Reconfigurable Microsystem Based on Wide Band Gap Materials, Miniaturized and Nanostructured RF-MEMS

European Nanoelectronics Forum 2012
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Munich, Germany

Grant Agreement #270701

Objectives

NANOCOM Missions

- Micro and Nano Technologies for smart systems:
  - GaN for power and robustness at high frequencies
  - MEMS and Mini-MEMS for reconfigurability and tunability
  - Sensor for interfacing to real-world
- NANOCOM Mission:
  - Integrate new nanostructured materials in MEMS technology to address charging effect and enhance thermal performances in order to increase the power handling capability of the device

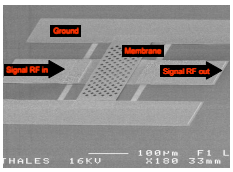
NANOCOM Objectives

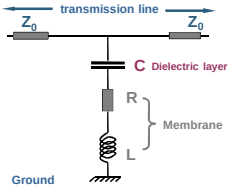
- Developing innovative solutions for the RF front-end baseband by fabricating agile RF transceiver and reconfigurable antennas with MEMS switches, sensors and actuators.
  - Objective 1: Achieve the integration of WBG devices and RF-MEMS switches in LCP.
  - Objective 2: Achieve the long-term reliability of RF-MEMS in order to bring this technology to industrial systems.
  - Objective 3: Realize and optimize WBG based sensors and actuators and develop the necessary technology for their monolithic integration with WBG MMICs and RF MEMS.
  - Objective 4: Display the integration of all of these technologies through four demonstrators
  - Objective 5: Transfer of the demonstrator process flow to foundry and system developers to apply the project result in real applications.

RT Developments during first year

Nanostructured materials integration

- Integration of nanostructured PZT
- Development and integration of oriented carbon nanotubes in silicon nitride dielectric
- Development and first integration of diamond thin layers
- Electrical and thermal characterizations of dielectrics
- Development and fabrication of Mini-MEMS

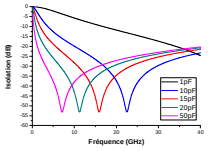




RF-MEMS isolation

RLC circuit with a frequency resonance : $f_0 = \frac{1}{2\pi\sqrt{LC}}$

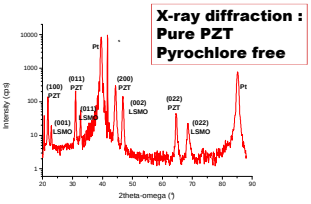
Capacitance : $C = \varepsilon_r \varepsilon_o \frac{S}{e}$ (Area, Permittivity, Thickness)

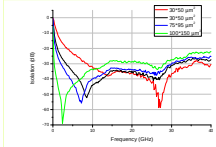


S21 coefficient for different capacitances

Results on PZT

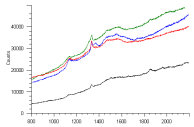
X-ray diffraction : Pure PZT Pyrochlore free





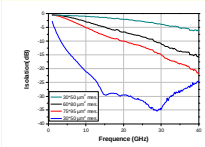
- Isolation >30 dB @10GHz
- Max isolation at 2.5GHz : 70dB
- Permittivity : 500

Results on diamond



Raman spectrum

Signature of diamond at 1333 cm^{-1}
Others peaks:
grain boundaries + defects



- Isolation >15 dB @10GHz
- Max isolation at 30GHz : 35dB
- Permittivity : 9

Application Demonstrators

DEM # 1

- Reconfigurable smart active antenna with RF-MEMS switches
- X-Band, 20W CW

DEM # 2

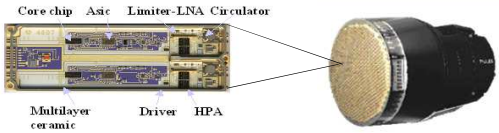
- RF-MEMS based agile radio for air traffic management radars
- Wideband, 5W CW, High reliability

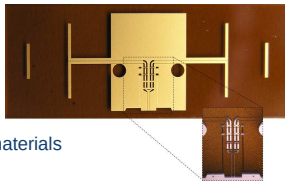
DEM # 3

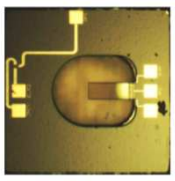
- RF-MEMS based reconfigurable Reflect Array antenna
- X-Band, 20W CW

DEM # 4

- Miniaturized piezo sensor and actuator based on III-Nitride materials
- Humidity sensor module







Transmitter / Receiver (T/R) Modules:

- Replace circulators by RF-MEMS based SPDT
- RF-MEMS Monolithic integration on GaN susbtrates
- Active Antenna

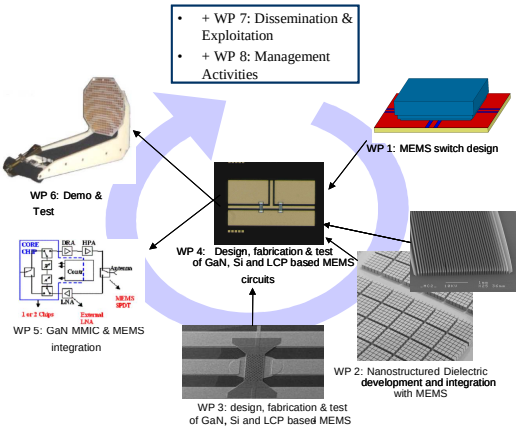
Reflect Array antenna:

- Low cost, reconfigurable cells
- Weather and Vortex detection radars

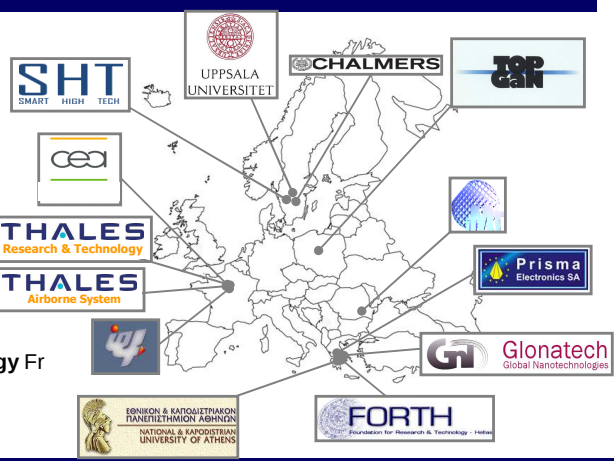
Sensors:

- Electronic devices protection (condensation coating…)

Project Fact Sheet



- ✓ **ENIAC Joint Undertaking**
  SP 2 - Wireless Communications
  SP 3 – Energy Efficiency
- ✓ **Total cost: 5,57 M€**
  ENIAC Contribution: 0.93 M€
  Total efforts: 626.25 pm
- ✓ **13 European Partners**
  5 countries
  2 large industries
  4 innovative SMEs
  7 academic institutes
- ✓ Coordinator: **Thales Research & Technology** Fr
- ✓ Duration: **3 years**



THALES Research & Technology
Palaiseau (91) - France
www.thalesgroup.com

Contacts:
Afshin.ziaei@thalesgroup.com