A European Centre of Excellence in

Microwave, Millimetre Wave and Optical Devices, based on Micro-Electro-Mechanical Systems (MEMS) for Advanced Communication Systems and Sensors (MIMOMEMS)

Coordinator: Dr. Alexandru Müller

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National Institute for R&D in Microtechnologies (IMT-Bucharest)

(www.imt.ro)

Project financed (2008-2011) through the "Regional potential" part of the European Framework Programme - FP7

Capacities - Part 4 - Research Potential.
Activity: 4.1.Unlocking and developing the research potential in the EU´s convergence regions and outermost regions (REGPOT-2007-1)

(start date May the 1st 2008)

Outline

1. Highlights and results obtained by IMT in previous European projects in the RF MEMS topics “MEMSWAVE”, and “AMICOM”; Other new results obtained.
2. Research objectives to be supported by the MIMOMEMS project
3. The F7 REGPOT “MIMOMEMS” project and its objectives

-Exchange of know-how and experience

-Increase IMT’s Human Potential

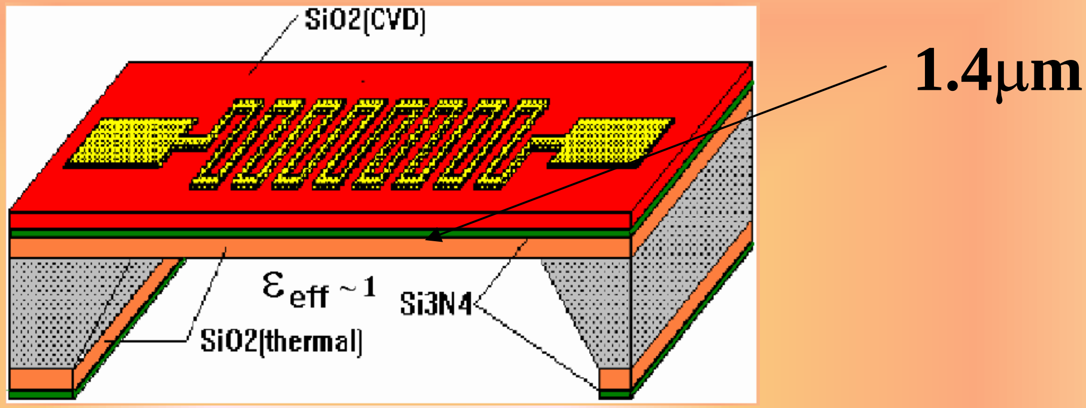
-Increase IMT’s Technology Potential. The “MINAFAB” centre of IMT

-Increase IMT’s Scientific Visibility

-Increase IMT’s technology transfer for economic needs

4. Results obtained in the frame of the The F7 REGPOT “MIMOMEMS” project after the first 6 months.

Highlights and results obtained by IMT
Why membrane supported millimeter wave circuits?



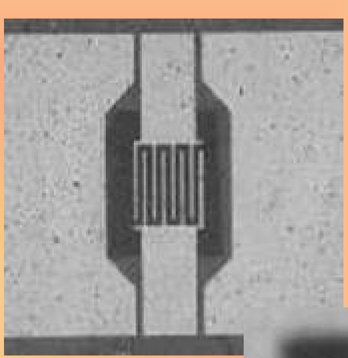
Advantages of membrane-supported passive circuit elements

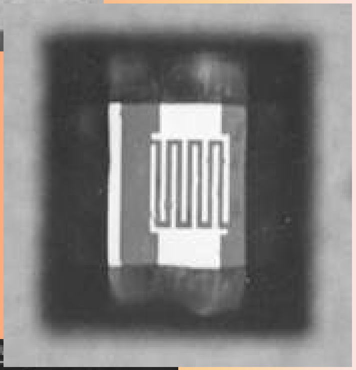
- reduction of losses due to the dielectric substrate
- reduction of dispersion effects
- the structure looks like being "air suspended" ($\varepsilon_{eff} \sim 1$)
- suppression of unwanted substrate modes
- new features for the design of integrated subsystems

Membrane Supported Circuits for Millimeter Wave Applications

First European results: 1996-1997.

- **IMT Bucharest and CNR Rome**
- **LAAS/CNRS, Toulouse**
- **IRCOM Limoges**





Micromachined Circuits for Microwave and Millimeter Wave Applications
(MEMSWAVE)
Project No.977131
1998 - 2001

IMT-Bucharest (Project coordinator)

Partners:

FORTH Heraklion
ITC-IRST Trento
Uppsala University
Tor Vergata Univ. Rome
CNR-M²T Rome
HAS-MFA Budapest
ISP Kiev
Microsensor Kiev Ltd.

TARGETS

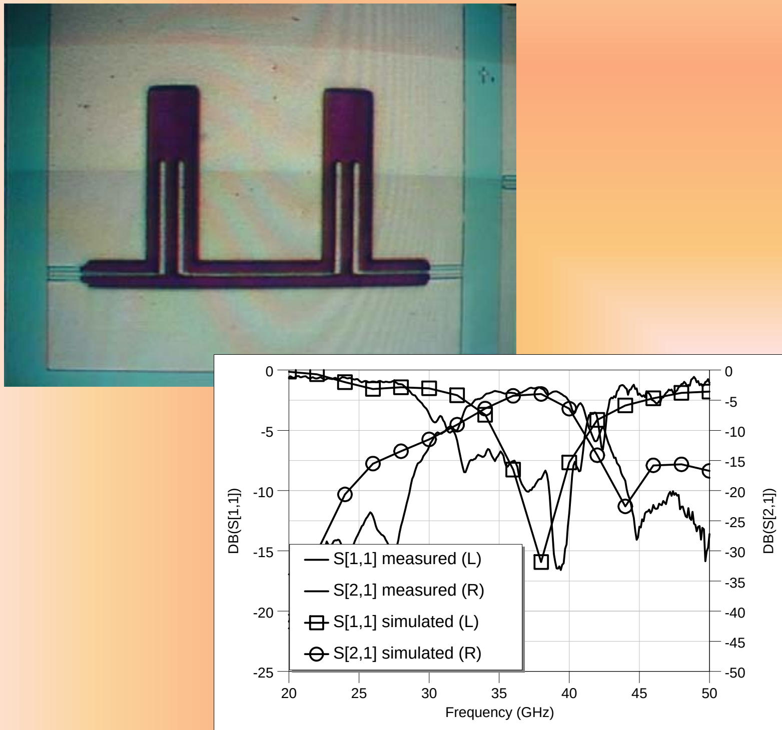
- **Thin dielectric membranes on high resistivity silicon substrate;**
- **GaAs membranes manufacturing;**
- **Micromachined passive circuit elements on silicon and GaAs substrate;**
- **Micromachined millimetre wave band pass filters and antennas;**
- **Receiver modules for 38GHz and 77GHz based on micromachining technology;**
- **Transmitter module for 38GHz.**

•The project was nominated between the 10 finalists for the Descartes Prize 2002 of the European Commission

•The MEMSWAVE conference became an itinerant European event

Micromachined Millimeter Wave Filter Structures Supported on 1.5 µm $SiO_2/Si_3N_4/SiO_2$ Membrane on Silicon Substrate

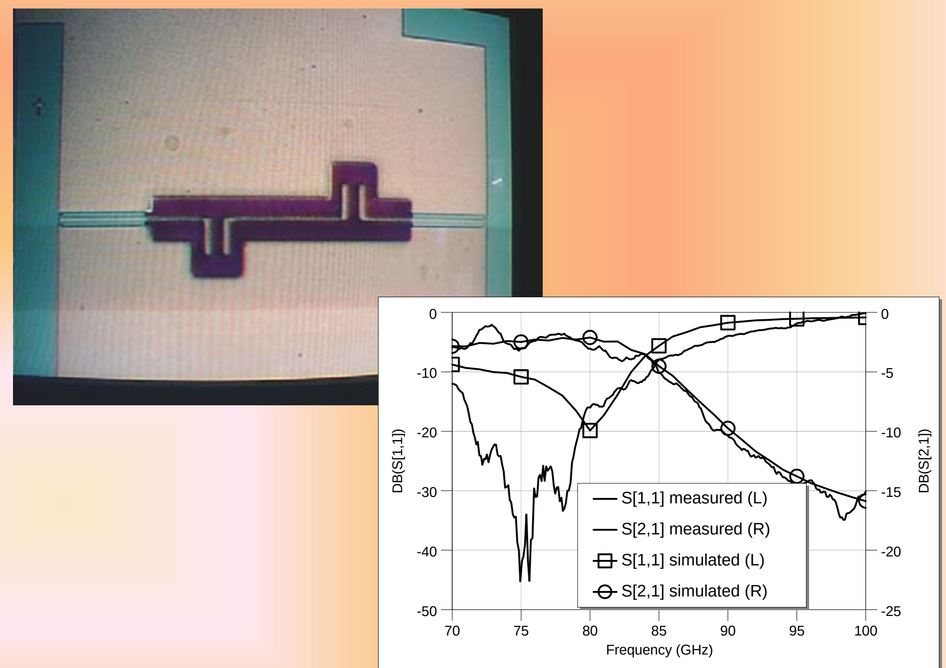
(The MEMSWAVE Project IMT -ITC-CNR-Tor Vergata Univ.-IRCOM -1999-2000)



On wafer measurements for the 38GHz grounded coplanar waveguide filter supported on $SiO_2/Si_3N_4/SiO_2$ membrane

38 GHz filter

- **Minimum insertion loss: 1.9 dB**
- **Maximum return loss: 16.5 dB**



On wafer measurements for the 77GHz grounded coplanar waveguide filter supported on $SiO_2/Si_3N_4/SiO_2$ membrane

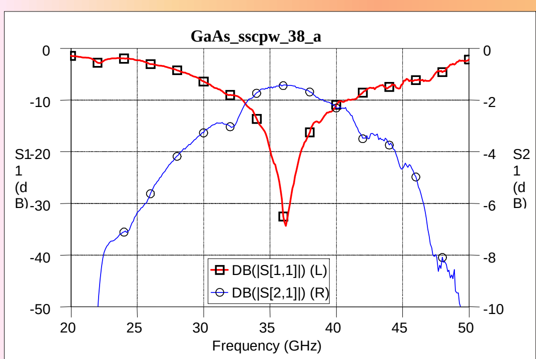
77 GHz filter

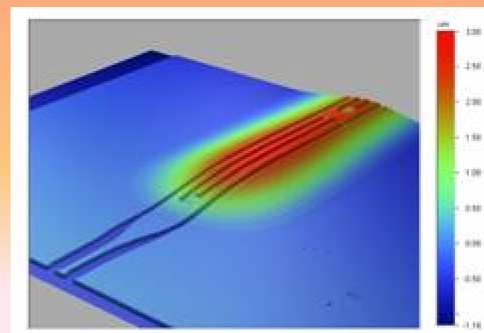
- **Minimum insertion loss: 1.5 dB**
- **Maximum return loss: 44.5 dB**

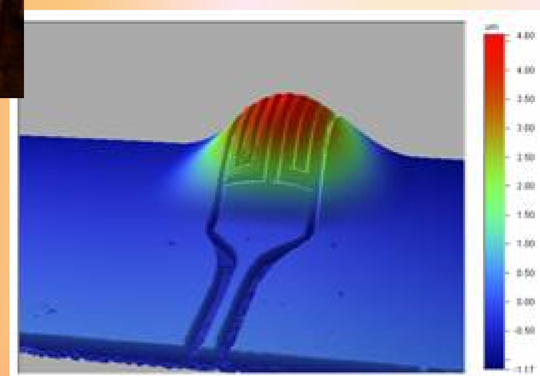
Millimeter wave filter structures on GaAs membranes

IMT Bucharest- FORTH Heraklion in the MEMSWAVE Project -2001

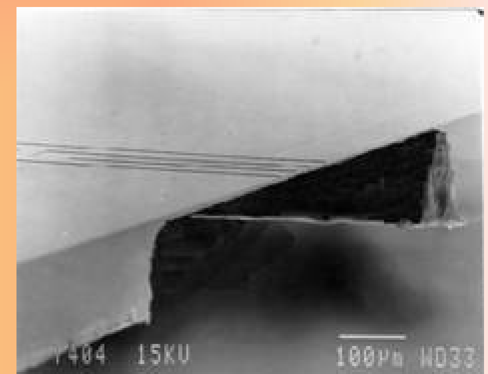
38GHz filter

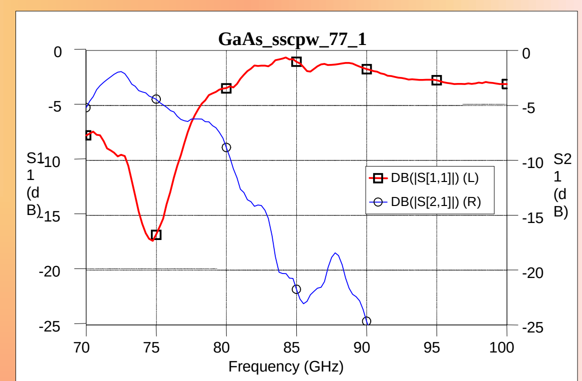






77GHz filter





♦ **Minimum insertion loss: 1.46 dB**

♦ **Maximum return loss: 34.2 dB**

♦ **Minimum insertion loss: 1.87 dB**

♦ **Maximum return loss: 17.4 dB**

On wafer Measurements were performed at IRCOM Limoges

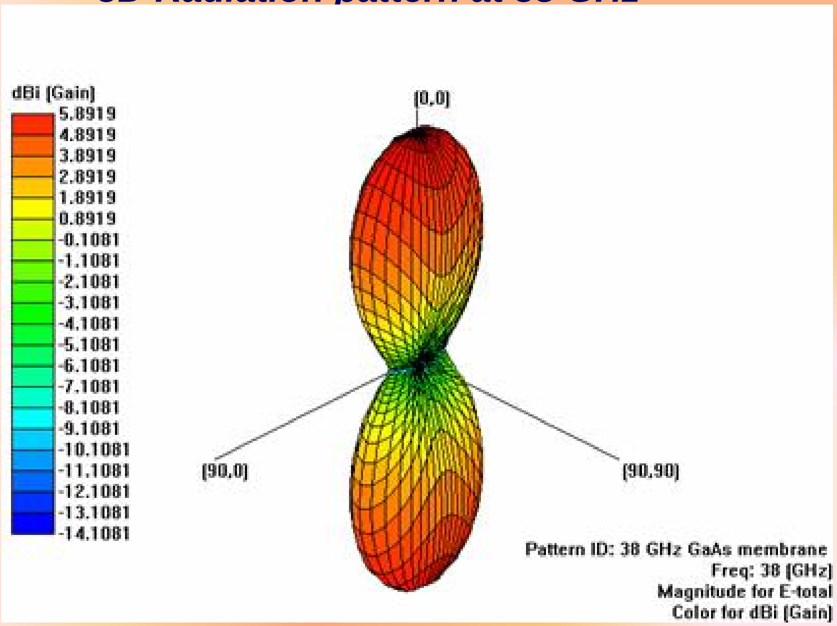
WLI profilometry performed at Univ.Uppsala

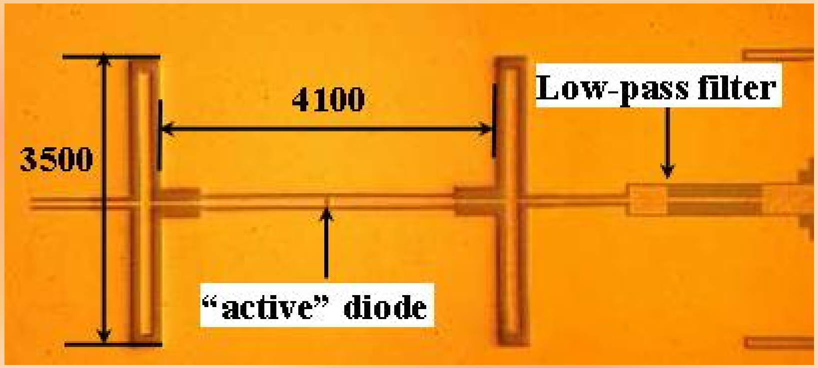
MIMOMEMS, FP 7 Project

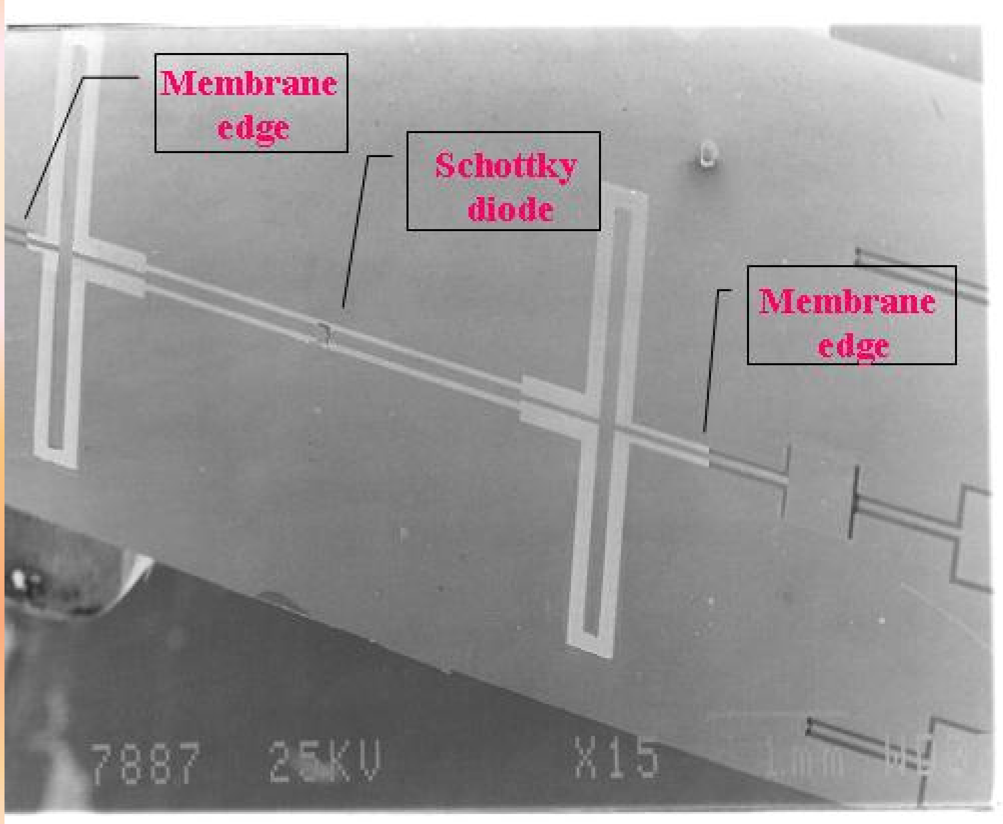
38GHz monolithic receiving module on GaAs membrane

IMT –FORTH 2001

3D Radiation pattern at 38 GHz

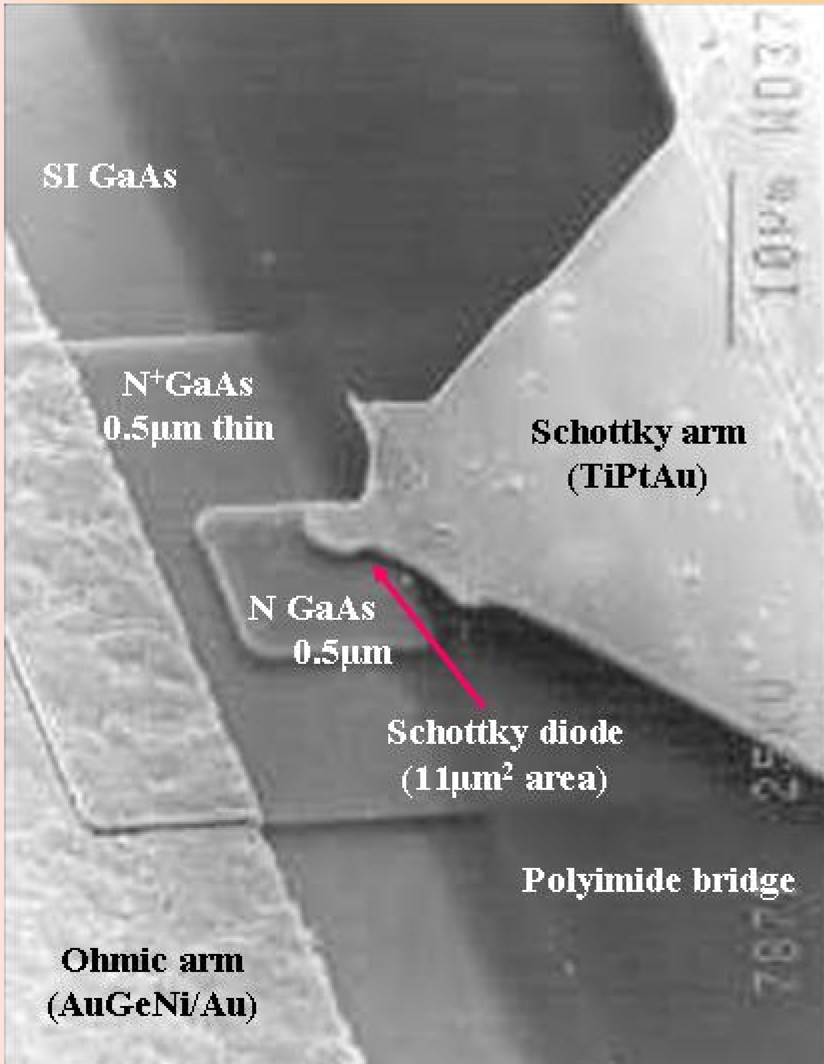


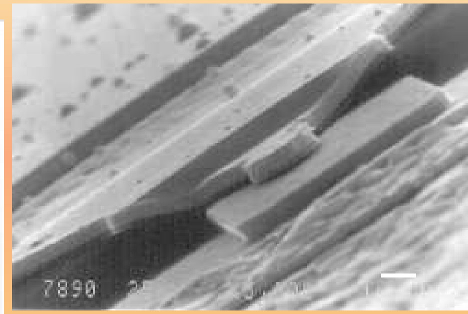


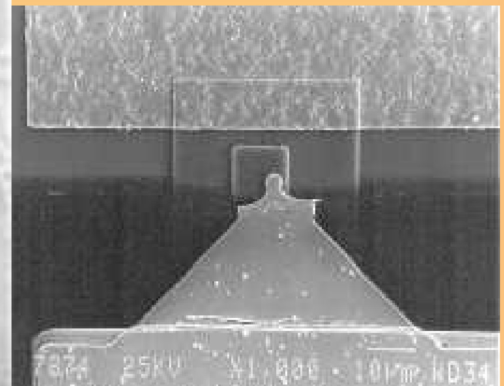


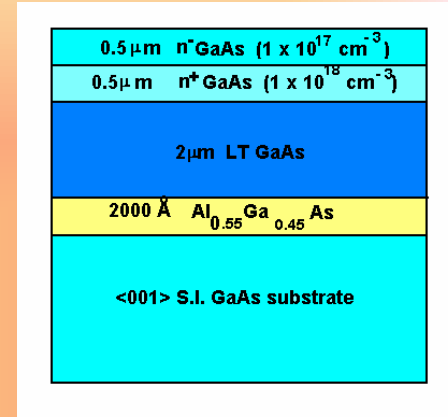
Membrane supported integrated 38 GHz GaAs micromachined receiving module (the antenna as well as the Schottky diode are supported on a 2.2μm thin GaAs membrane). The membrane is transparent in the white areas, which are unmetalized.

Details of the Schottky diode region

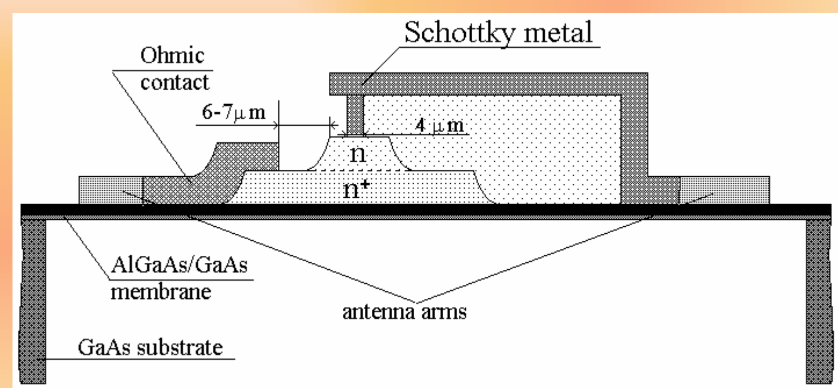








The MBE heterostructure



Cross section of the receiver structure

IMT Bucharest-FORTH Heraklion
in the MEMSWAVE Project
JMM-March 2003

The MEMSWAVE Workshop

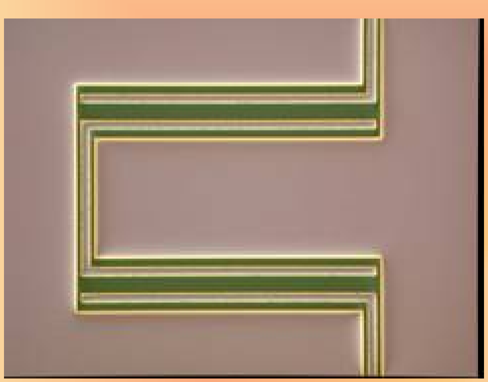
- In 1999 it was organized the first “MEMSWAVE” workshop in Sinaia with participation also from outside the Consortium ……LAAS Toulouse
- In 2001 it was organized the second MEMSWAVE” workshop in Sinaia
- In 2009, after Heraklion, Toulouse, Uppsala, Laussane, Barcelona, Heraklion the 9th edition will be organized in Trento

AMICOM FP6 NoE (2004-2007)

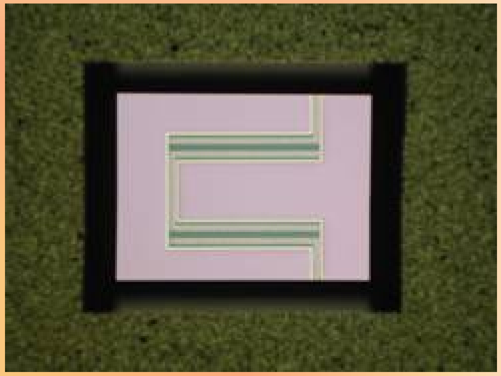
Coordinator – LAAS CNRS Toulouse

CNRS (France) (LAAS -IEMN-IRCOM)
- CHALMERS (Sweden)
- CRANFIELD (United Kingdom)
- EPFL (Switzerland)
- FORTH (Greece)
- IMEC (Belgium)
- IMPERIAL COLLEGE (UK)
- IMT- Bucharest (Romania)
- ITME (Poland)
- MILLILAB & VTT (Finland)
- PERUGIA (Italy)
- TECHNION (Israel)
- TUD (Germany)
- TUM (Germany)
- ULM (Germany)
- UPPSALA (Sweden)
- UNIVERSITY OF ATHENS (Greece)
- ITC-IRST (Italy)
- ARMINES (France)
- METU (Turkey)
- FRAUNHOFER ISIT (Germany)
- FRAUNHOFER IZM (Germany)
- TELEMIC (Belgium)
- LETI (France)
- DIMES (The Netherlands)

45 GHz Membrane supported filters IMT-LAAS



Top and bottom view



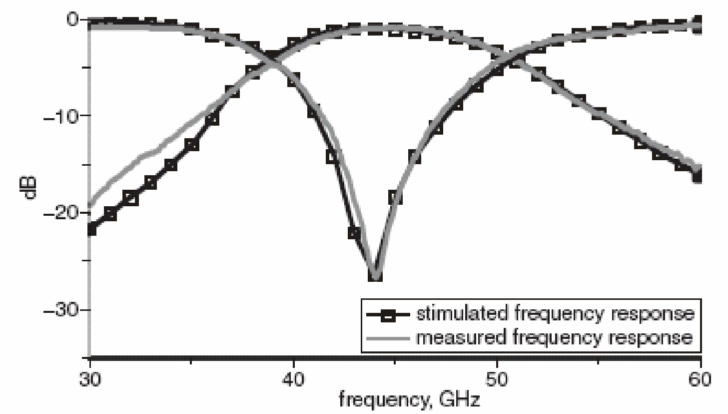
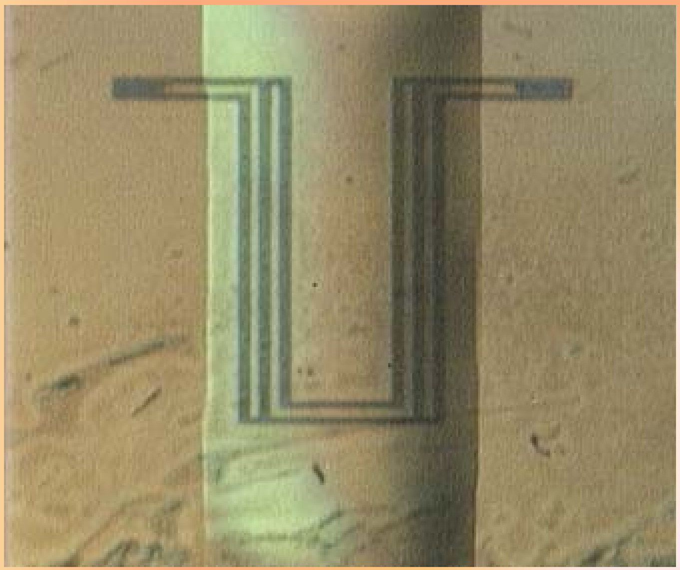


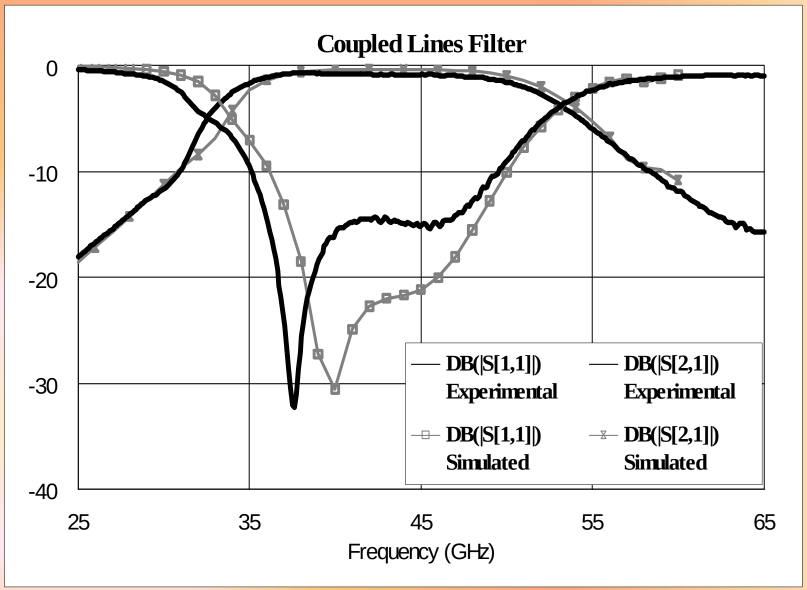
Fig. 3 *Simulated and measured frequency responses for bandpass filter fabricated using silicon micromachining*

Insertion losses < 1 dB

New GaAs membrane filter topology and design



GaAs membrane supported coupled line filter for 45 GHz



S parameter measurements for the new coupled line filter structure

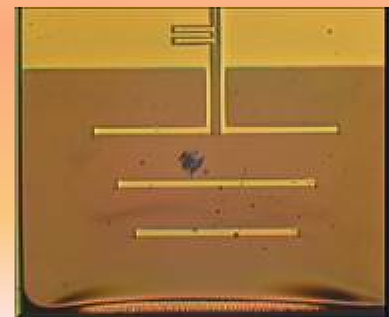
Insertion losses < 0.8 dB

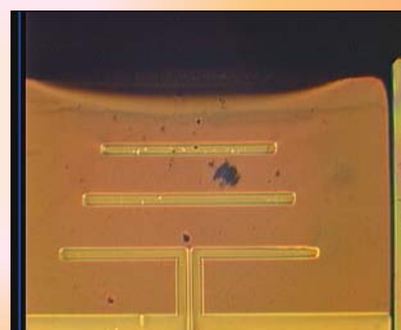
IMT Bucharest -FORTH Heraklion - LAAS Toulouse 2003

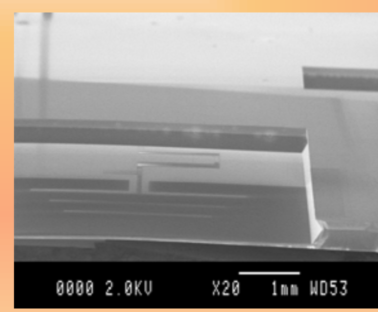
Yagi-Uda antennae structures manufactured using backside etching processing-2003 IMT-LAAS

Wet

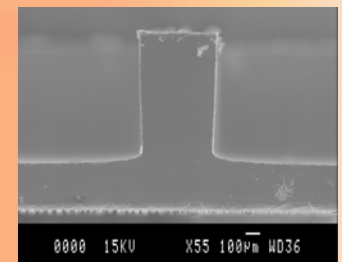
Dry

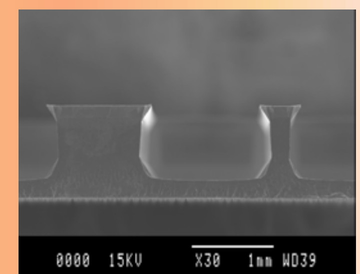


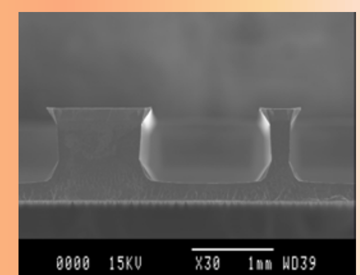


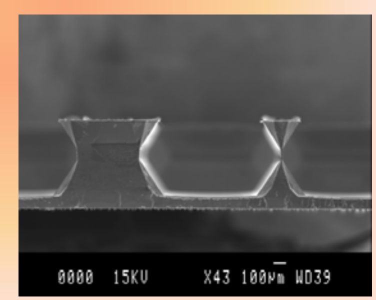


Dry +Wet



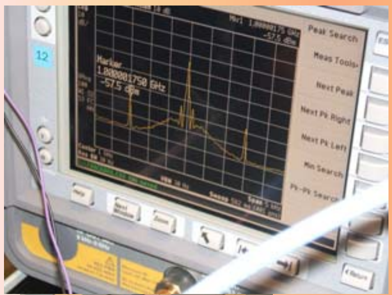






GaAs micromachined 60 GHz Yagi-Uda antennae based receiver used as millimeter wave identification tag

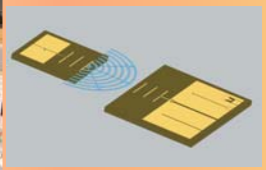
Common work in the of IMT Bucharest, VTT Helsinki, FORTH Heraklion -2007 AMICOM Project

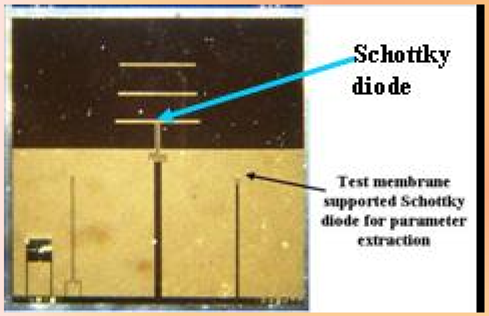


•The MMID concept was demonstrated at distances between 0.5 … 2.5 m two passive tags:

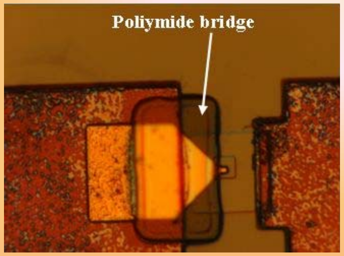
-60GHz monolithic integrated micromachined receiver structure with Yagi-Uda antenna

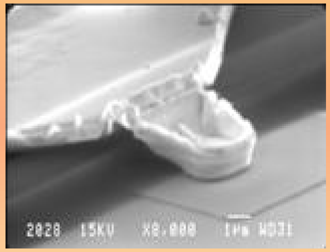
-77 GHz receiver structure based on the hybrid integration of a membrane supported folded slot antenna with two types of detector diodes (GaAs Schottky diode and InSb based quantum backward diode)



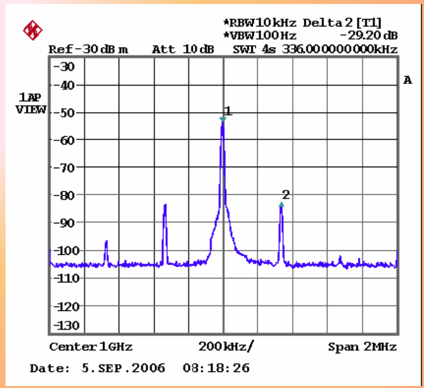


The receiver structure

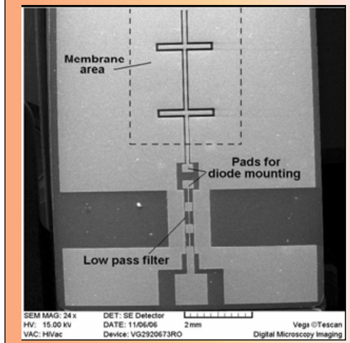




Details of the Schottky diode region



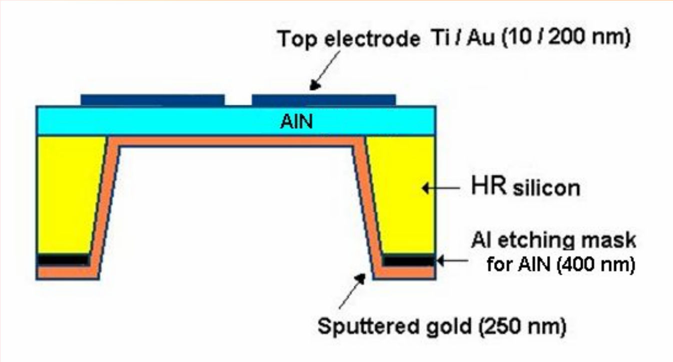
Received backscattered spectrum at a distance of 1.04 m. The transmission power was 34 dBm EIRP.



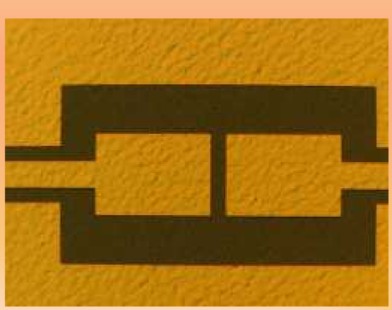
Top SEM photo of the micromachined receiver structure for 77 GHz (before the flip chip detector diode mounting).

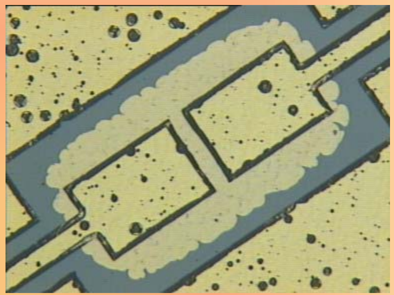
GHz acoustic devices manufactured using micromachining and nanoprocessing of wide band gap semiconductors (2006-2008)and other results

First GaN membrane FBAR structures

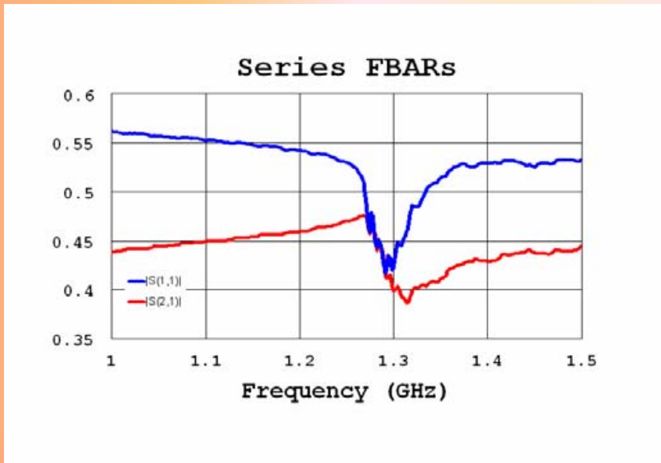


Cross section of the FBAR structure with the evaporated Ti/Au for the top metallization and sputtered Au for the bottom contact. Sputtered Al is used as mask for the bulk-micromachining of the membrane



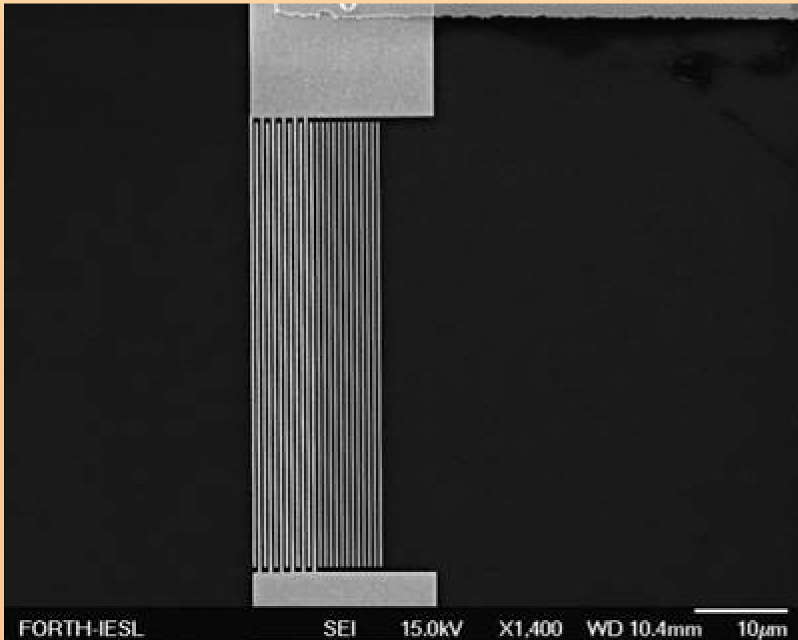


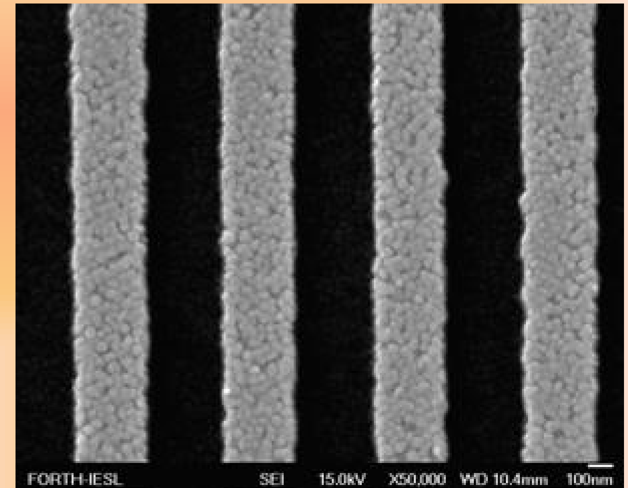
GaN membrane supported series connection of two FBAR structures (test structures)



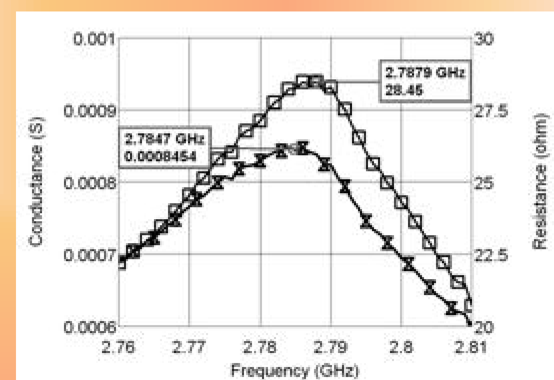
IMT-FORTH-TUD 2006

The thickness of the membrane was 2.2μm

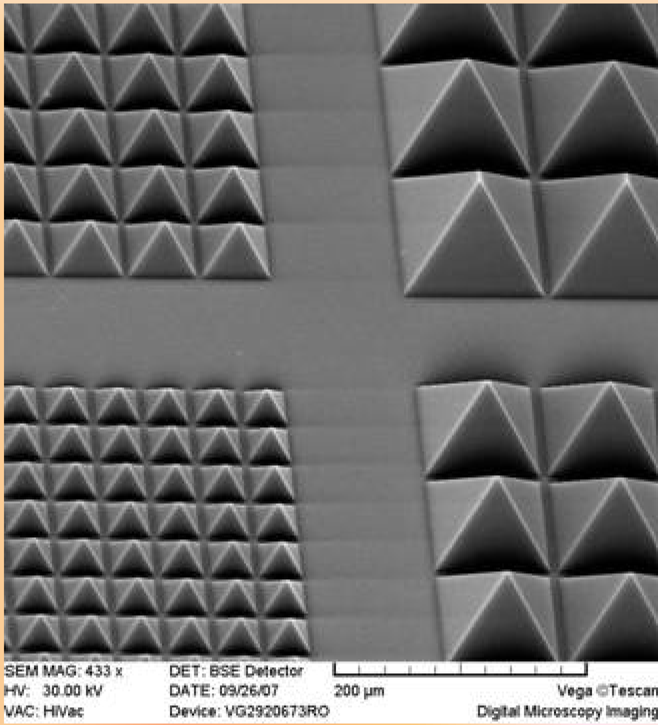


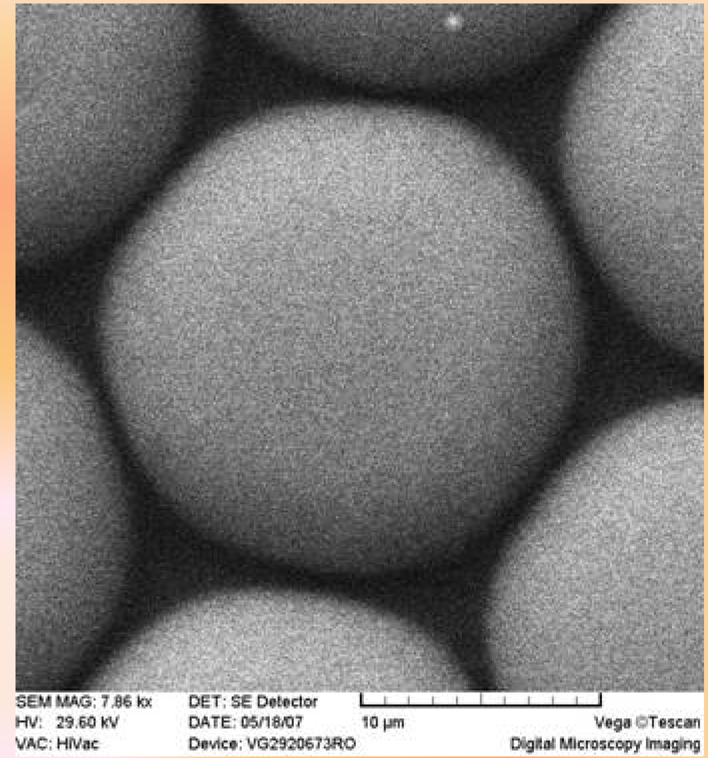


New experimental AlN SAW structure for GHz applications manufactured and measured at IMT-Bucharest . Fingers and pitches with a width on 300 nm have been obtained with the new purchased nanolithographic equipment (Vega-SEM and Elphy Plus EBL)



IMT-FORTH-NIMP 2007





Polymer-based diffractive optical elements (DOE) obtained by replication: (left) Polymethyl methacrylate (PMMA) DOEs; (right) Polydimethylsiloxane (PDMS) microlenses

Two IMT- Bucharest laboratories, for RF-MEMS and Microphotonics, respectively, already active in previous European programmes, have joint their efforts to achieve this excellence centre.

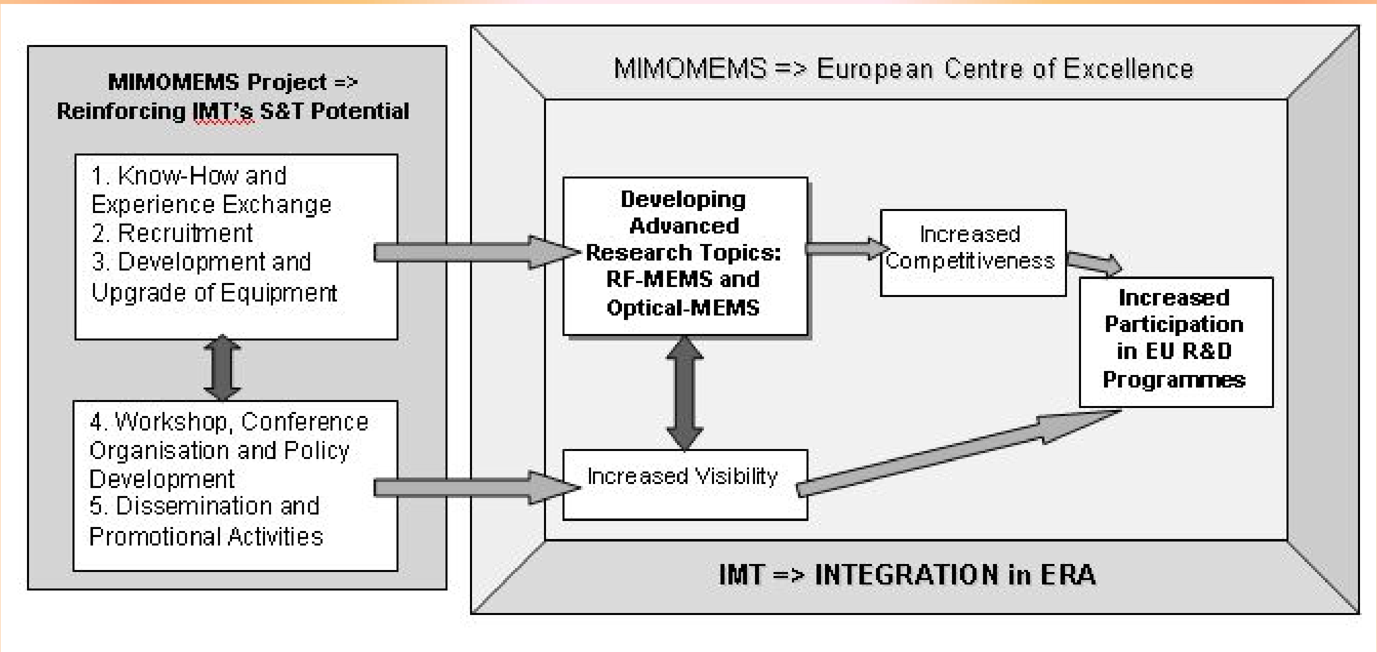
- ***The Laboratory of RF-MEMS*** **has coordinated one of the first European projects in RF-MEMS:**

- Micromachined Circuits for Microwave and Millimetre Wave Applications (MEMSWAVE, 1998-2001, FP4-INCO); coordinator: Dr. Alexandru Müller, alexandru.muller@imt.ro, IMT-Bucharest. The project was nominated in 2002 among the top ten European projects for the Descartes Prize (awarded for the best European co-operative research projects). Also, the RF-MEMS Laboratory was a key partner in the FP6 NoE:
-RF-MEMS "Advanced MEMS for RF and Millimetre Wave Communications" (AMICOM, 2004-2007 FP6 NoE),
and is also involved in the recently approved FP7 STREP
-MEMS 4 MMIC FP7 STREP (2008-2011) call ICT-2007-2.

- ***IMT's Laboratory of Microphotonics*** **(Dr. Dana Cristea, dana.cristea@imt.ro) was also participating in several FP6 projects:**

-Waferbonding and Active Passive Integration Technology and Implementation (WAPITI, STREP, 2004-2007, FP6-IST);
-Multi-Material Micro Manufacture: Technologies and Applications (4M, NoE, 2004-2008, FP6-NMP);
-Advanced Handling and Assembly in Microtechnology (ASSEMIC, Marie Curie Action, 2004-2007, FP6-Mobility),
and it is now involved in the FP 7 Integrated Project
-FlexPAET (2008-2010), FP7 IP call NMP-2007-1.

The overall aim of the MIMOMEMS project is to bring the research activity in RF and Optical-MEMS at the National Institute for R&D in Microtechnologies (IMT) to the *highest* European level and create a European Centre of Excellence in Microwave, Millimetre Wave and Optical Devices, based on Micro-Electro-Mechanical Systems (MEMS) for Advanced Communication Systems and Sensors.



Research topics to be developed in the frame of the MIMOMEMS project

A: RF-MEMS

A1. Development of silicon micromachined circuits for microwave and millimetre wave communication systems
A2. Development of GaAs monolithic integrated micromachined receiver modules
A3. Development of Surface Acoustic Wave (SAW) and Bulk Acoustic Wave (BAW) structures on GaN and AlN membranes

B: Optical-MEMS

B1. Heterogeneous integration of silicon and polymer-based micro-photonic devices to improve the functionality and the performance of Optical-MEMS
B2. Sub-wavelength photonic structures for highly integrated optical systems

MIMOMEMS – Objectives (1)

1. Exchange of know-how and experience

The Centre of Excellence will be created by developing IMT's existing scientific expertise and capacities and collaborating closely (twining) with specialist research groups from:

a) LAAS-CNRS Toulouse which has strong expertise in silicon based RF and millimetre wave microsystems, photonic devices, and circuits manufacturing and characterization

b) FORTH-IESL-MRG Heraklion which has excellent knowledge of IIIVs (GaAs and related semiconductors) and wideband gap semiconductor processing (GaN, AlN).

These cooperation will contribute to the development of IMT's Strategic Research Partnerships one of the major objectives (1) of the project.

Scientific and technological results on the topics A1, A2, A3 and B1, B2 are a measure of quality of the cooperation and twining action with the two partners (deliverables).

Previous co-operation with LAAS

IMPACT Project no. HPRI-1999-00059 **coordinated by LAAS-CNRS Toulouse (access to research infrastructure of LAAS)**

- **"Micromachined filters and antennas for 77 GHz and 94 GHz"** ***2000-2001***
- **"Micromachined emitter circuit for the 45 GHz frequency band"** ***2001-2002***
- ***Micromechanical tunable interferometer for communications*** **2002-2003**

Brâncusi Programme

- **"Silicon based Microsystems for Millimeter wave Circuits" – LAAS-CNRS Toulouse (2003 -2004)**
- **Integration of photodiodes in MOEMS for communications – LAAS-CNRS Toulouse (2005-2006)**

FP6 project

- **"*AMICOM" FP6 NoE* in RF MEMS (2004-2007) coordinated by LAAS Toulouse/ Univ Perugia. Dr A Muller was member in the Board of Directors** Regpot

Previous co-operation with FORTH Heraklion

Bilateral cooperations:

“Sensors based on III V semiconductors 1998-2000”

“Millimeter wave circuits supported on thin polyimidic and IIIV semiconductor membranes” 2000 – 2002

“New devices based on micromachining of III-nitrides” 2003 – 2005

FP4 project

“ MEMSWAVE” (1998 -2001) coordinated by IMT Bucharest. Project coordinator: Dr A Muller

FP6 project

"*AMICOM" FP6 NoE* in RF MEMS (2004-2007) coordinated by LAAS Toulouse

2007 - 2013

Cooperation with LAAS-CNRS:

RF MEMS The work together with LAAS-CNRS in their labs will permit high quality technological development and will facilitate the use of latest generation technological facilities (DRIE) for vertical etching profiles of the silicon up to the membrane. We will have also the opportunity to use their microwave characterization facilities up to 110 GHz in the training of the Romanian scientists.

OPTICAL MEMS This topic will provide an excellent opportunity to exploit the complementary expertise of the teams from LAAS-CNRS and IMT in Optical-MEMS. The common research stages, the hands-on training of young researchers from IMT at LAAS-CNRS Toulouse will allow the building of a common team, the optimum exploitation of the research expertise and facilities and the development of advanced devices. The devices will be designed in IMT (with LAAS-CNRS as a consultant), fabricated and tested partly in LAAS-CNRS, and partly in IMT. The twinning with LAAS-CNRS will facilitate the access to a world-class technology facility (silicon processing), and also to the expertise in MOEMS technology and characterisation

Cooperation with FORTH-IESL-MRG

RF MEMS The collaboration in twinning actions with FORTH-IESL-MRG will allow access at the Molecular Beam Epitaxy equipment for GaAs heterostructure growth, as well as for GaAs technological processes. GaAs monolithic integrated micromachined receiver modules will be processed at FORTH-IESL-MRG by IMT together with FORTH-IESL-MRG scientists. Design, mask manufacturing as well as microwave characterization will be performed by IMT. Monolithic integrated micromachined receivers will be manufactured for 60 GHz, 77 GHz and 110 GHz. Collaboration with FORTH-IESL-MRG will permit the growth of metal organic chemical vapour deposition GaN layers on silicon substrate and processing of SAW and BAW structures on GaN and AlN membranes (deep RIE).

MIMOMEMS – Objectives (2)

ii. Increase IMT's Human Potential

- 2 experienced scientists will be hired (for post-docs) using the project budget (starting from the second year). The researchers will be initially hired for 20 months fellowships with 6 monthly reviews. At the end of the period, the researchers will have the possibility to become full time IMT employees.

MIMOMEMS – Objectives (3)

iii. Increase IMT's Technology Potential

List of equipments, upgrades etc. already purchased or to be purchased through the MIMOMEMS project:

- **Near field scanning optical microscope (SNOM)**
- **Upgrade to 110GHz the 1-65 GHz set-up for on wafer characterization**
- **Frequency synthesiser up to 65GHz-110 GHz**
- **Au plating facility for semiconductor wafers**

***These new equipments will be used to provide services into the new IMT-MINAFAB facility* (see next).**

A new characterization equipment recently installed (November 2008) in the technological are of IMT:

- **Near field scanning optical microscope (SNOM)**

IMT-MINAFAB centre of services (1)

• **Using a model known from USA and some Western European Countries (France, Germany, UK, Sweden, Belgium etc.), IMT is currently building a "centre of micro- and nanofabrication", i.e. a centre of services providing access to experimental facilities in micro- and nanotechnologies.**

"*Building*" means here: reconstructing the support infrastructure, adding new equipments, training and reorganizing teams

***Most of the facility is already operational*, since the inauguration of a new technological area, beginning September 2008.**

The key point is that such a facility should provide access of various categories of people, in order to provide:

- **Multidisciplinary research (with people from various disciplines, belonging to different organizations);**
- **Education and training (including "training by research" of M.Sc. and Ph.D. students and "hands-on training" of people from industry);**
- **Innovation, including direct access of companies to design and experimental resources.**

IMT-MINAFAB centre of services (2)

From the "technical" point of view such a "micro-nano" facility includes a "clean-room" type environment, for the "fabrication" part itself.

IMT-MINAFAB already has such a "clean room" and it is developing other similar spaces. A high advantage is the fact that IMT - MINAFAB contains technological and characterization equipments, but also the computer-aided design (CAD) centre and a mask-shop, allowing the way along the whole cycle, from conception to small-scale production, not excluding fundamental research related to new material, as well as to innovative processes and physical structures.

A special feature of the "construction" of IMT-MINAFAB, is the result of the initiative of various research laboratories. These R&D laboratories "open" the use of their experimental equipments to other users, starting with their colleagues from other laboratories.

R&D labs are "investing" the common experimental centre. This "investment" continues with putting people to exploit fully the equipments and cooperate, also by adding money for supplementary modules, current materials etc.

IMT-MINAFAB centre of services (3)

The validation of the concept is also proved by cooperation with other European facilities, i.e.:

- **LAAS/CNRS, Toulouse (France)**
- **London Centre of Nanotechnology (LCN), London (UK)**

Experts from the above (similar) centres already have cooperated with IMT in improving the operation and design of the clean room facilities, whereas an exchange of services is also envisaged.

Note: At the time being, the only "competitor" in new member states (NMS) is IET, from Warsaw (Poland), although they have in microtechnologies a more or less traditional "research centre" (from the organizational point of view).

Further details available at www.imt.ro/MINAFAB

Contact: minafab@imt.ro

New equipments already functional in IMT-Bucharest connected with the Microwave/MEMS activity purchased through, national programs

-SEM from Tescan

-Nanolithography equipment from Raith (Elphy Plus)

-EBL “E-line nanoengeneering work station ” from Raith

-mask manufacturing facility up to 0.6 µm (pattern generator) from Heidelberg

-Photomask aligner (double side) MA6 from Suss Microtec

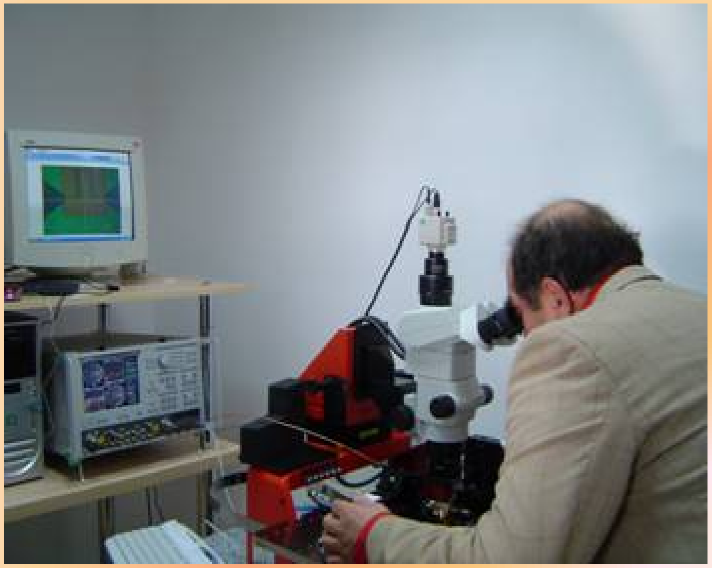
-VNA up to 65 GHz (Anritsu) with on wafer S parameter setup (Suss Microtech)

-high resolution Raman spectrometer

-elipsometer

-optical profilometer from Fogale

-E-beam/sputtering machine from Eduards



The new "on wafer" microwave measurement equipment till 65 GHz purchased by IMT-Bucharest in 2007 in the frame of the National Programme CEEX (Module 4)

The new high resolution Raman spectrometer purchased by IMT – Bucharest, in 2007 in the frame of the National Programme CEEX (Module 4)

MIMOMEMS – Objectives (4)

iv. Increase IMT's Scientific Visibility

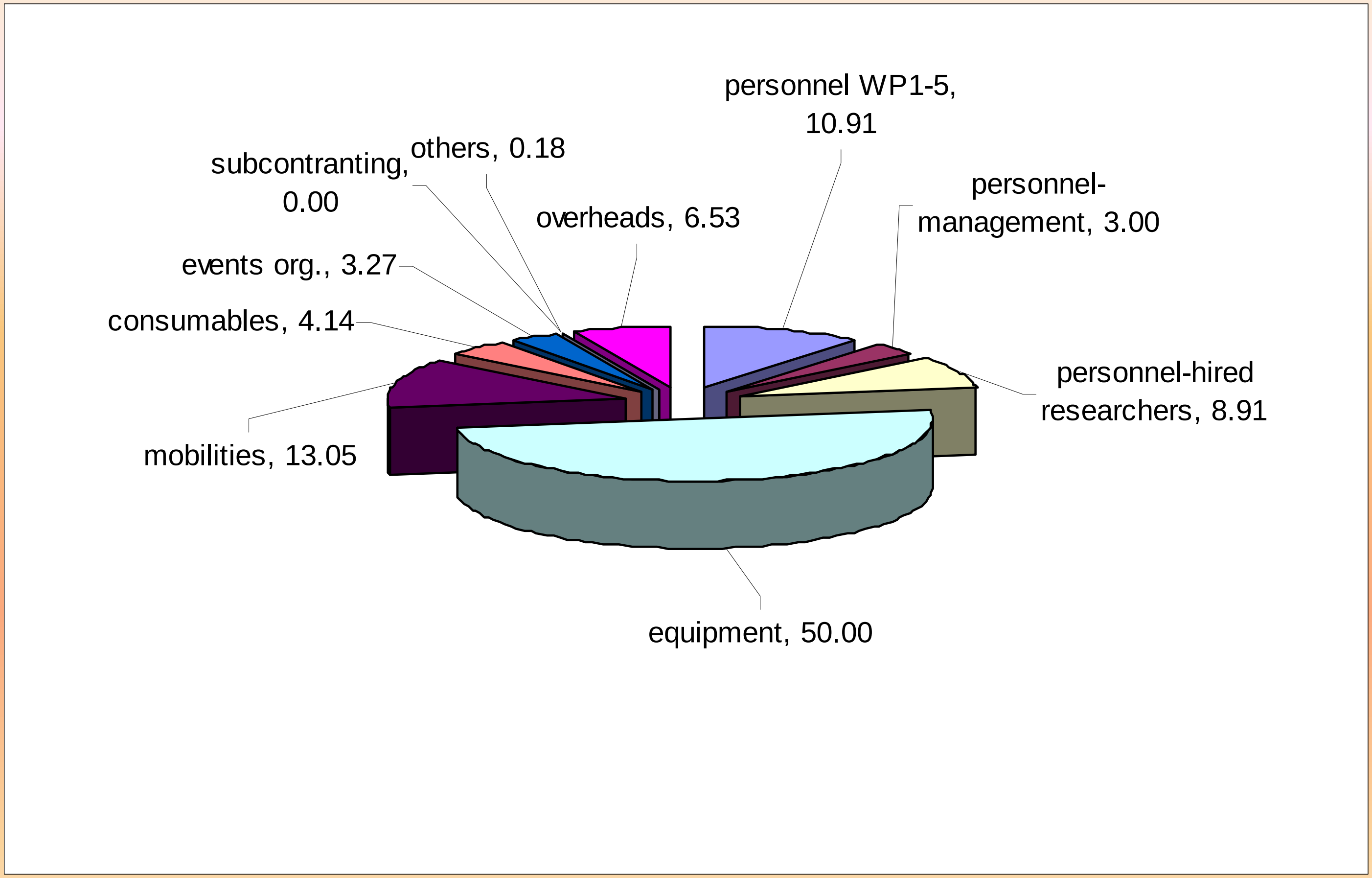
The objective is to support knowledge transfer at national and international levels, and facilitate research policy development in the field of RF- and Optical-MEMS.

This will be achieved through IMT's organisation of scientific events and seminars. Also, through the organisation of research policy workshops involving researchers, research policy experts and research policy makers from Romania and the EU.

v. Increase IMT's technology transfer for economic needs

The objective is to maximise the transfer and promotion of project results and activities of the MIMOMEMS project in Romania and across the EU. Actions: publication of research results in peer reviewed journal and presentation at international conferences; organisation of workshops to make research proposal submissions to relevant calls from the FP7 ICT Work Programme.

Budget distribution in the MIMOMEMS Project



Results after 6 months(1)

WP1

- Research visits IMT to FORTH for common work regardind manufacturing of accoustic devices and optical devices (July 2008, 2 scientists for 11 days). see next slides
- Research visit of Dr G Konstantinidis (FORTH) and Prof R Plana (LAAS) in the IMT Nanofab facility (during the kick off of the project- september 2008) were technical discusions took place regarding the MINAFAB facility
- Visit of Hugues Granier and Paul Fadel experts in LAAS Toulouse clean room, to advise the future developments in the MINAFAB clean room facility of IMT (24-26 November 2008)
- Visit at Thales Alenia Space Toulouse of two IMT scientists for a new FP7 STREP proposal (see next slides); one of them also visited LAAS Toulouse to consult LAAS scientists regarding the 110 GHz “on wafer” facility upgrading offer

WP2

- An anouncement regarding the hire intention for 2 postdocs with expertise in RFMEMS and Optical MEMS was posted on the website of the project. Dr George Simion from Purdue Univ USA (an excellent researcher who worked at IMT in the first 2 years ,1998-2000, after he absolved the Physics Univ Bucharest), was contacted and we have his “principle” agreement to come on one of these positions in September 2009.

Results after 6 months (2)

WP3

- **-The SNOM Acquisition finished in August the SNOM was delivered in October 2008 It was installed at IMT Minafab Facility and is fully operational.**

Upgrade to 110 GHz the 65 GHz "on wafer" characterization set-up:

- **-upgrade of the VNA up to 110 GHz Acquisition procedure finished Contract will be signed on December the 5-th**
- **-upgrade the on wafer measurements set-up up to 110 GHz Acquisition procedure will finish and contract will be signed before the end of December**
- **-The frequency synthesiser up to 65 GHz (+ mixer for 110 GHz), Acquisition procedure finished. Contract will be signed on December the 5-th**
- **-The Au plating facility- in 2009**

WP4

The MIMOMEMS project has organized the first International Scientific Sessios at the CAS Conference 2008 (13-15 October 2008): 3 oral sessions and 1 poster session.
2 invited lecturers: G. Konstantinidis (FORTH Heraklion); T. Vähä Heikkilä (VTT Helsinki)

WP5

Project web page
Promotional article in the Romanian Journal "Market Match"
Promotional article in Parliament Magazine (IMT founds-not MIMOMES)

Proposal:

***Joint European Laboratory* between : LAAS-CNRS Toulouse, Forth Heraklion, IMT Bucarest (2008-2011) "SMART MEMS/NEMS for advanced communications**

WP1

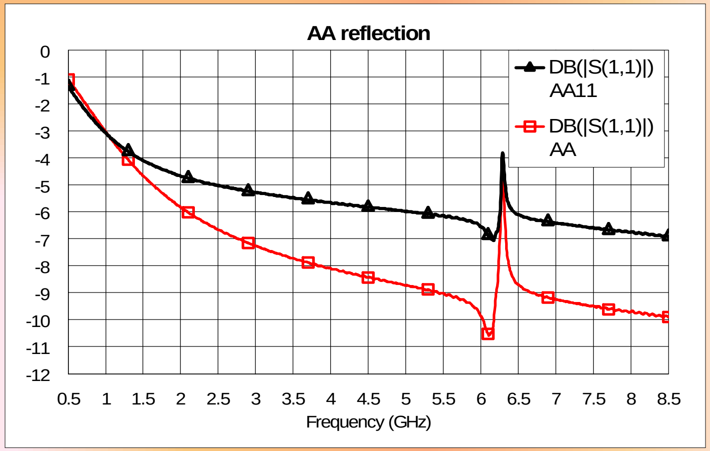
IMT and FORTH
July 2008

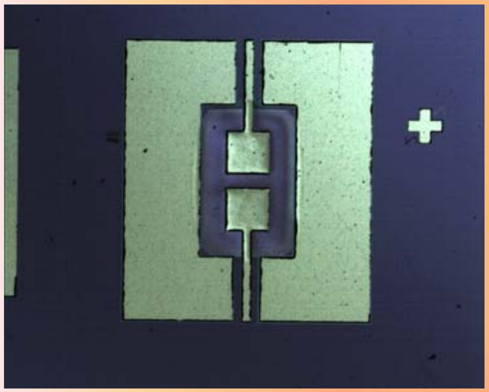
GaN FBARs

300 nm (GaN) +280nm (buffer) thin membrane supported FBAR structure based on GaN micromachining

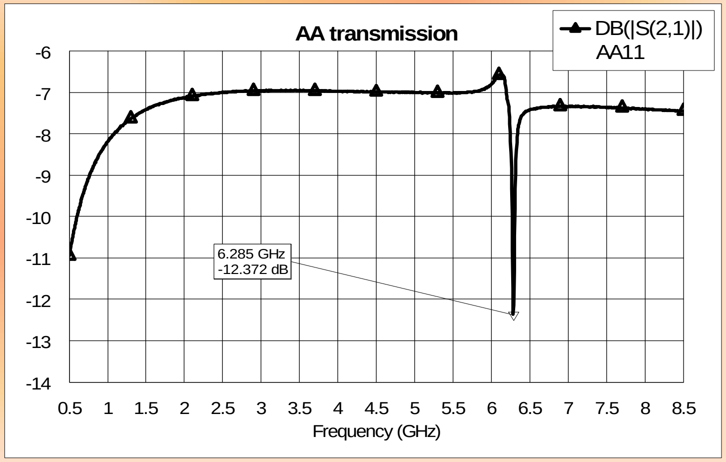
50nm thin Mo metallization

GaN/Si wafers from NTT AT Japan





Final structure (top and bottom view)



Proposal for the 2nd Space Call in FP7

MINOTAUROS

"MIcrowave Nitride nOvel Technologies for Advanced tUnable and RecOnfigurable Satellites«
Deadline 4 December 2008

- **Consortium made up of 7 partners from 4 EU members, one of which is a new member state**
  - **THALES ALENIA SPACE (France)**
  - **FORTH (Greece)**
  - **LAAS-CNRS (France)**
  - **IMT (Romania)**
  - **NKUA (Greece)**
  - **FEMTO-ST (France)**
  - **AZZURO AG (Germany)**
  - **EPFL (Switzerland)**

- **Project proposed in the STREP frame on a 3 years duration**

- **Project leader : Thales Alenia Space (France), a leading actor in the space industry**

Conclusions

- The **MIMIOMEMS project** has an important contribution to the increasing of the **scientific and technological potential** of the two labs of **IMT- Bucharest** involved, to their infrastructure and visibility. It facilitates the high level scientific cooperation with European partners and not only.
- The **facilities** which are or will be installed through the **MIMOMEMS project** together with those obtained from other national projects (the Capacities Program, Module 4) will contribute to the development of **IMT- Bucharest** as a **European Center of Excellence** in **Micro and Nanotechnologies**
- **MIMOMEMS** contributes to the integration of our group in ERA.