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

September 2013
Newsletter #2

NANOTEC
3 demonstrators
10-24 GHz / 94 GHz / 140 GHz

1st
T/R module on GaN/SiC based on MEMS-RF and GaN MMIC integration
Reflect Array Phase Shifting Cell for Weather radar and Wake Vortex detection

2nd
94 GHz Passive imaging sensors based on GaAs/SiGe MMIC technologies
Use of on-chip RF-MEMS switches

3rd
140GHz miniaturized MIMO radar front-end based on SiGe RFIC technologies
Use of on-chip RF-MEMS switches

Simulation, study and fabrication of dielectric materials at the nanometer scale for enhanced control of the charging effect.
Integration with Wide Band Gap semiconductors
Application of technologies development to three demonstrators covering three economically major applications

WORK PROGRESS DURING THE 2nd 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 3rd 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\textsuperscript{nd} 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**
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 0.13µm 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-µm SiGe:C BiCMOS with 2 mW output power”, In proceedings of International Microwave Symposium (IMS), Seattle, USA, 2013


9. V. Valenta, C. Ulusoy, A. Trasser and H. Schumacher, “Wideband 110 GHz frequency quadrupler for an FMCW imager in 0.13-µm SiGe: C BiCMOS process”, In proceedings of Silicon Monolithic Integrated Circuits in RF Systems (SiRF), Austin, USA, 2013


13. C. A. Ulusoy et al., “A 110 GHz LNA with 20 dB Gain and 4 dB Noise Figure in an 0.13 µm SiGe BiCMOS Technology,” in Proc. International Microwave Symposium (IMS), Seattle, 2013.


