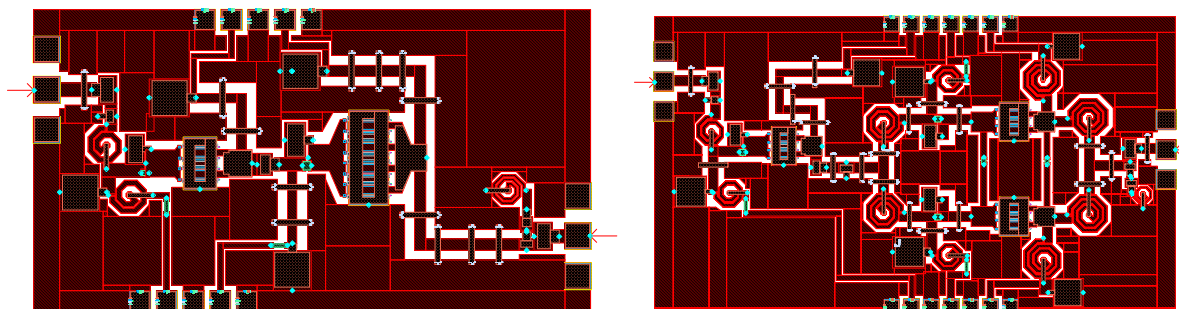
# Nanostructured materials and RF-MEMS RFIC/MMIC technologies for highly adaptative and reliable RF systems

September 2013  
Newsletter #2

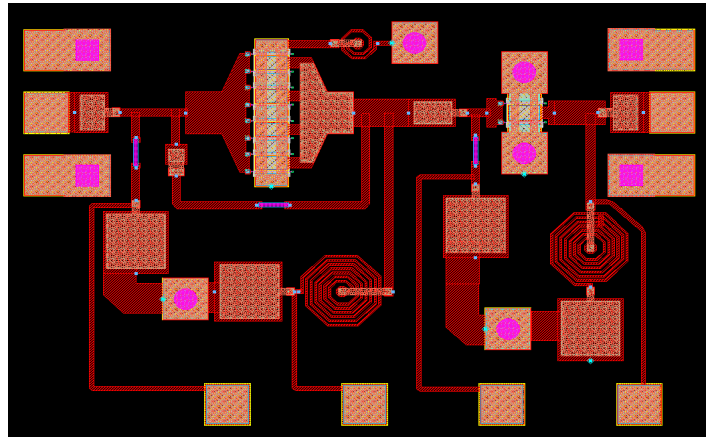


## WORK PROGRESS DURING THE 2<sup>nd</sup> YEAR: KEY ISSUES

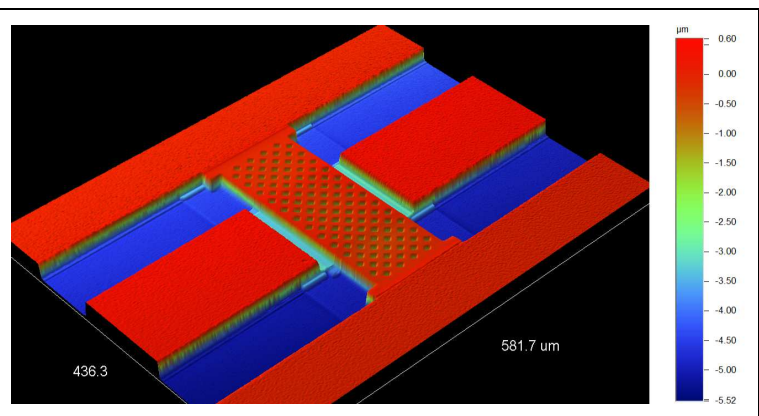
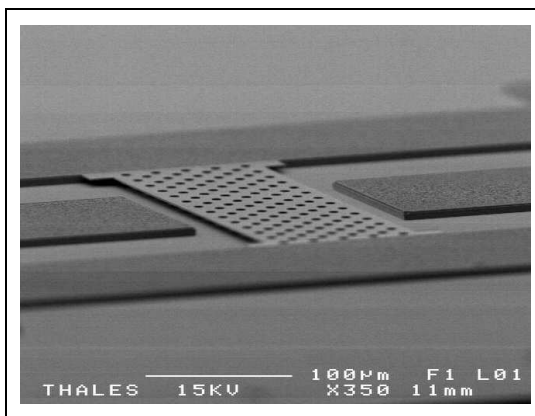
### Demonstrator # 1 : 10-24GHz Applications



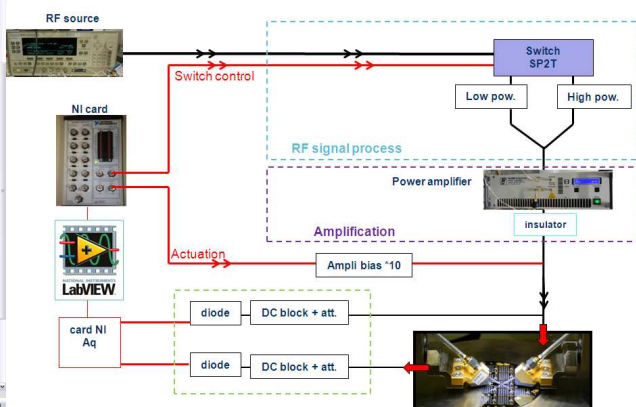
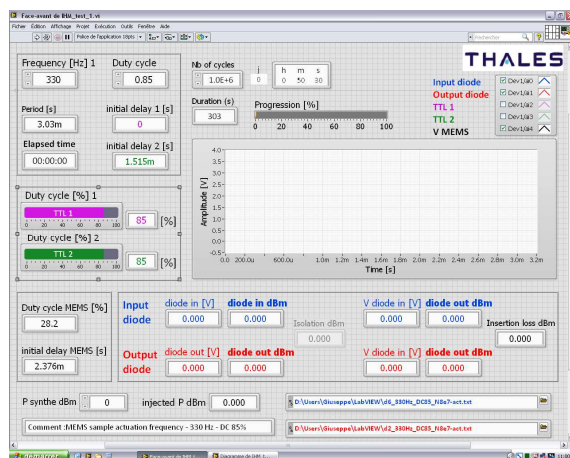
- Validation of the design of HPA, LNA and HEMTs devices based on a typical GH25 technology for the GaN/SiC – based T/R module



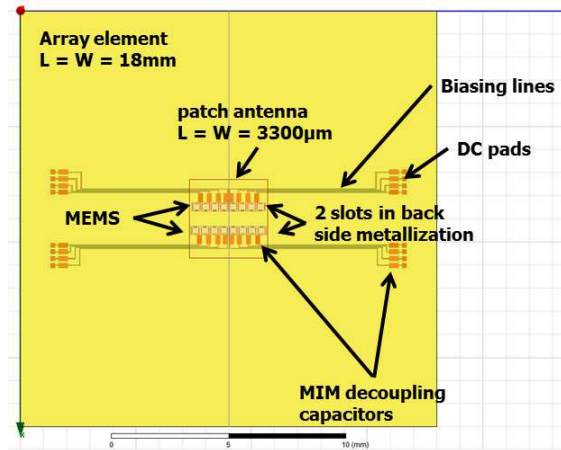
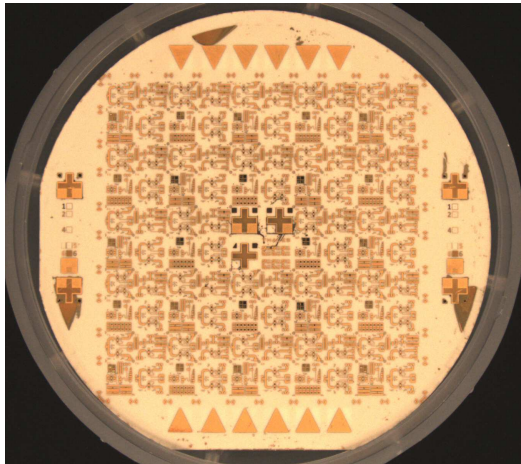
- Validation of the layout of an unmatched LNA circuit designed in the GH25 technology



- Validation of novel design of RF MEMS for better power handling and reliability issues

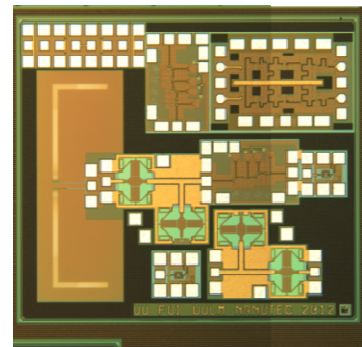
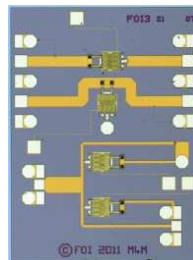
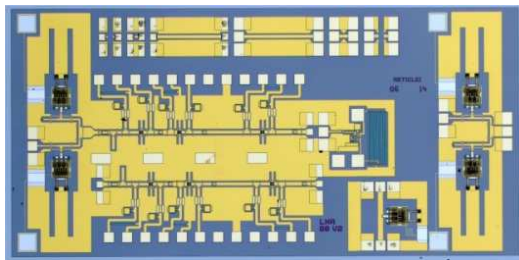


- Development of reliability set-up for the reliability testing of RF MEMS at TRT
- Demonstration of **20W power handling** capabilities of fabricated devices over  $10^6$  cycles

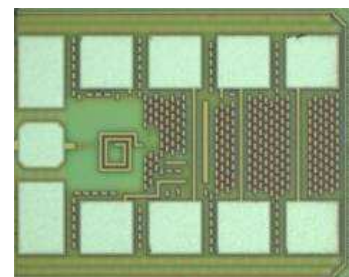
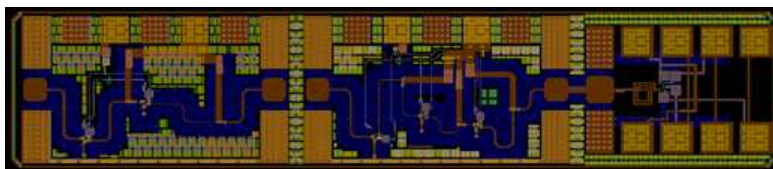


- Validation of the design for the Reflect Array Cells
- Validation of the fabrication of RF MEMS on ceramic-based substrates

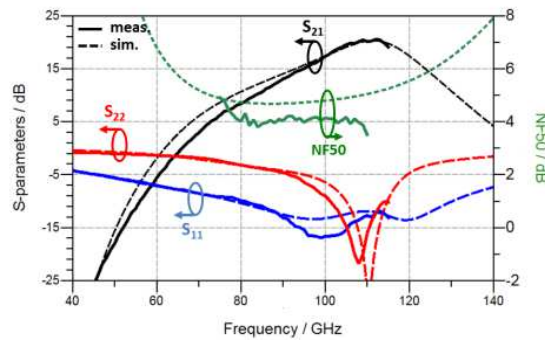
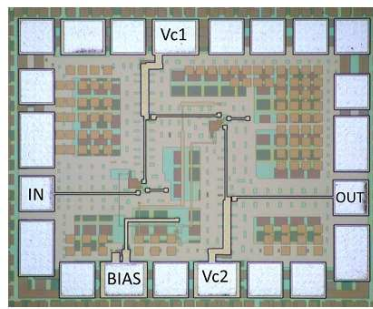
## Demonstrator # 2 : 94GHz applications



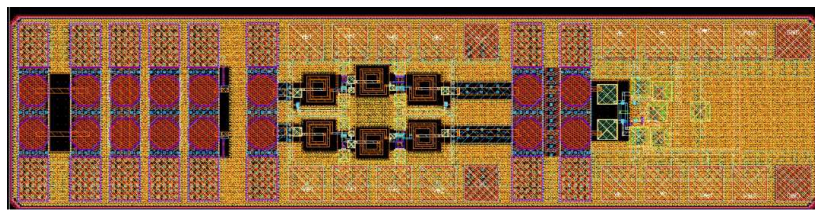
- Validation of the design , fabrication and characterisation of first run of 94 GHz chip set



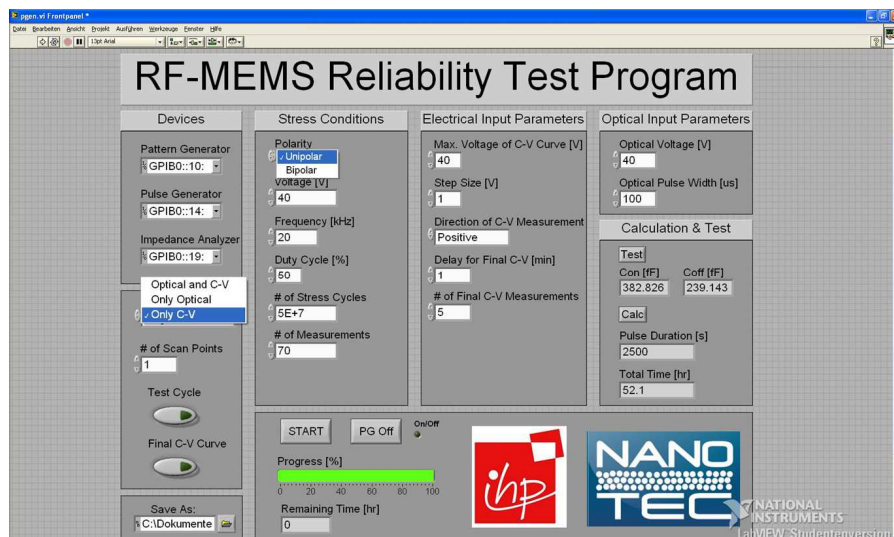
- Validation of the design, fabrication and characterisation of second run of 94 GHz chip set with improved characteristics



- 94GHz chip set with the measurement characteristics compared to simulated performance

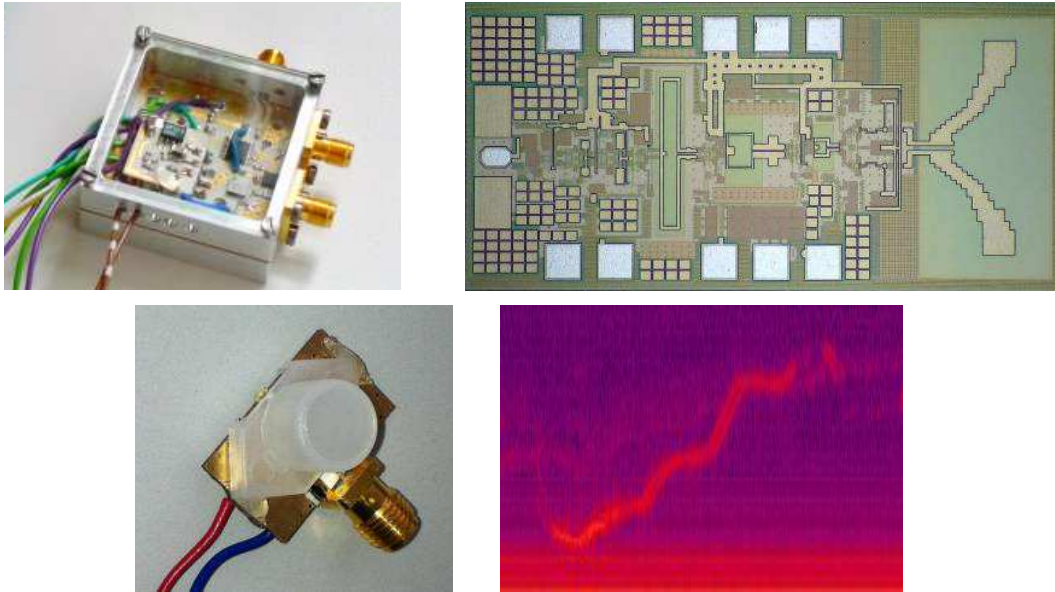


- Validation of the design of the 3<sup>rd</sup> run of 94 GHz chip set with fabrication currently in progress

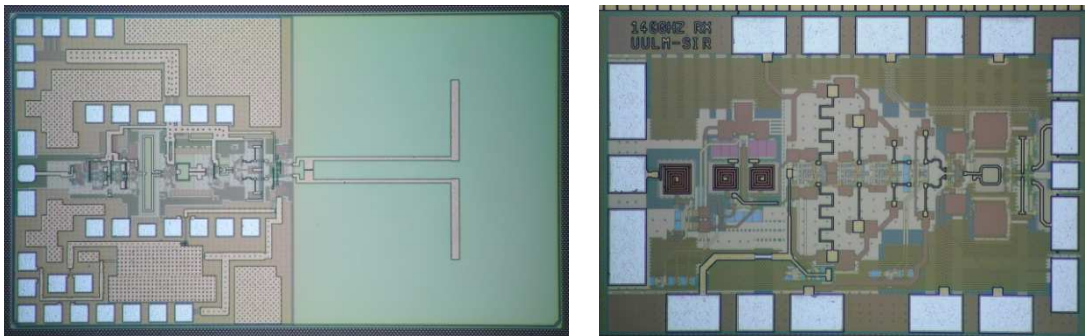


- Development of a complementary reliability set-up for the reliability testing of RF MEMS at IHP
- Extensive study on the 94GHz chipsets currently under study

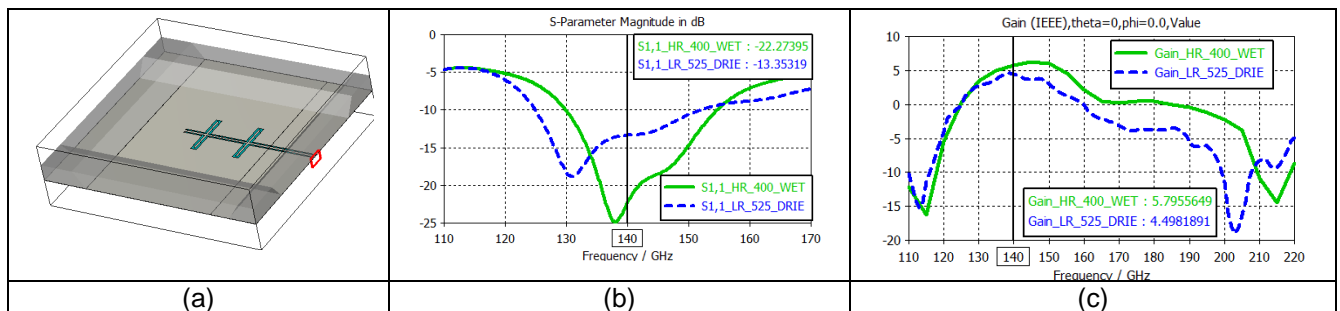
## Demonstrator # 3 : 140 GHz applications



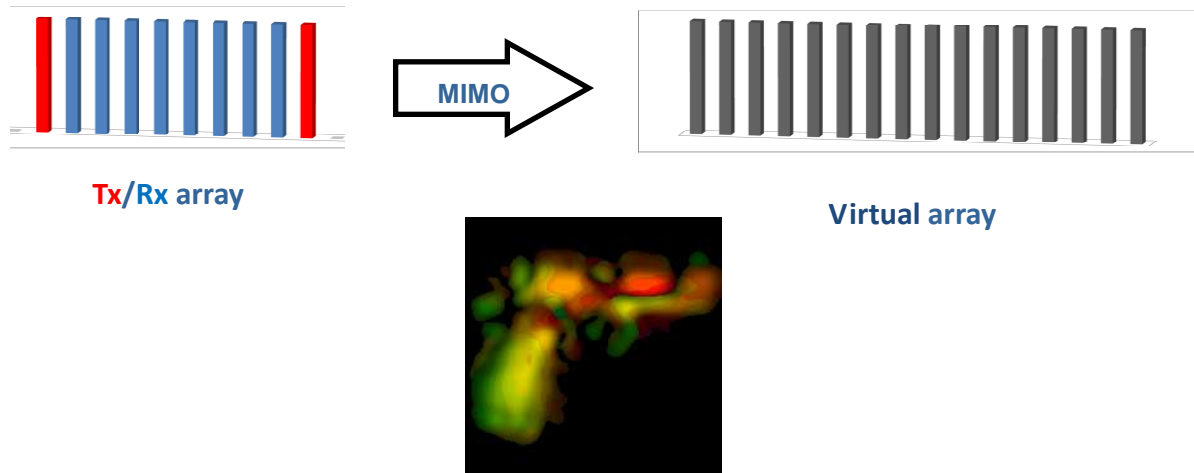
- First F-band FMCW single-channel detection successfully demonstrated



- 2<sup>nd</sup> generation TX/RX chips ready to be tested (on/off-chip antenna solutions)



- Investigation of 140 GHz double folded slot antennas processed on thin dielectric membranes released through micromachining of a silicon substrate



- **Reconstruction MIMO algorithm ready to be deployed**

## Dissemination activities

### • Workshops

1. **Organization and chairing the MEMSWAVE 2013 Symposium in Potsdam/Germany, 1-3 June, 2013 by M. Kaynak.**
2. **Organization of RF-MEMS Workshop in EuMW 2012: RF-MEMS for mm-wave reconfigurable ICs.**
3. **NANOTEC workshop has been organized in EuMW 2013 in Germany in October 2013**

### • Publications

1. S. Reyaz, C. Samuelsson, R. Malmqvist, S. Seok, M. Fryziel, P.-A. Rolland, B. Grandchamp, P. Rantakari, and T. Vähä-Heikkilä, "W-band RF-MEMS Dicke switch networks in a GaAs MMIC process," (Article first published online: 23 SEP 2013 DOI: 10.1002/mop.27983) *to be published in Microwave and Optical Technology Letters*, Vol.12 , no. 12, Dec. 2013, pp. 2849–2853.
2. R. Malmqvist, R. Jonsson, C. Samuelsson, A. Gustafsson, S. Reyaz, D. Dancila, A. Rydberg, B. Grandchamp, S. Seok, M. Fryziel, P.-A. Rolland, P. Rantakari, M. Lahti, T. Vähä-Heikkilä, R. Baggen, "RF-MEMS reconfigurable GaAs MMICs and antennas for microwave/mm-wave applications," *to presented at the 2013 Int. Semiconductor Conf.*, Sinaia, Romania, Oct. 2013.
3. R. Malmqvist, C. Samuelsson, D. Dancila, S. Reyaz, M. Kaynak, A. Rydberg, "Design and test results of a wideband SiGe detector and on-chip slot antenna for W-band sensing applications," *in Proc. of 2012 Int. Semiconductor Conf.*, Sinaia, Romania, Oct. 2012, pp. 205–208.
4. R. Jonsson, C. Samuelsson, S. Reyaz, R. Malmqvist, A. Gustafsson, M. Kaynak, and A. Rydberg, "SiGe wideband power detector and IF-amplifier RFICs for W-band passive imaging systems," *to be presented at the 2013 Int. Semiconductor Conf.*, Sinaia, Romania, Oct. 2013.
5. D. Dancila, R. Malmqvist, S. Reyaz, R. Augustine, C. Samuelsson, M. Kaynak, and A. Rydberg, "Wide band on-chip slot antenna with back-side etched trench for W-band sensing applications", *in Proc. of 2013 European Conf. on Antennas and Propagation*, Gothenburg, Sweden, April 2013, pp. 1576 – 1579.

6. C. Ulusoy, M. Kaynak, V. Valenta, Bernd Tillack and Hermann Schumacher, "A 110 GHz LNA with 20 dB Gain and 4 dB Noise Figure in an 0.13 $\mu$ m SiGe BiCMOS Technology", In proceedings of International Microwave Symposium (IMS), Seattle, USA, 2013.
7. V. Valenta, S. Yuan, A. Trasser and H. Schumacher, "F-band frequency octupler in 0.13- $\mu$ m SiGe:C BiCMOS with 2 mW output power", In proceedings of International Microwave Symposium (IMS), Seattle, USA, 2013
8. V. Valenta, M. Kaynak, A. Trasser, H. Schumacher, "Quadrupleur de fréquences en technologie SiGe: C BiCMOS 130 nm pour un radar à ondes continues modulées en bande-F", In proceedings of 18èmes Journées Nationales Microondes (JNM), Paris, France, 2013.
9. V. Valenta, C. Ulusoy, A. Trasser and H. Schumacher, "Wideband 110 GHz frequency quadrupler for an FMCW imager in 0.13- $\mu$ m SiGe: C BiCMOS process", In proceedings of Silicon Monolithic Integrated Circuits in RF Systems (SiRF), Austin, USA, 2013
10. (Invited) M. Kaynak et al., "MEMS Module Integration into SiGe BiCMOS Technology for Embedded System Applications," in IEEE Bipolar / BiCMOS Circuits and Technology Meeting (BCTM), Portland, 2012.
11. M. Kaynak et al., "A CMOS Based Fast High-Voltage Generation Circuit for BiCMOS Embedded RF-MEMS Applications," in 13th Topical Meeting on Silicon Monolithic Integrated Circuits in RF Systems (SiRF), Austin, 2013.
12. M. Kaynak et al., "BiCMOS Embedded RF-MEMS Technologies for mm-Wave Applications," in The European Microwave Conference (EuMC), RF-MEMS Workshop, Amsterdam, 2012.
13. C. A. Ulusoy et al., "A 110 GHz LNA with 20 dB Gain and 4 dB Noise Figure in an 0,13  $\mu$ m SiGe BiCMOS Technology," in Proc. International Microwave Symposium (IMS), Seattle, 2013.
14. M. Wietstruck et al., "BiCMOS-integrierte RF-MEMS Technologien fuer mm-Wellen Anwendungen," in Proc. MST Workshop , 2013.
15. S. Tolunay et al., "An Accurate EM Modeling of 140 GHz BiCMOS Embedded RF-MEMS Switch," in Proc. MEMSWAVE, Potsdam, 2013.
16. B. Tillack et al., "SiGe BiCMOS Technology for More than Moore Functional Diversification for Opto- and Microelectronic Application," in Proc. International Semiconductor Conference Dresden - Grenoble (ISCDG), Dresden, 2013.
17. Goeritz et al., "Anwendung eines HF-Gasphasenaetzprozesses zum Freilegen von monolithisch integrierten RF-MEMS-Schaltern," in Proc. Mikrosystemtechnik-Kongress 2013, Aachen, 2013.
18. (Invited) Tillack et al., "MEMS and Photonics Module Integration into SiGe BiCMOS Technologies for MORE THAN MOORE Functional Diversification," in Proc. ECS Conference, San Francisco, 2013.
19. N. T. Matabosch et al., "Failure Cause Detection Methodology for RF-MEMS on a BEOL BiCMOS Process," in Proc. 24th European Symposium on Reliability of Electron Devices, Failure Physics and Analysis, Arcachon, 2013.
20. M. Wietstruck et al., "Electro-Thermo-Mechanical Analysis of a BiCMOS Embedded RF-MEMS Switch for Temperature from -55°C to 125 °C," in Proc. 13th Topical Meeting on Silicon Monolithic Integrated Circuits in RF Systems (SiRF), Austin, 2013.
21. B. Tillack et al., "SiGe BiCMOS - A More than Moore Baseline Technology for Functional Diversification of Opto- and Microelectronic Devices and Circuits," in Proc. of the Sino-German Joint Symposium on Opto- and Microelectronic Devices and Circuits (SODC), 2012.
22. N. T. Matabosch et al., "An Accurate Equivalent Circuit Model for RF-MEMS Circuit Optimization and Fabrication Process Monitoring in BiCMOS Technology," in Proc. 13th Symposium on RF-MEMS and RF-Microsystems (MEMSWAVE), Antalya, 2012.
23. M. Wietstruck et al., "Material Properties Characterization of BiCMOS BEOL Metal Stacks for RF-MEMS Applications," in Novel RF MEMS Technologies, 2012