National Institute for R&D in Chemistry and Petrochemistry ICECHIM Bucharest

International Symposium

PRIORITIES OF CHEMISTRY FOR A SUSTAINABLE DEVELOPMENT

PRIOCHEM XVIIIth Edition

Round Table

Make Innovation Happen

Support tools/methodologies to pave the way
toward **T**echnology **R**eadiness **L**evel **TRL 7-8-9**

Moderator:
Dr.Nicolae Varachiu, Innovation Manager ICECHIM

–

26th of October 2022, Bucharest, Romania

Rize innovative project to accelerate the transition to regenerative agriculture

International symposium PRIOCHEM - 2022
Make innovation happen

Agriculture, the new sustainability frontier

24Mt/yr

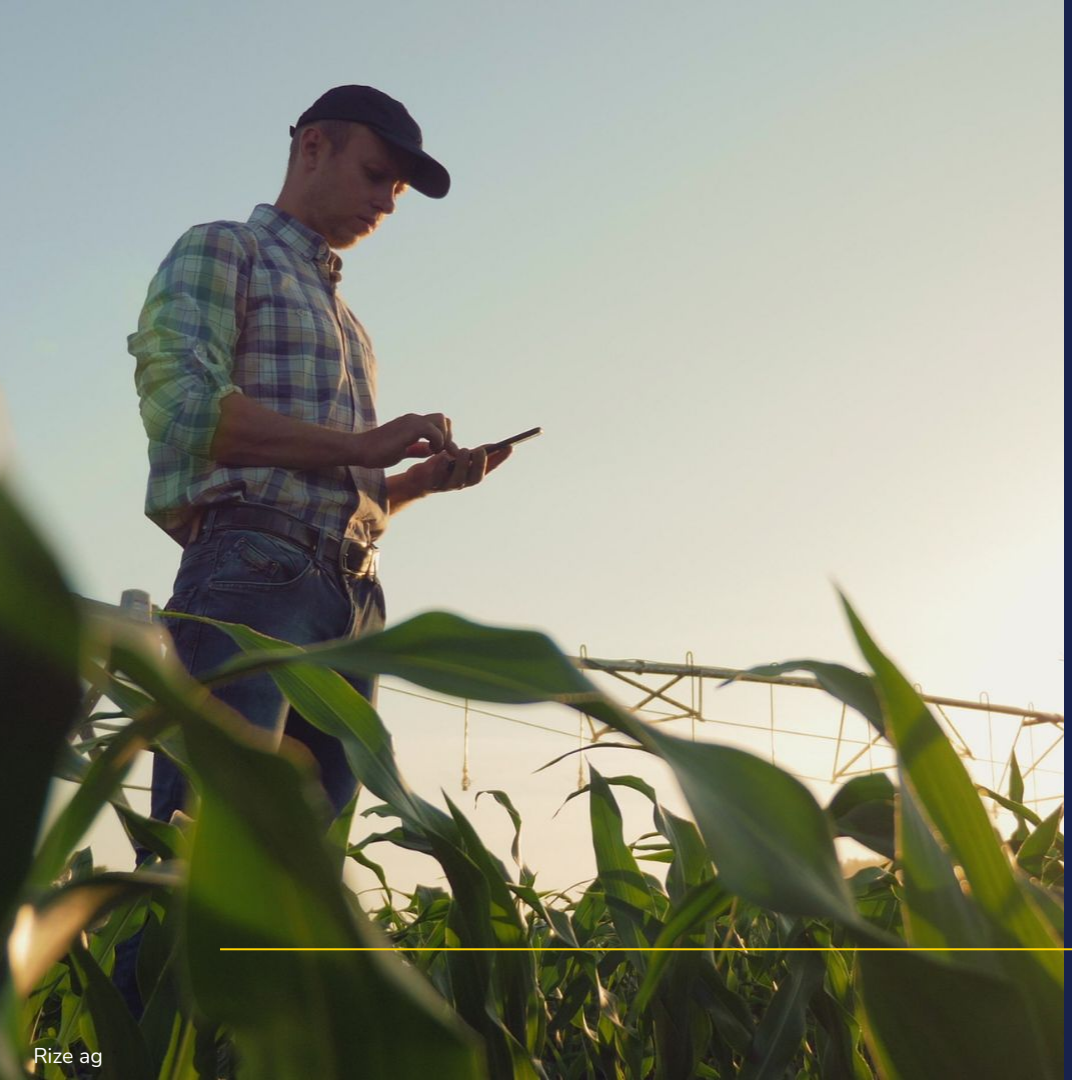
lost arable lands globally

#1

natural carbon sink in Europe

70%

of our food carbon footprint



Our mission

Leveraging carbon finance to make sustainable agriculture attractive

An integrated digital solution to accelerate the transition

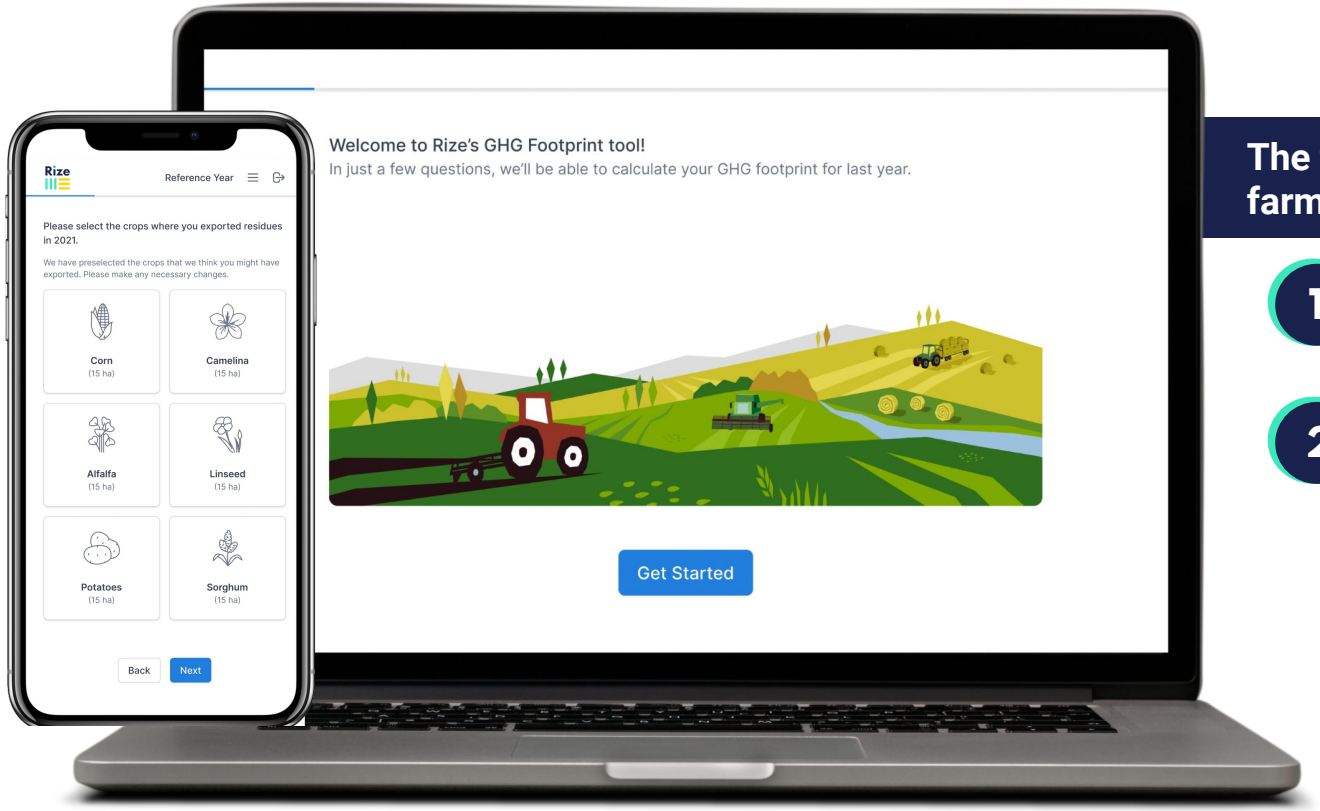
A **digital platform** to easily access carbon financing

100% proprietary *Monitoring, Reporting and Verification* infrastructure

A **team of 18**

Created in
Sept 2020
Rize

An integrated digital solution to incentivise the adoption of regenerative practices



The turnkey platform, free for farmers

1. Carbon footprint measurement
2. Carbon potential calculation and new practices definition

Easy and simple access to carbon certificates!

An advanced technological infrastructure to measure environmental KPIs

Infrastructure MRV (Monitoring, Reporting, Verification) 100% proprietary

Food industry

Advisors

Farmers

Traceability through satellite imagery

- Practices verification
- Biomass estimation

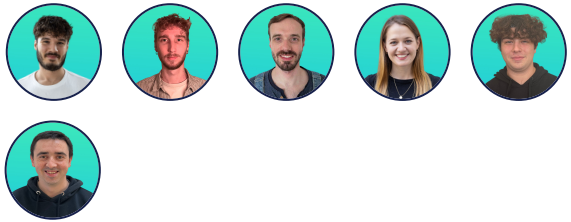
Carbon calculations models

- Soil carbon modelling
- GHG emissions modelling

A management tool to monitor and assess the adoption of regen ag practices

Rize team

Digital



Science & Certification

Samuel Collin
CPO

Etienne Variot
CEO

Partnerships & Innovation

Operations

Customer Discovery Process

IDEATION

Customers interview
- Understand and learn
- Natural & informal ; open-ended questions

Continuous interviewing
Story-based interview questions

PROTOTYPING

User prototype
- Learn more about customers behaviors to test the usability

Live-data prototype
- Collect quantitative data to test whether an idea works

TESTING

Short interview
- Validate the problem
- Understand how the problem is solved today & what it could take for them to switch

Usability test with hi-fi prototype

Letter of intent

Time spent by customers

→ Creating customer value

Key Milestones & Past Achievements

- 60+ interviews
- Scientific literature review

- Data input test (carbon modelling)
- UX test (web-app simplified version)

PILOT PHASE

- Platform test with 300+ farmers
- 30+ partnerships

- Data input process simplification

Innovation projects and testing opportunities

EUROPEAN EXPANSION

Pilot project in Romania

Use case: **financing scheme test for carbon farming** in Romania

FOOD & BEV. INDUSTRY PARTNERSHIPS

Opportunities assessment

Use case: **environmental performance monitoring** for regen ag projects

Rize European expansion: pilot project in Romania

Use case: financing scheme test for carbon farming in Romania

Assess Romanian farmers:
- interest in carbon farming
- carbon potential

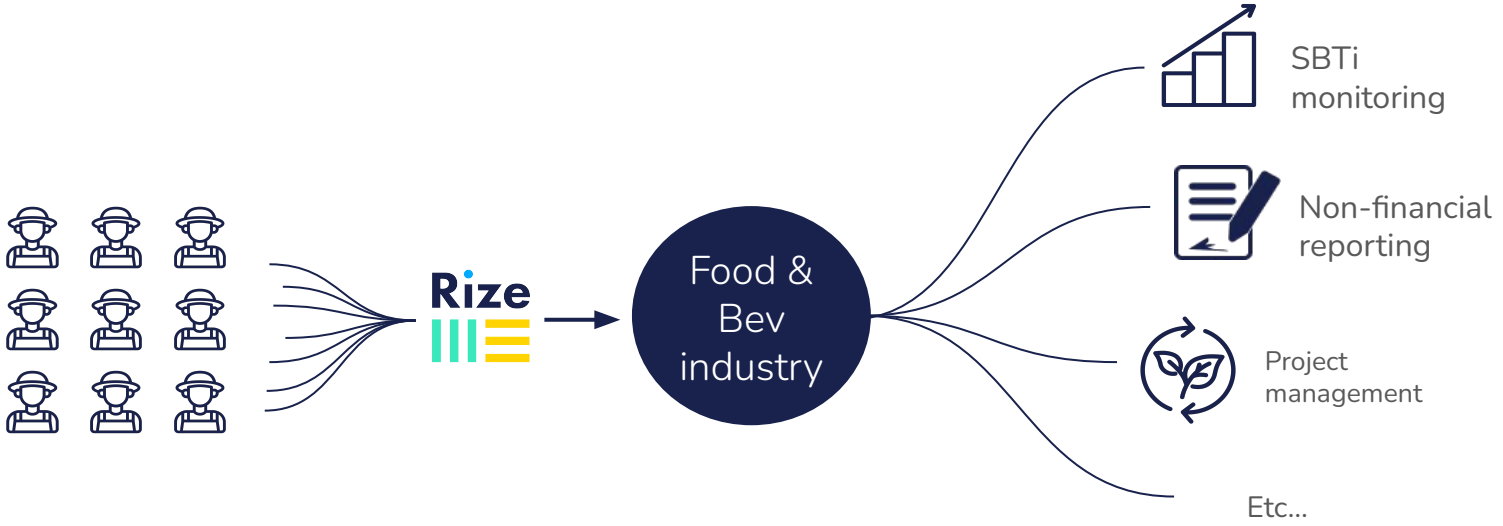
Confirm technological feasibility

Qualify Raiffeisen's interest in carbon finance

Opportunities Assessment: the case of the Food and Beverage industry

Use case: environmental performance monitoring for regen ag projects

Food & beverage companies want to encourage “good” sustainable agriculture projects within & outside their value chains but they are struggling to do this.
Preliminary discovery phase: understand why and how they do it, and where they struggle.



Rize

Contact :

Etienne Variot

www.rizeag.com

DDS DIAGNOSTIC

PhD Lorena Bocancia-Mateescu

Researcher

DDS DIAGNOSTIC

The most innovative Romanian BioTech company
for in-vitro diagnostics - since 2002.

We develop, manufacture and sell
fast, accurate, and easy to use rapid tests.

DDS Diagnostic objective: European BioTech leader

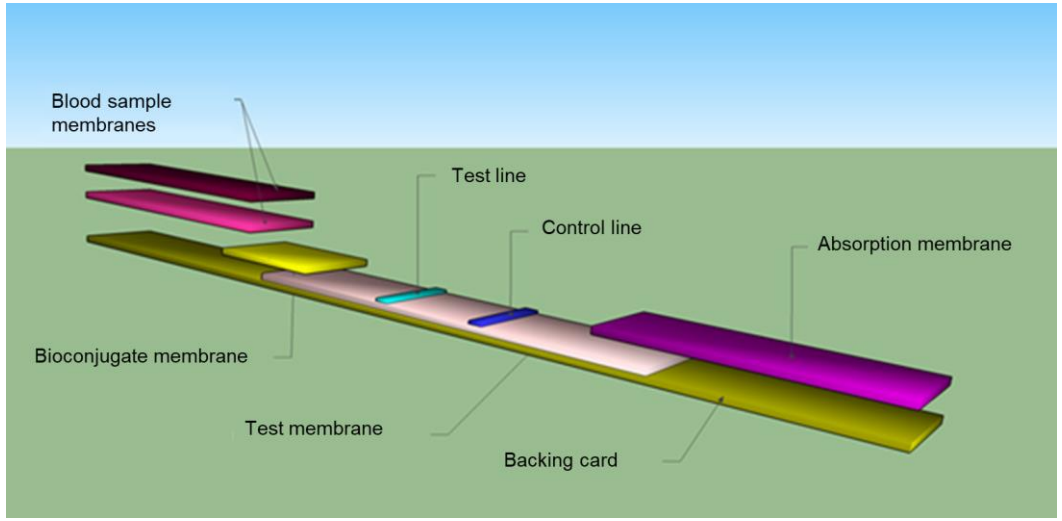
Research new (rapid) test technologies

Focused on immune and molecular diagnostics in the POCT field

Develop production and international sales

Fund expansion via private & EU funds

OUR VISION: Development, Evolution and Innovation.



LFIA rapid test architecture

All people will have ***faster, accurate***, and ***more accessible*** diagnosis by getting ***easy to use, precise*** **and** ***affordable rapid tests*** to conveniently use either at home, Point-of-Care, clinics or in hospitals.

Post Covid-19 is ***the right moment to accelerate rapid tests offering*** into additional segments, building on high awareness and rapid adoption.

DDS DEPARTMENTS

Production

Sales and Marketing

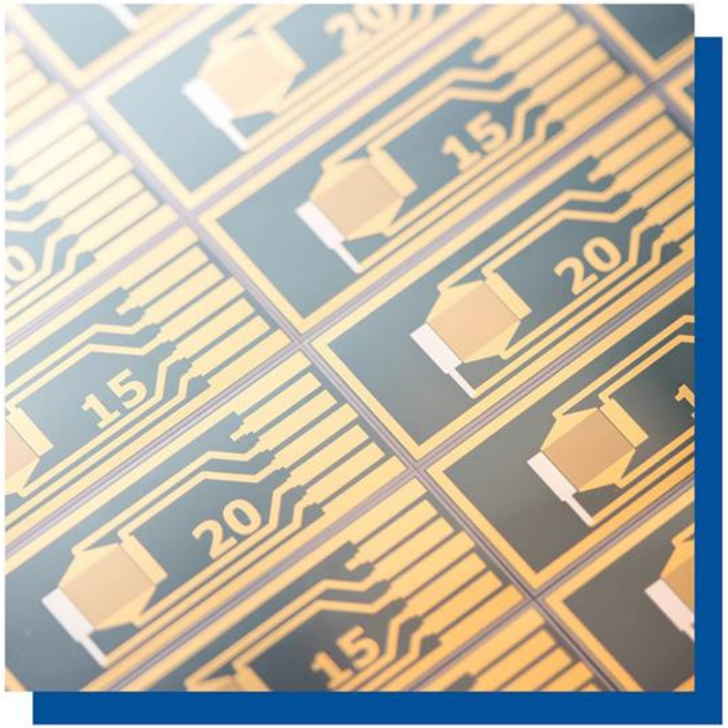
Logistics

Research and Development

Technical Support

Regulation

OUR PURPOSE



Electrochemical immunosensors

Our goal is to provide ***affordable, efficient and safe*** solutions for medical laboratories and patients.

We develop, manufacture and sell ***original test kits & equipment for rapid and accurate diagnosis*** of various pathologies.

Our ***research*** projects in ***bio and nanotechnologies*** aim to adapt and improve our products and services.

THE PROBLEM: people delay screening and receive late diagnosis

Overcrowded medical facilities

- Inconvenient access, crowded, few doctors
- Services become too expensive
- Late diagnosis reduces chances for a cure

One of the root causes:

Quantitative preferred vs. Qualitative testing

THE SOLUTION: extend screening/diagnosis with rapid quality testing

Rapid test adoption accelerated by Covid-19

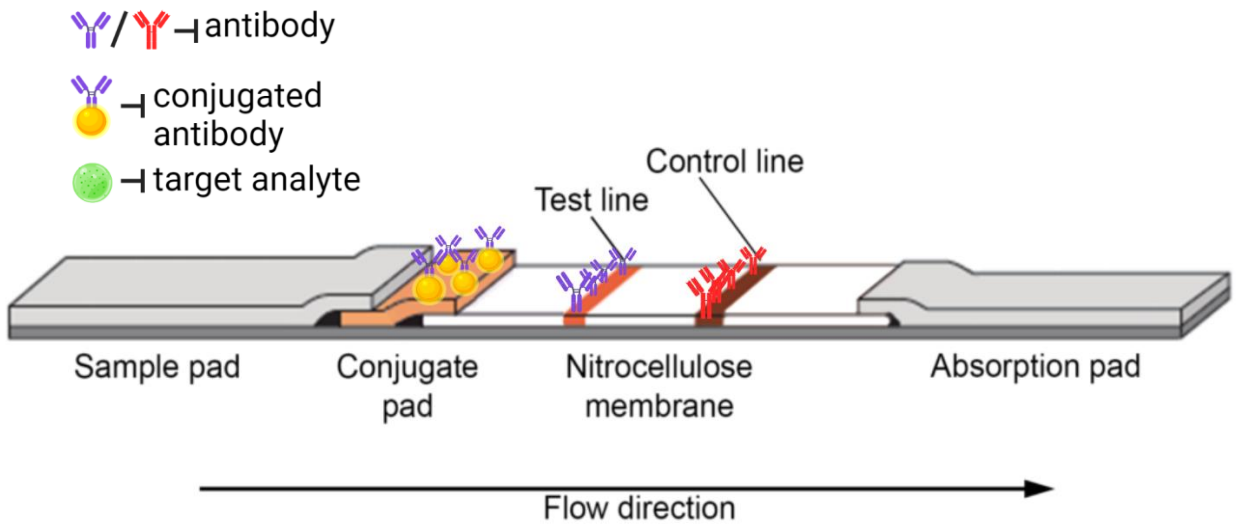
- Provide immediate diagnostic/indication (Y/N)
- Can be done at home /convenient location
- Much more affordable

Strong enablers:

Qualitative tests get accepted post-Covid-19

EU directive/recommendations XY/20zz

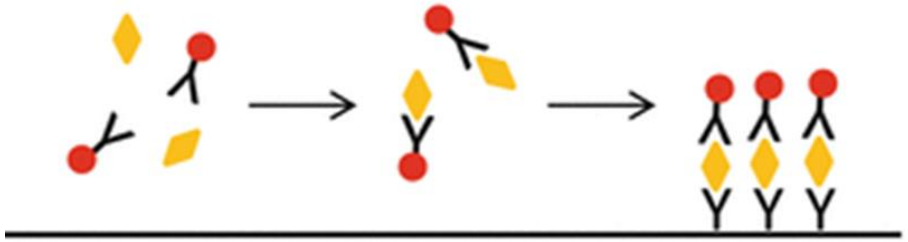
Lateral flow immunoassay (LFIA)



- **Lateral flow immunoassay (LFIA)** is a popular, easy to perform and low-cost analytical method which can be used for screening, diagnosis and monitoring of various diseases.
- The assay consists of several zones, typically constituted by **membranes** made of different materials. The parts overlap onto one another and are mounted on a backing card using a pressure-sensitive adhesive.
- In addition to membranes, the rapid tests also contain
  - **Conjugate Solution**
  - **Antibody solution for test line**
  - **Antibody solution for the control line**

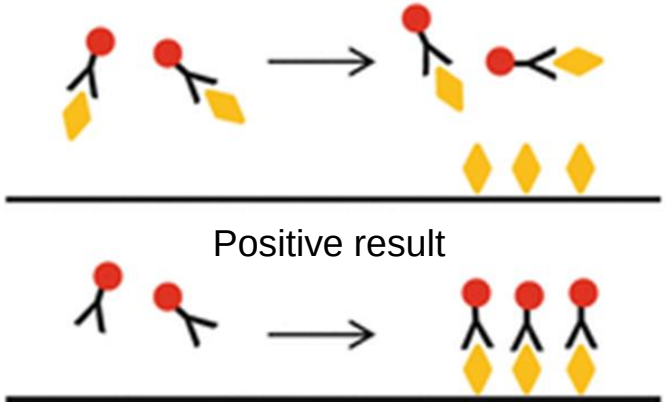
Lateral flow immunoassay (LFIA)

LFIA sandwich type



Positive result

LFIA competitive type



Positive result

Negative result

- Positive **sandwich** tests are represented by the presence of a colored line in the area of the "T" test line.
- Positive **competitive** tests are represented by the absence of a colored line in the area of the "T" test line.
- **Nanotechnology** can play an essential role in different personalized medicine applications.
- **Lateral flow immunoassays** can be included in **telemedicine** which allows health care professionals to evaluate, diagnose and treat patients at a distance using telecommunications technology.

Lateral flow immunoassay (LFIA)

➢ LFIA can accurately detect:

- **Hormones**: Gonadotropin (hCG), Thyroid-stimulating hormone (TSH)
- **Viruses**: SARS-CoV-2, Influenza (A,B), Hepatitis (A,B,C), HIV (1,2) etc.
- **Microorganisms**: *Clostridium difficile*, *Helicobacter pylori*, *Treponema pallidum*, *Streptococcus Pneumoniae* etc.
- **Cardiovascular diseases biomarkers**: Cardiac troponins, CK-MB, Myoglobin, h-FABP
- **Cancer biomarkers**: Alpha-fetoprotein (AFP), Prostate-specific antigen (PSA)
- **Parasites**: *Trichomonas Vaginalis*, *Leishmania*
- **Fungal infections**: *Candida albicans*

DDS DIAGNOSTIC

- RESEARCH – PARTNERSHIP WITH RESEARCH INSTITUTES
- CERTIFICATIONS (and PATENTS - TBC)
- PRODUCTION
- SALES
- MARKETING
- LOGISTICS
- SUPPORT SERVICES

THANK YOU!

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Round Table
"Make innovation happen"

Cornel Cobianu[1,2], Marin Gheorghe[1] and Mircea Modreanu[3]
Yael Gutierrez[4], Maria Losurdo[4], Gonzalo Santos[5], Fernando Moreno[5]

[1] NANOM MEMS, Râșnov, Romania,
[2] Academy of Romanian Scientists,
[3] University College Cork, Tyndall National Institute, Ireland
[4] CNR-NANOTEC (Italy),
[5] CANTABRIA UNIVERSITY (Spain)

Fundamentals of innovation at organization level:

1. Collective intelligence

2. Hybrid management

CEO as enabler

INSTITUTUL NATIONAL DE CERCETARE DEZVOLTARE PENTRU FIZICA MATERIALELOR
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Telefon: +40(0)21 3690185, Fax: +40(0)21 3690177, email: director@infim.ro, http://www.infim.ro

În atenţia OSIM şi a celor interesaţi

07.07.2020

INSTITUTUL NATIONAL DE CERCETARE DEZVOLTARE PENTRU FIZICA MATERIALELOR BUCUREŞTI-RA
INTRARE Nr. 1625
IEŞIRE
Ziua 07 Luna 07 Anul 2020

NOTIFICARE

Institutul Naţional de Cercetare Dezvoltare Pentru Fizica Materialelor, prin prezentul document, confirmă faptul că firma NANOM-MEMS srl deţine integral proprietatea intelectuală revendicată în cererile de brevet de invenţie de mai jos:

1. Senzor de gaze inflamabile pe bază de catalizator fără metale preţioase, înregistrată la OSIM cu numărul A/00112 din data de 20.02.2019.
2. Pelistor cu catalizator fără metale preţioase pe bază de compozite ale oxidului de cobalt, înregistrată la OSIM cu numărul A/00323 din data de 31.05.2019.
3. Senzor catalitic de gaze inflamabile cu material catalitic ne-nobil pe bază de compozite ale oxidului de mangan şi procedeu de realizare ale acestuia, înregistrată la OSIM cu numărul A/00484 din data de 08.08.2019.
4. Pelistor cu material catalitic binar pe bază de metal preţios şi procedeu de realizare al acestuia, înregistrată la OSIM cu numărul A/00674 din data de 24.10.2019.
5. Pelistor cu material catalitic ternar şi cuaternar pe bază de metal preţios şi procedeu de realizare, înregistrată la OSIM cu numărul A/00096 din data de 25.02.2020.

Aceste invenţii au fost realizate în cadrul contractului de cercetare 1600/25.07.2018 încheiat între INCDFM şi NANOM-MEMS srl.

Director Stiintific si Director de proiect
Dr. Fiz. Lucian Pintilie

Our contribution to novel plasmonic photonic devices:

Plasmonic solar cell and photodetectors as multiband multi-polarization devices

1. “Multiband, Multi-polarization Plasmonic Photodetector and Fabrication Method".

   EU application **EP22465517.5/17.03.2022**

Applicants: SC NANOM MEMS SRL(RO), CANTABRIA UNIVERSITY(ES), CNR-NANOTEC(IT), Tyndall National Institute (IE),

Inventors: COBIANU Cornel, GHEORGHE Marin, GUTIERREZ Yael Vela, LOSURDO Maria, MODREANU Mircea, MORENO GRACIA Fernando, SANTOS PERODIA Gonzalo

2. "Reconfigurable plasmonic photodetector and fabrication method",

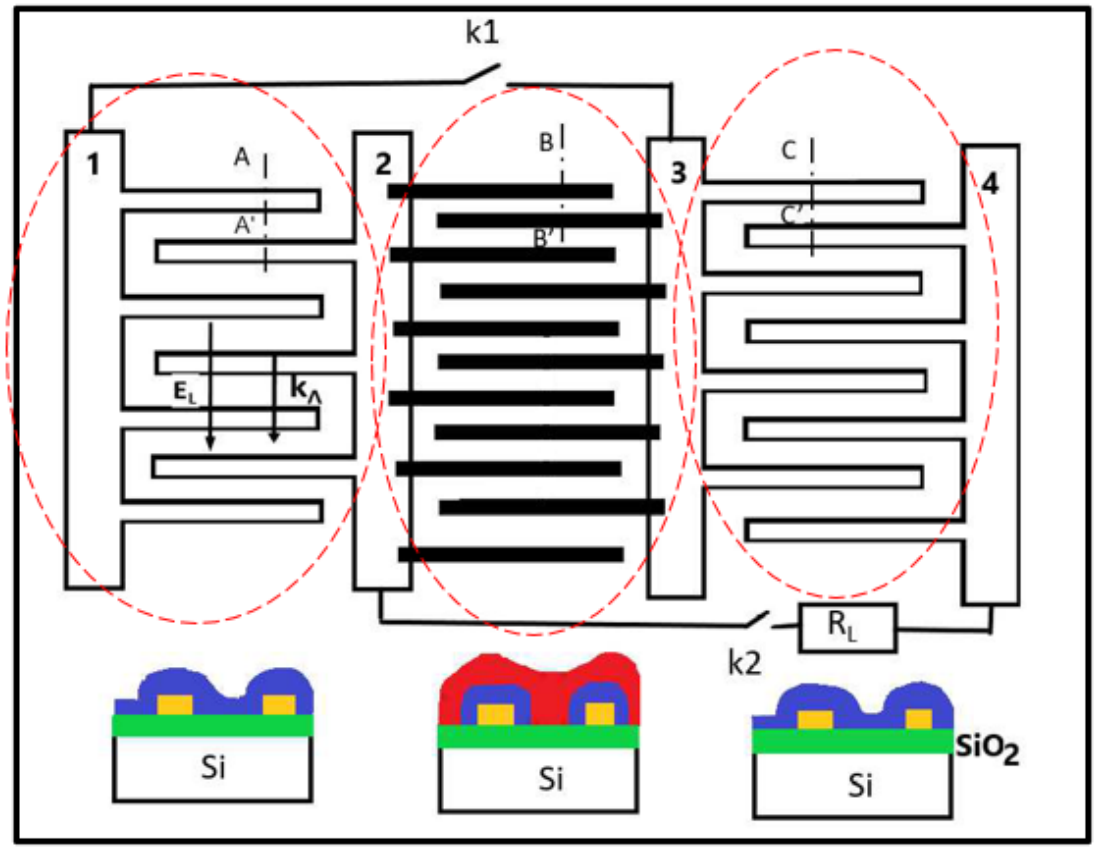
   EU application **EP22465538.1/02.06.2022**

Applicants: SC NANOM MEMS SRL (RO), CANTABRIA UNIVERSITY (ES), CNR-NANOTEC (IT), Tyndall National Institute (IE),
Inventors: COBIANU Cornel, GHEORGHE Marin, GUTIERREZ Yael Vela, LOSURDO Maria, MODREANU Mircea, MORENO GRACIA Fernando, SANTOS PERODIA Gonzalo.

Self-powered on-chip integrated sensing nano and microsystem and fabrication method for the same

Inventors: Cornel COBIANU[1], Marin GHEORGHE[1] and Mircea MODREANU[2]

Applicants: [1]NANOM MEMS srl, Romania and [2]Tyndall National Institute-University College Cork, Ireland



Back-up slides

Fundamentals of Plasmonic Photonic Devices

Extraordinary light transmission through subwavelength hole array !

a_o=period of hole array

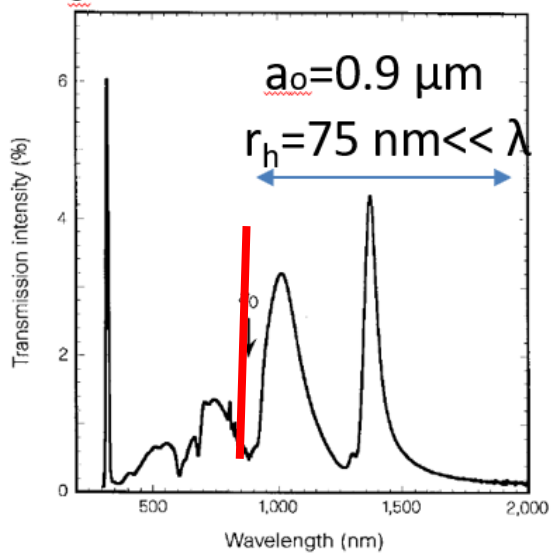
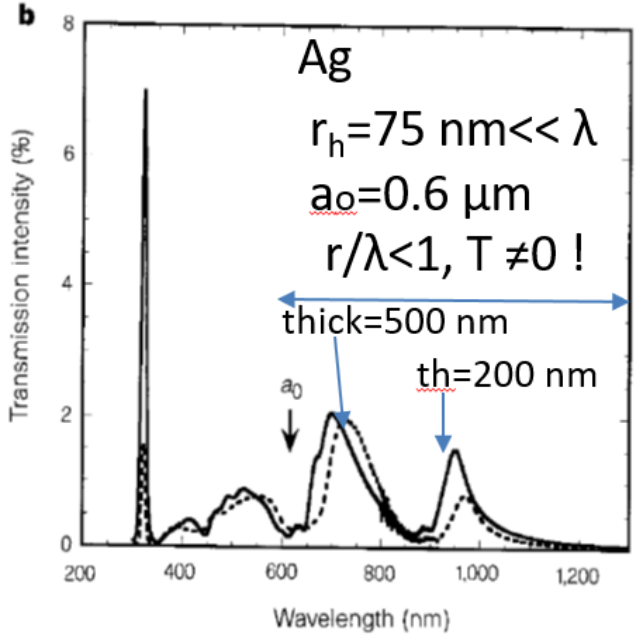
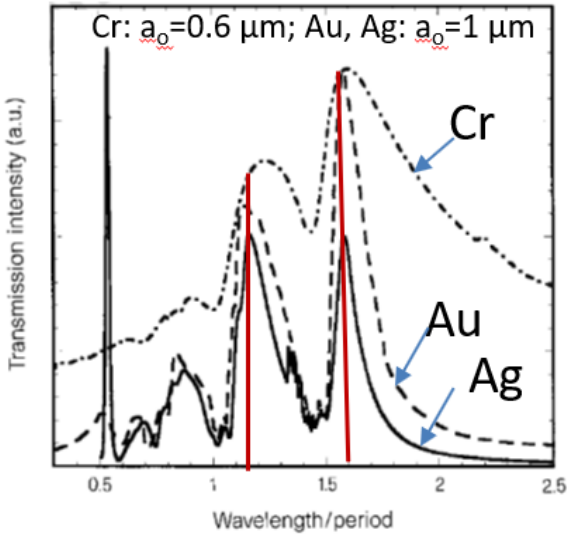


Figure 1 Zero-order transmission spectrum of an Ag array ($a_0 = 0.9\,\mu m$, $d = 150\,nm$, $t = 200\,nm$).

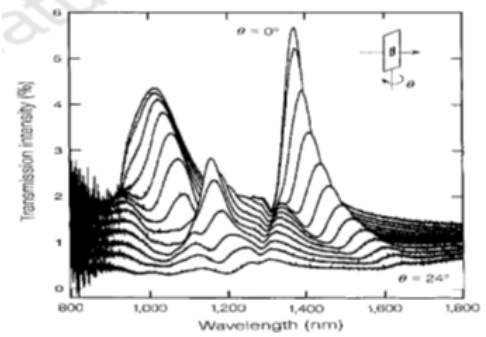




a_o determines maxima !

Transmission efficiency=η=fraction of light transmitted/
fraction of surface occupied by the holes=2 !
Hole array : Active device !
Bethe : $\eta=10^{-3}$

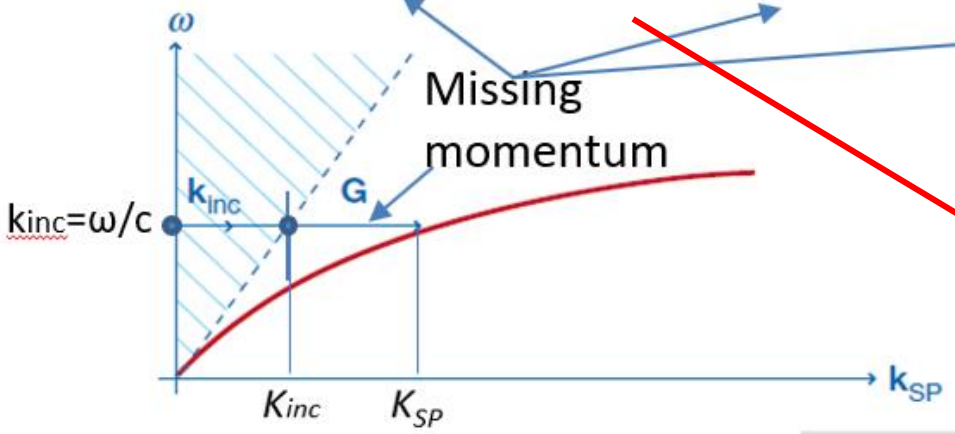
T.W. Ebbesen, et al, Nature, vol. 391, 12 Feb 1998

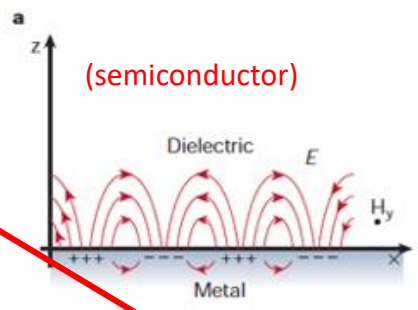


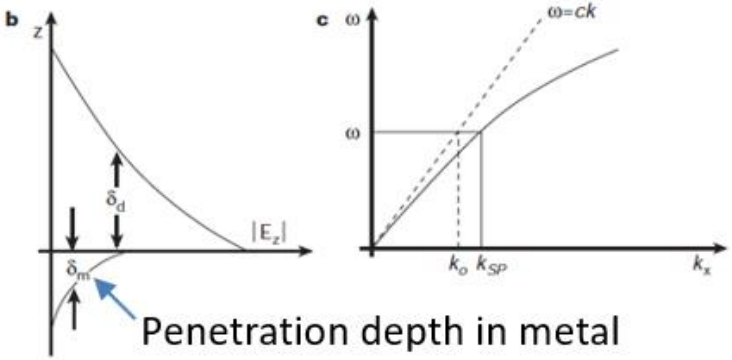
Incidence angle changes T !

Design of periodicity of the grating

Prism, topological defect (subwavelength hole), periodic corrugation of metal surface







Surface plasmon momentum $=\hbar * K_{SP}$

$$k_{SP} = \frac{\omega}{c}\sqrt{\frac{\varepsilon_m \varepsilon_d}{\varepsilon_m + \varepsilon_d}} = \hbar * K_{inc}$$

Incident photon momentum

$K_{inc} = (\omega/c)\sin\theta = (2\pi/\lambda)\sin\theta$

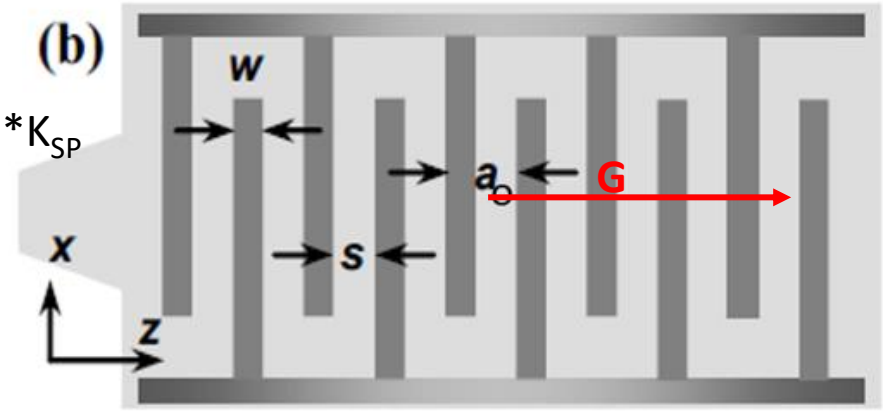
Grating momentum

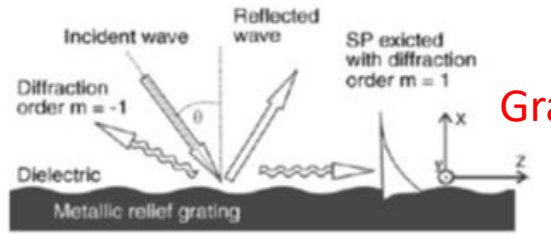
$G = m * 2\pi/a_o = \hbar * G$

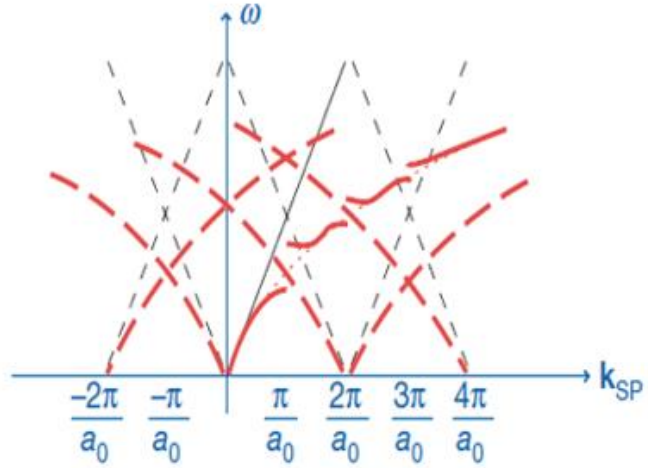
m=integer =diffraction order

Momentum conservation:

$K_{SP} = K_{inc} + G$

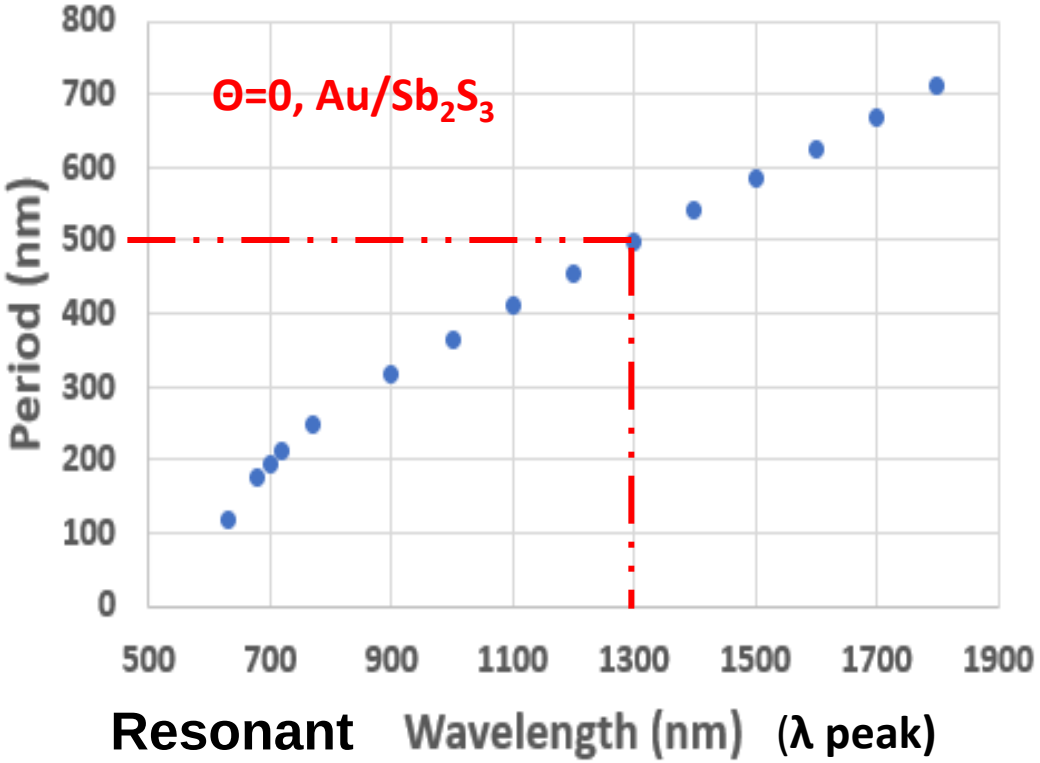


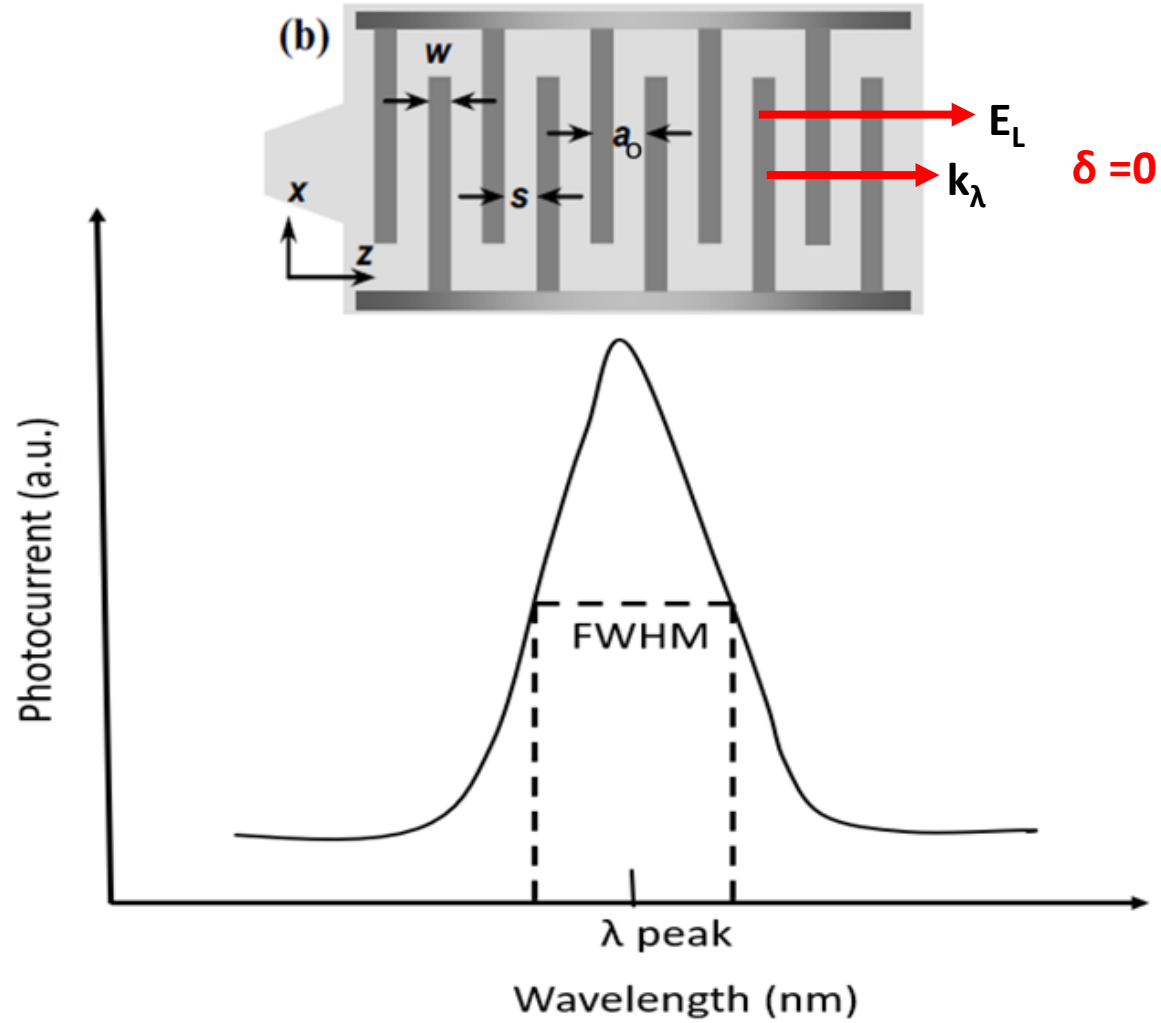




Grating Period=a_o=W+S

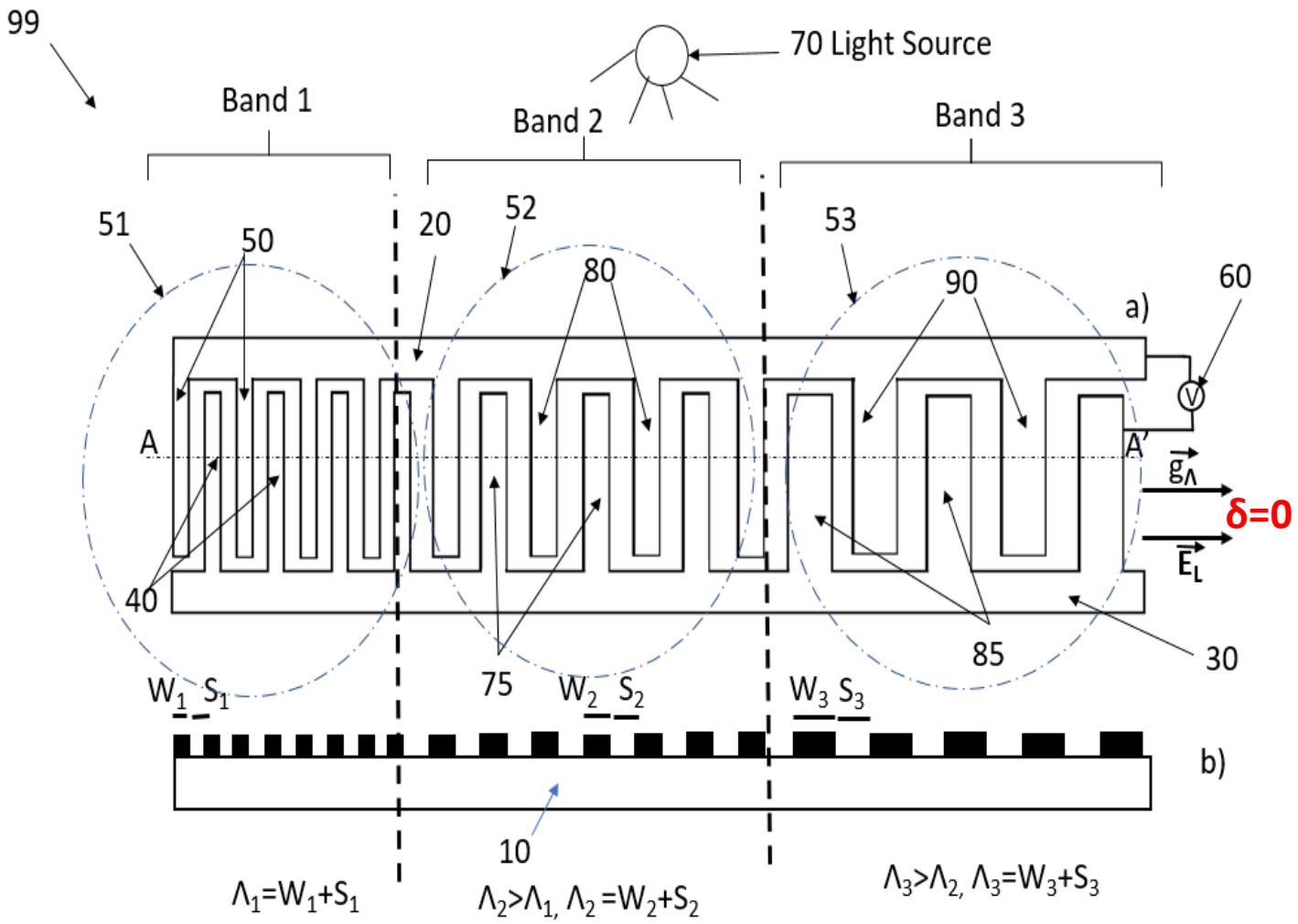
Single-band single-polarization plasmonic solar cell



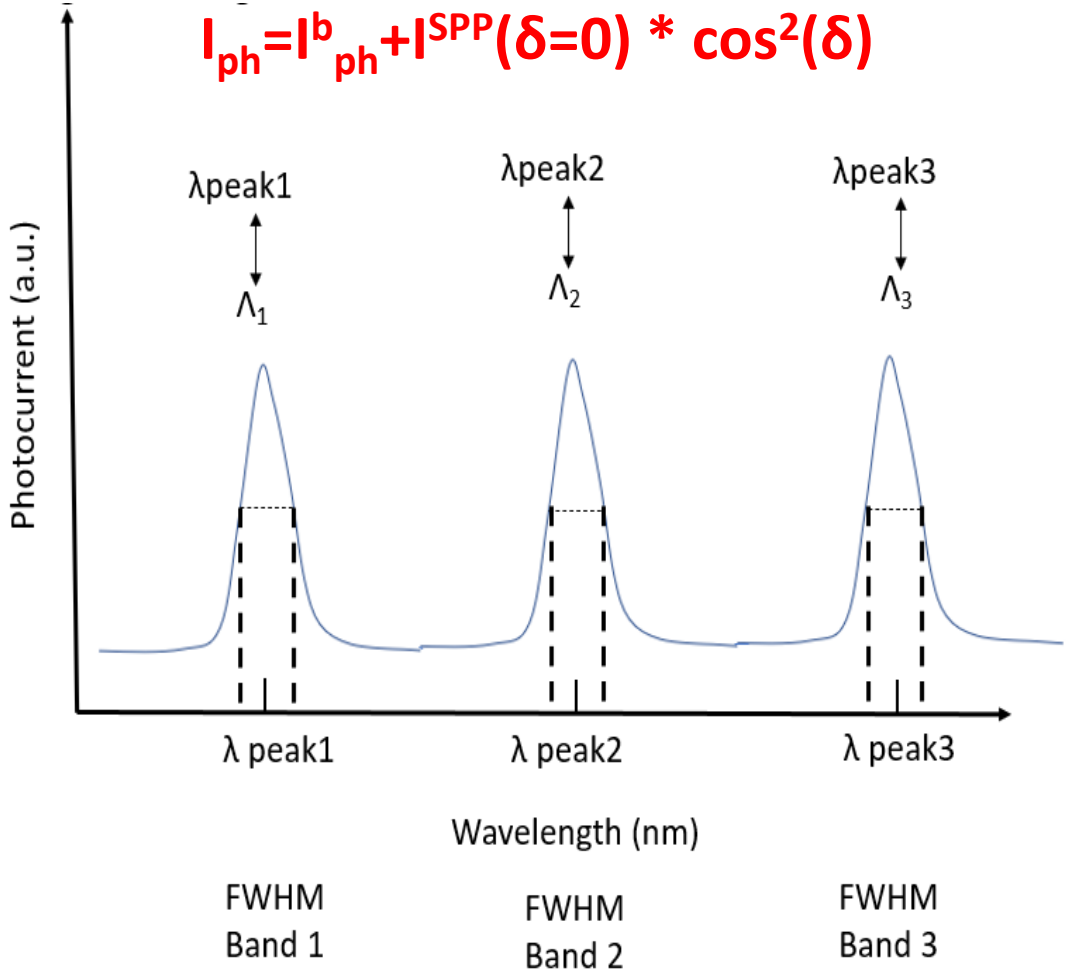


$$I_{ph}=I^{b}_{ph}+I^{SPP}(\delta=0) * \cos^2(\delta)$$

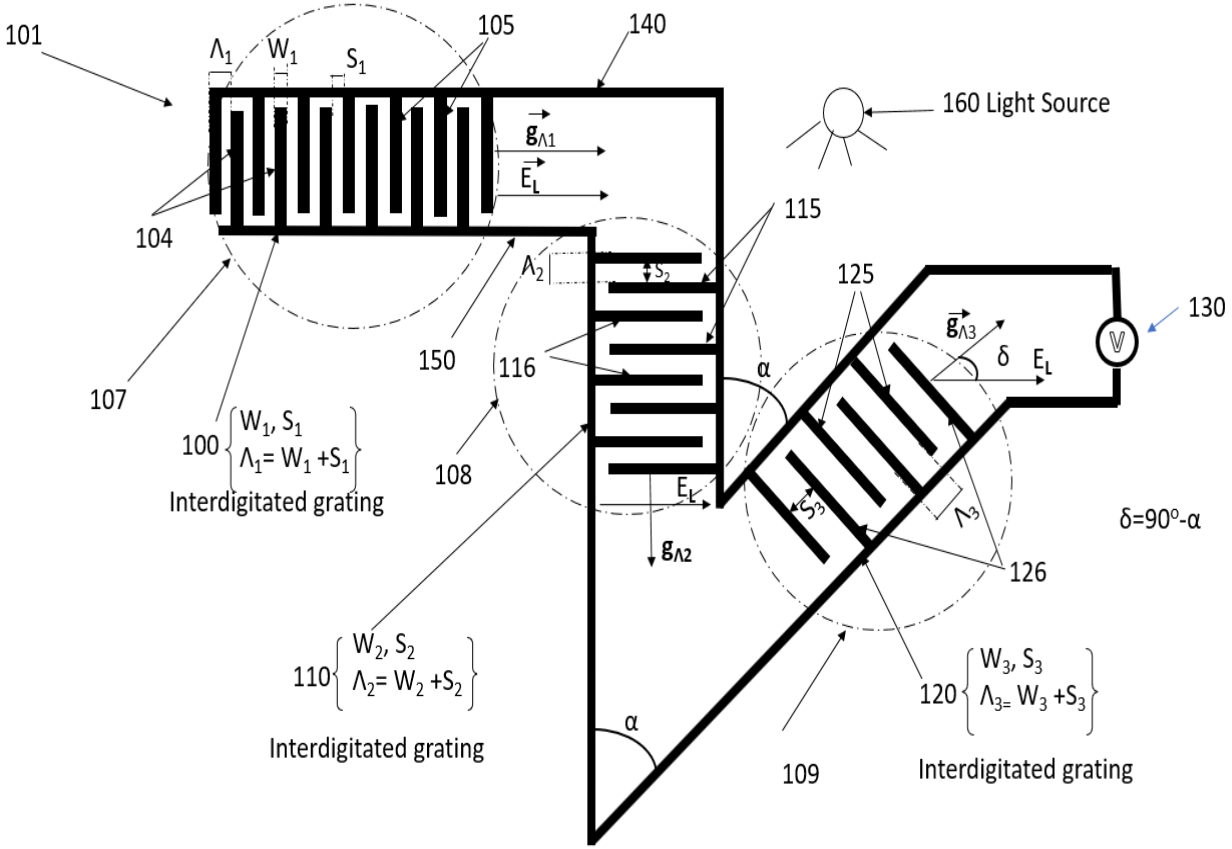
Multiband single-polarization plasmonic solar cell

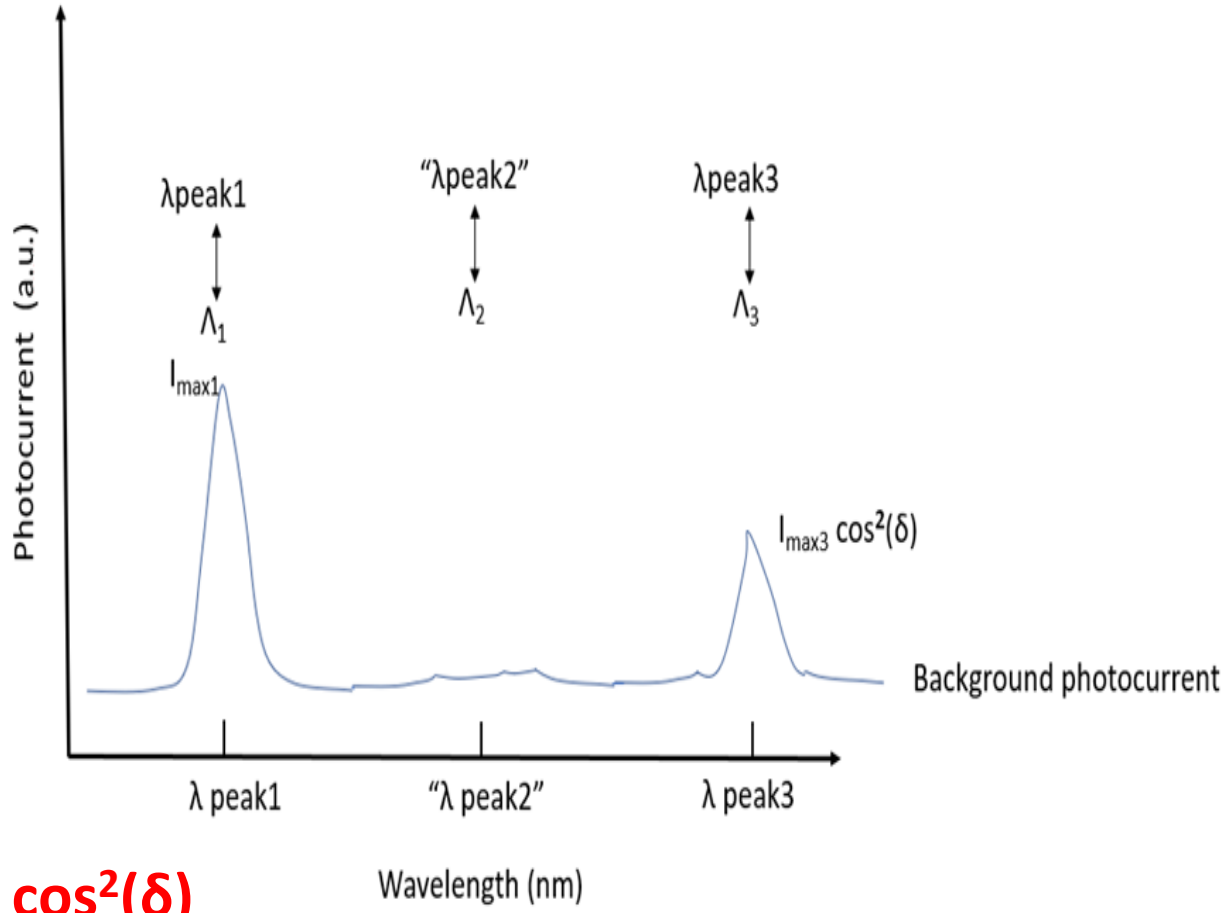


$$I_{ph}=I^{b}_{ph}+I^{SPP}(\delta=0) * \cos^2(\delta)$$



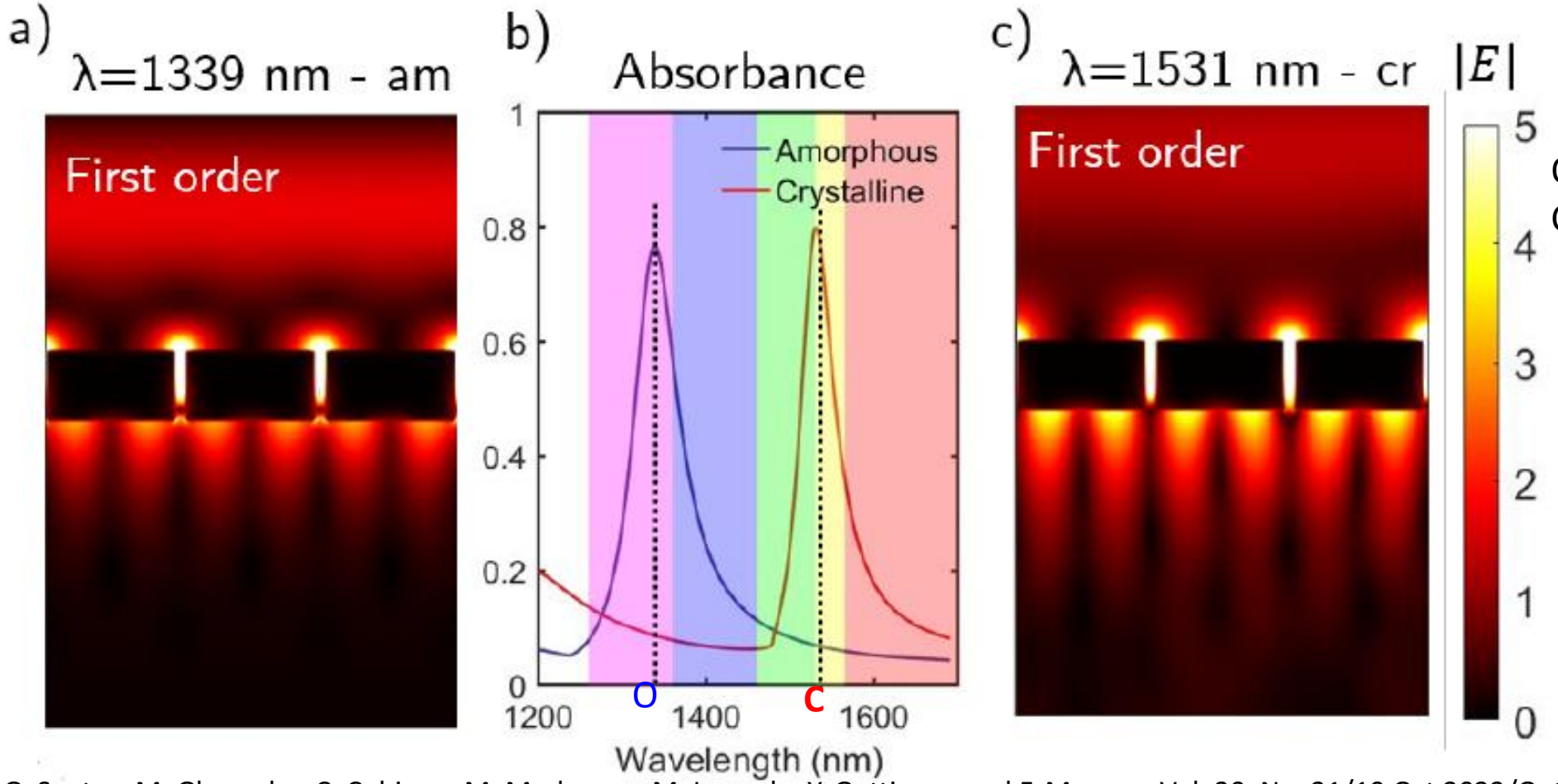
Multiband multi-polarization plasmonic solar cell





$$I_{ph}=I^{b}_{ph}+I^{SPP}(\delta=0) * \cos^2(\delta)$$

Numerical simulation of evanescent electric field distribution and absorption of NIR light in Au/Sb_2S_3 photodetector



O band: 1260-1360 nm

C band: 1530-1565 nm

G. Santos, M. Gheorghe, C. Cobianu, M. Modreanu, M. Losurdo, Y. Guttierez, and F. Moreno, Vol. 30, No. 21/10 Oct 2022/Optics Express 38954

A novel concept of self-powered plasmonic nanosystem for light detection

Cornel Cobianu[1,2], Marin Gheorghe[1] and Mircea Modreanu[3]

[1] NANOM MEMS, Râșnov, Romania,
[2] Academy of Romanian Scientists,
[3] University College Cork, Tyndall National Institute, Ireland

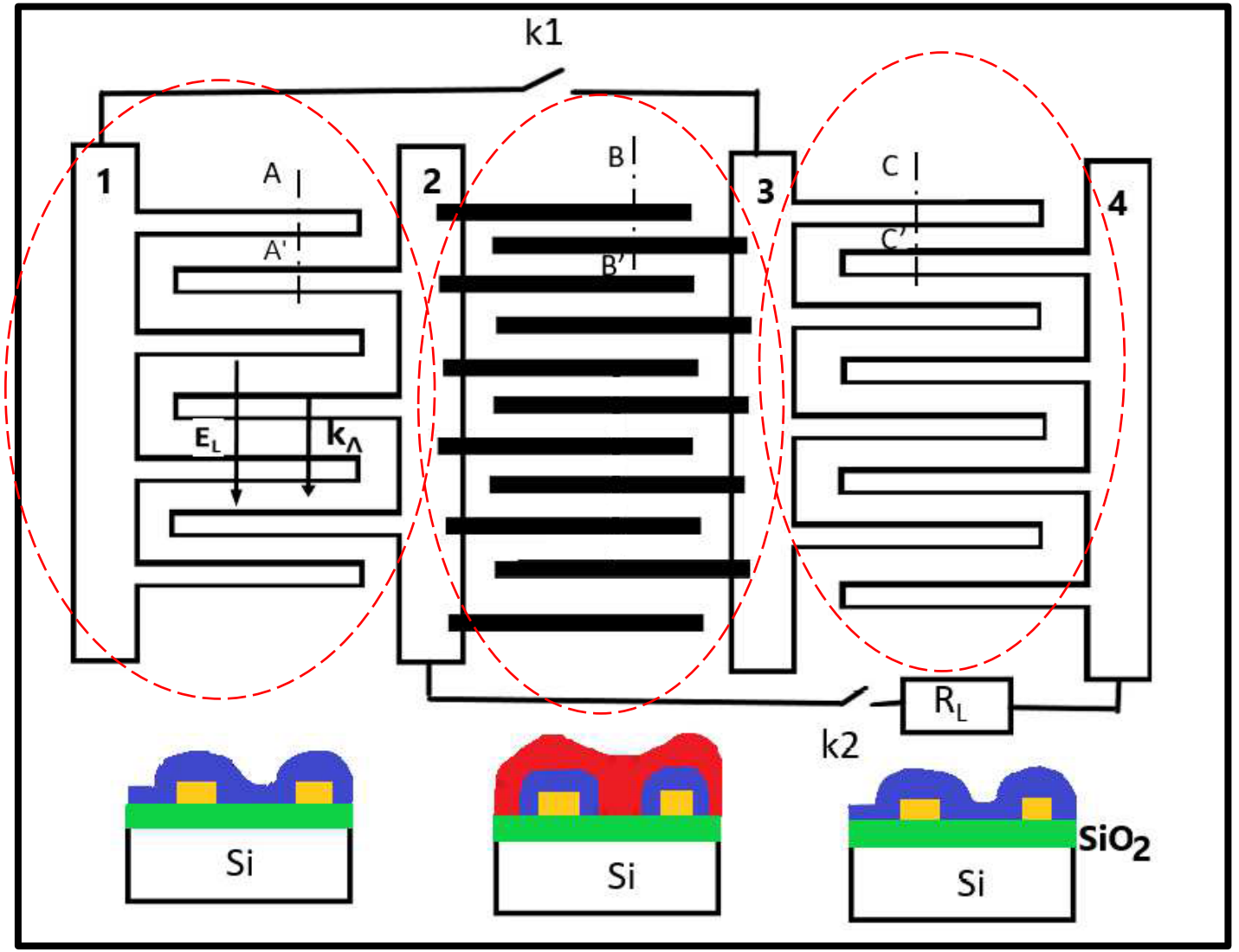
Top view of the generic layout of the novel self-powered plasmonic nanosystem

1-2: Plasmonic, MSM solar cell
Au/Ti –Sb_2S_3 Schottky contact
(yellow)-(blue)

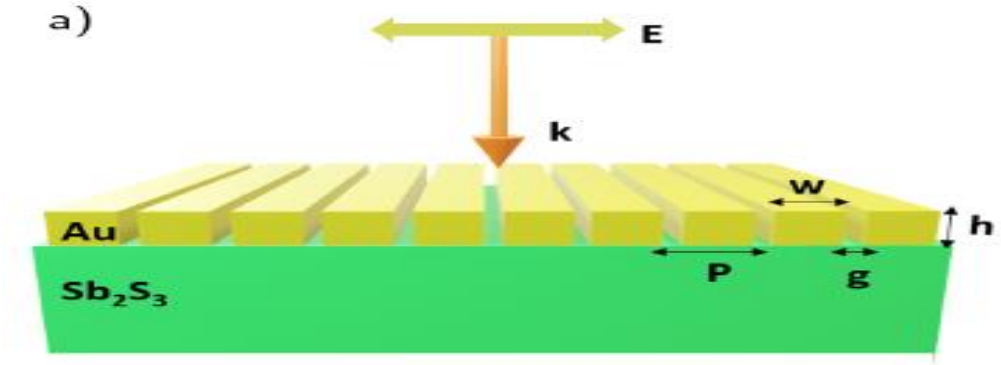
2-3: Solid-state microsupercapacitor
Au/Ti=current collector-yellow
Sb2S3=electroactive electrode-blue
(PVA)-NaOH=quasi-solid state electrolyte-red

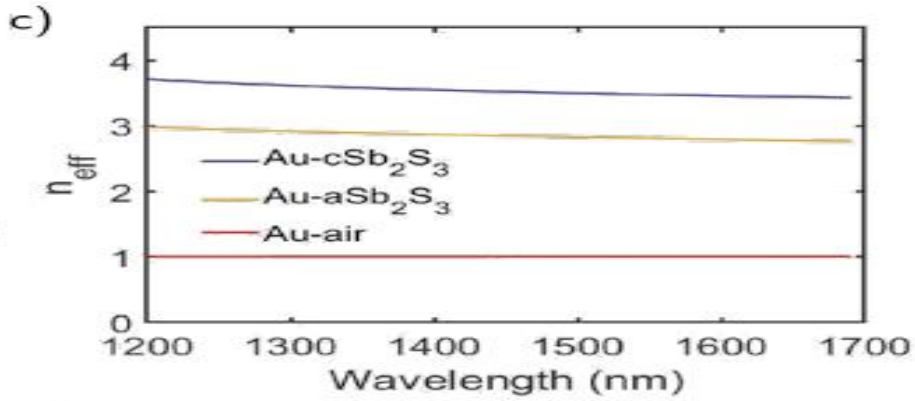
3-4: Plasmonic MSM photodetector
Au/Ti–Sb_2S_3 Schottky contact
(yellow)-(blue)

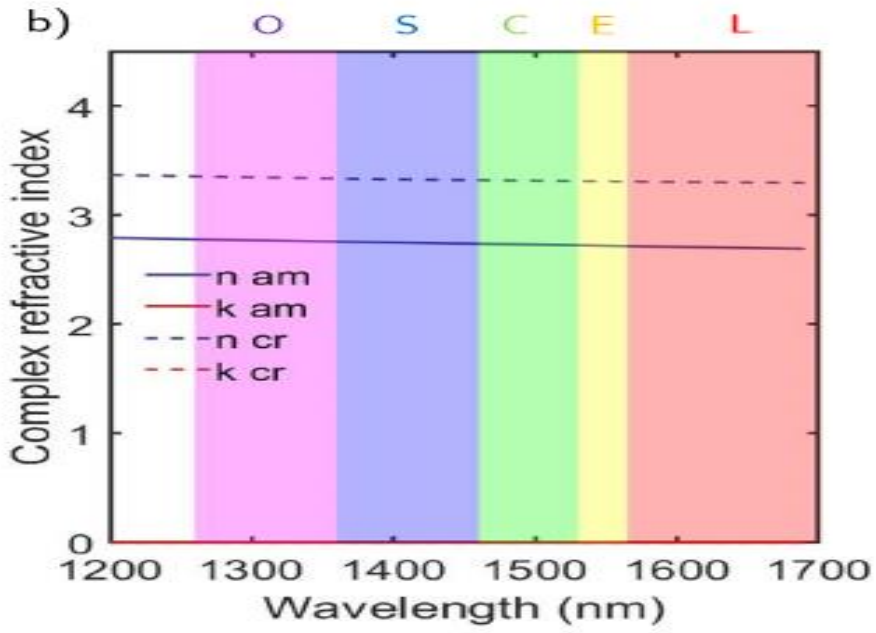
Three-mask technological process !

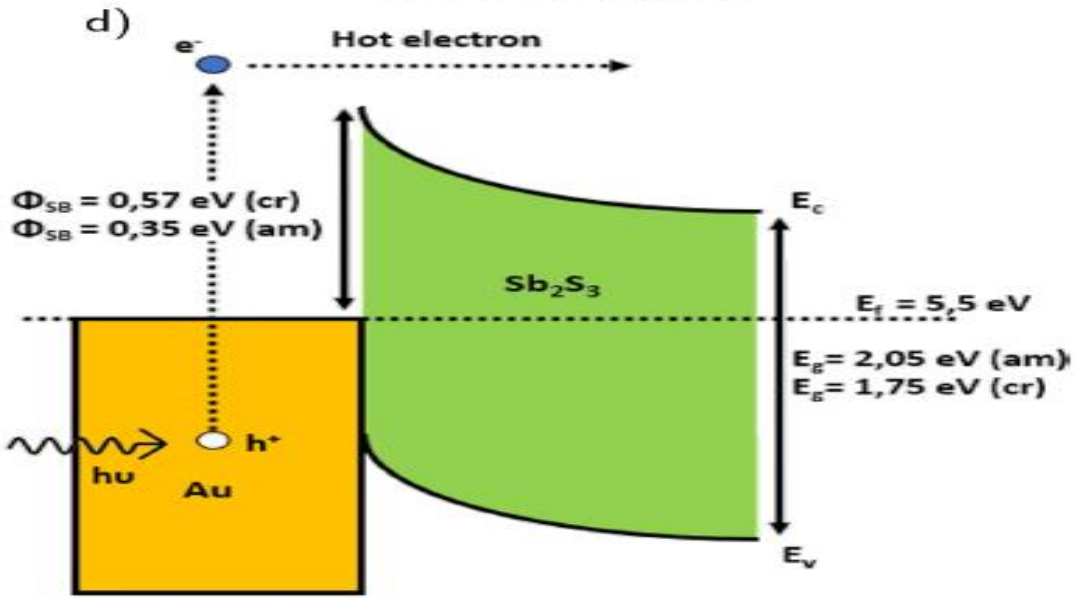


Modeling of Au/Sb_2S_3 hot electron plasmonic MSM Schottky photodetector for IR light









G. Santos, M. Gheorghe, C. Cobianu, M. Modreanu, M. Losurdo, Y. Guttierez, and F. Moreno, Vol. 30, No. 21/10 Oct 2022/Optics Express 38954

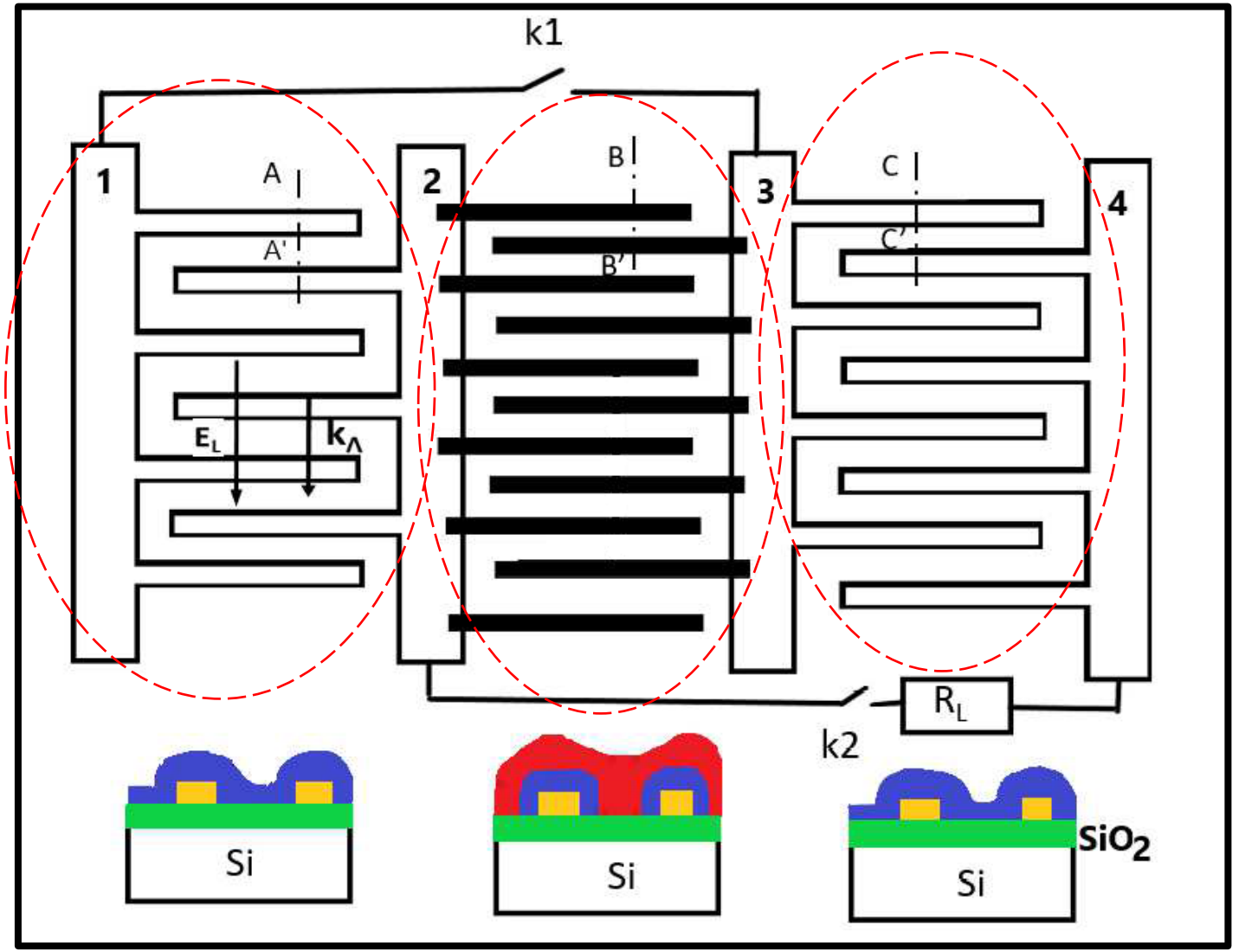
Top view of the generic layout of the novel self-powered plasmonic nanosystem

1-2: Plasmonic, MSM solar cell
Au/Ti –Sb_2S_3 Schottky contact
(yellow)-(blue)

2-3: Solid-state microsupercapacitor
Au/Ti=current collector-yellow
Sb2S3=electroactive electrode-blue
(PVA)-NaOH=quasi-solid state electrolyte-red

3-4: Plasmonic MSM photodetector
Au/Ti–Sb_2S_3 Schottky contact
(yellow)-(blue)

Three-mask technological process !



Conclusions

1. Self-powered wireless nanosystems based on multifunctional Sb_2S_3 can be obtained by a simple three-mask process !

2. Innovative design techniques can minimize the wavelength and polarization sensitivity of the photonic devices.

3. Multiband multipolarization plasmonic solar cell and photodetectors open the way to new photonic devices

Acknowledgments

This work has received funding from the European Union's research and innovation programme under grant agreement No. 951761.

Thank you for your attention !

“1 Decembrie 1918” University of Alba Iulia
Romania, Center Region

About the organisation: ”1 Decembrie 1918” University of Alba-Iulia (UAB) is one of 34 universities included in U-Multirank for Romania. UAB is a midsize public university with 4660 students enrolled (2021 data). UAB graduation rate is 51,07 for bachelors (D score) and 94,52 for masters (B score).

R&D activities

In recent years, UAB has been involved in many projects with various funding: H2020, COST, UEFISCDI, CNFIS, s.a. The most relevant RDITT grants are:

“Intelligent system based on machine learning and artificial vision to optimize the porcelain manufacturing flow”; “Computational models for color reproduction in ceramic products” (PN-III-2018)

“Innovative technologies for advanced recovery of waste materials from computer and telecommunications equipment” (PN-III-2019)

“Multi-source Big Data Fusion Driven Proactivity for Intelligent Mobility-OPTIMUM” H2020

Other important ITT information:

- UAB has several contracts with multinational companies located in the central region (especially in the automotive industry):

-Development of an automatic washing machine control system – with MIELE Technika Brasov/ 2018

-Experimental measurements for evaluating the level of electromagnetic field radiation in the indicated locations and their interpretation – with Siemens SIMEA Sibiu / 2019

-DFMEA Design and FMEDA- element diagnose analyse for Body control module C1_HS - with Continental Automotive Systems Sibiu/ 2020

CENTER FOR RESEARCH IN ELECTRONIC SYSTEMS AND INTELLIGENT CONTROL (SECI)

University "December 1, 1918" from Alba Iulia

- Presentation
- Regulation of organization and functioning
  - Regulation of organization and functioning
- Structure
  - Mathematical Modeling and Simulation Collective
  - Electronic Systems Collective
  - Computational Intelligence Collective
- Research plan
  - 2019-2020
- project
  - unroll
  - In progress
- Contact

Projects carried out

PNCDI III	Program 2, Subprogramme 2.1, Demonstration experimental project	**PN-III-P2-2.1-PED-2016-1835 "Computational models for color reproduction in ceramic products (Acronym: CMRCC) "**	483,838.00 lei	Professor Breaz Valer Daniel
PNCDI III	**Program 2 - Increasing the competitiveness of the Romanian economy through research, development and innovation. Transfer of knowledge to the economic agent "Bridge Grant"**	**50BG/2016 Intelligent system based on machine learning and artificial vision for the optimization of porcelain manufacturing flow (SIVAP)**	456,320 lei	Assoc Bîrlutiu Adriana
H2020	H2020- RFCR-CT-2015-00003	Bucket wheel excavators operating under difficult mining conditions including unmineable inclusions and geological structures with excessive mining resistance - BEWEXMIN	8000000 lei	Assoc Rîșteiu Mircea
Contract No. 87/20.10.2017	Contract with third parties	Experimental measurements for evaluating the level of electromagnetic field radiation in the indicated locations and their interpretation.	11000 lei	Professor Trouble Adrian

Center for Technology Transfer at UAB

- After PhD and R&D engineer position

at RWE Solutions GmbH in Germany, I work as a university professor at UAB in the field of power electronics , electrical testing and electronic measurements.

- The CTT made over 50 energy, environment and technical audit reports in the last 20 years.

The beneficiaries of these studies are multinational companies, autonomous companies, industrial plants, residential areas and other. The concrete and valuable/quantifiable result of the energy audit is materialized in analysis of energy flow, structure of energy consumption and action plan proposals for measures on energy saving in industrial areas.

ROMÂNIA
MINISTERUL CERCETĂRII, INOVĂRII ȘI DIGITALI

CERTIFICAT DE ACREDITARE

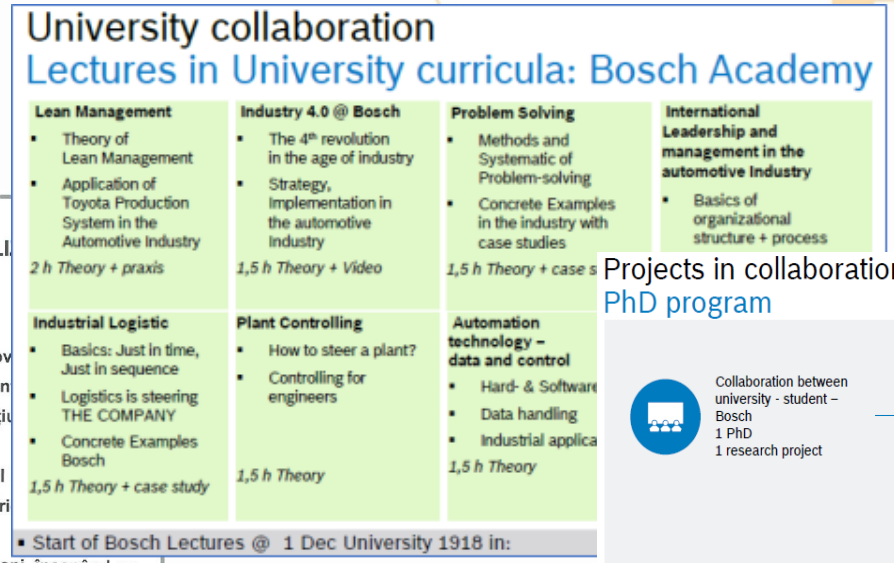
Se acreditează și se acordă titlul de entitate din infrastructura de inov tehnologic pentru "Centrul pentru transfer tehnologic – CTT-UAB", ca cen tehnologic în domeniile: Tehnologia informațiilor și a comunicațiilor, spați Energie, mediu și schimbări climatice, Automotive și mecatronică.

Entitatea este constituită ca structură fără personalitate juridică în cadrul decembrie 1918" din Alba Iulia, cu sediul în localitatea Alba Iulia, strada Gabri jud. Alba, Cod Unic de Înregistrare 5665935, din data de 20.05.1994.

Prezentul CERTIFICAT DE ACREDITARE se acordă pentru o perioadă de 5 ani, începând cu data aprobării Ordinului emis de MINISTRUL CERCETĂRII, INOVĂRII ȘI DIGITALIZĂRII.

MINISTRU,
CIPRIAN SERGIU TELEMAN

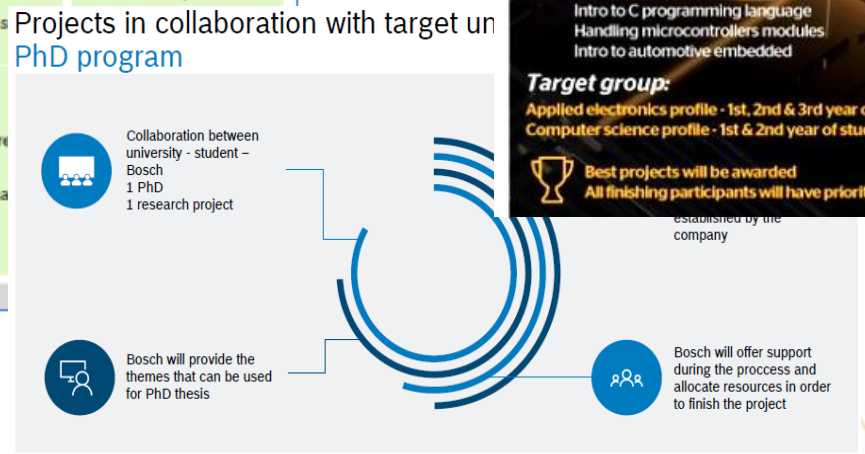
Nr. 121/2021, București



University collaboration
Lectures in University curricula: Bosch Academy

Lean Management ▪ Theory of Lean Management ▪ Application of Toyota Production System in the Automotive Industry *2 h Theory + praxis*	**Industry 4.0 @ Bosch** ▪ The 4th revolution in the age of industry ▪ Strategy, Implementation in the automotive Industry *1,5 h Theory + Video*	**Problem Solving** ▪ Methods and Systematic of Problem-solving ▪ Concrete Examples in the industry with case studies *1,5 h Theory + case s*	**International Leadership and management in the automotive Industry** ▪ Basics of organizational structure + process
Industrial Logistic ▪ Basics: Just in time, Just in sequence ▪ Logistics is steering THE COMPANY ▪ Concrete Examples Bosch *1,5 h Theory + case study*	**Plant Controlling** ▪ How to steer a plant? ▪ Controlling for engineers *1,5 h Theory*	**Automation technology – data and control** ▪ Hard- & Software ▪ Data handling ▪ Industrial applica *1,5 h Theory*	

▪ Start of Bosch Lectures @ 1 Dec University 1918 in:



Projects in collaboration with target un
PhD program

Collaboration between university - student – Bosch
1 PhD
1 research project

Bosch will provide the themes that can be used for PhD thesis

Bosch will offer support during the proccess and allocate resources in order to finish the project

Embedded Project by Continental Sibiu

Build a fully functional automotive door control module
- learn how to & program the entire framework step-by-step
- all projects will be tested on a real environment (car door)

You will get the chance to learn about:
Basic electronic circuits understanding
Input circuits, power supplies, DC motor, output circuits (drivers)
Microcontroller programming
Intro to C programming language
Handling microcontrollers modules
Intro to automotive embedded

Target group:
Applied electronics profile - 1st, 2nd & 3rd year of studies
Computer science profile - 1st & 2nd year of studies

Best projects will be awarded
All finishing participants will have priority in accessing Continental's Internship Program 2023

Project starts on November 11th

National Institute for Research and Development in Chemistry and Petrochemistry

ICECHIM Bucharest, Romania

PRIOCHEM XVIII

Round Table **Make Innovation Happen** – 26th of October 2022, Bucharest, Romania

About us

- Established in 1948 as the *Chemical Enterprises for Research, Design and Semi-Industrial Production (*ICEPS) and went through different reorganization processes. **Over 70 years of experience**.

Acad. **Costin D. Nenițescu**

- The **National Institute for R&D in Chemistry and Petrochemistry ICECHIM** Bucharest, Romania, was established by Government Decision no. 293 / 04.03.2004

- Currently a total staff of about 160 employees:

~**120** researchers / **75** Ph.D. / **7** Ph.D. supervisors (Dr.Habilitat)

Main player in the Romanian R&D *and* strategic partner of the European Research Consortia

Applied research projects in areas:

- Bioeconomy
- IT&C
- Space and security
- Energy, environment and climate changes
- Eco-nano-technologies and advanced materials
- Health
- Heritage and cultural identity
- New and emerging technologies

with a multitude of:

- published research works
- granted and requested invention patents
- *as well as* technologies transferred into industry

Main areas of activity

Applied research for the **development of new products** and **technologies** in the following areas:

- Capitalization of bioresources
- Nanosciences and nanomaterial
- Environmental protection and sustainable management of resources
- Recovery, recycling and capitalization of by-products
- *Increasing the competitiveness of industrial products*
- *Refurbishment and revitalization of the Romanian chemical and petrochemical industry*

30 Products
27 Technologies
2 Technological services

30 Patent applications
18 Granted patents

43 Award-winning participation in international invention and innovation fairs and exhibitions (2021)

Infrastructure

- State-of-the-art *equipment* and *accredited laboratories for chemical analysis (RENAR)* of water, wastewater, emissions, fertilizers, biocides, waste etc.

- Part of EERIS Engage in the European Research Infrastructures System

https://eeris.eu/erio-2000-000u-0181

List of infrastructures

https://eeris.eu/erio-2000-000u-0181

RESEARCH CENTER FOR PRODUCING, CONDITIONING AND CHARACTERIZATION OF ADVANCED MATERIALS
17 Services · 25 Equipment · 8 Experts

RESEARCH INFRASTRUCTURE FOR CIRCULAR AGRO-BIOECONOMY – AGRI-FLUX.
6 Services · 49 Equipment · 6 Experts

LABORATORY FOR PHYSICO-CHEMICAL CHARACTERIZATION AND CONFORMITY ASSESSMENT FERTILIZERS, SOIL AMENDMENTS AND SOIL IMPROVERS.
2 Services · 4 Equipment · 1 Experts

EMERGING NANOTECHNOLOGIES GROUP
8 Services · 32 Equipment · 7 Experts

LABORATORY FOR CONFORMITY ASSESSMENT OF ENVIRONMENT: EMISSIONS, IMMISSION, WATER AND WASTE.
7 Services · 23 Equipment · 2 Experts

BIOTECHNOLOGY, BIOASSAYS AND BIOSENSORS LABORATORY (part of RORIC-NEXT-BIONAN)
8 Services · 35 Equipment · 3 Experts

LABORATORY FOR PHYSICO-CHEMICAL CHARACTERIZATION, ANALYSIS AND TESTING OF MICRO- AND NANOSTRUCTURED HYBRID MATERIALS
5 Services · 8 Equipment · 5 Experts

RESEARCH LABORATORY FOR FUNCTIONAL DYES AND RELATED MATERIALS
3 Services · 6 Equipment · 2 Experts

The Research Center for Alternative Bioresources and Biofuels – BIORES
13 Services · 25 Equipment · 15 Experts

APPLIED RESEARCH INFRASTRUCTURE FOR EVALUATION AND CONSERVATION OF CULTURAL HERITAGE
3 Services · 27 Equipment · 13 Experts

EXCELLENCE CENTRE FOR POLYMER NANOCOMPOSITES
0 Services · 17 Equipment · 0 Experts

icechim.ro/en/

National Institute for Research & Development in Chemistry and Petrochemistry

ICECHIM

ROMANIAN

ANELIS PLUS

SEARCH

HOME INSTITUTE RESEARCH AREAS R&D GROUPS RESULTS CAREER SERVICES NEWS AND LINKS CONTACT

Organization

The National Institute for Research & Development in Chemistry and Petrochemistry – ICECHIM Bucharest is one of the major research entities in Romania, being involved in all fields of chemistry.

MORE

Management and personnel

MORE

History

In 1948, at the initiative of the professors from the Department of Organic Chemistry (Polytechnic School of Bucharest), department led by Professor Costin D. Nenițescu, the Chemical Enterprises for Research, Design and Semi-Industrial Production (ICEPS)

Technological Transfer Centre

ICECHIM's Technological Transfer Centr bridg resea busin to ap resea

National Institute for Research & Development in Chemistry and Petrochemistry

ICECHIM

ROMANIAN

ANELIS PLUS

SEARCH

We are interested in:

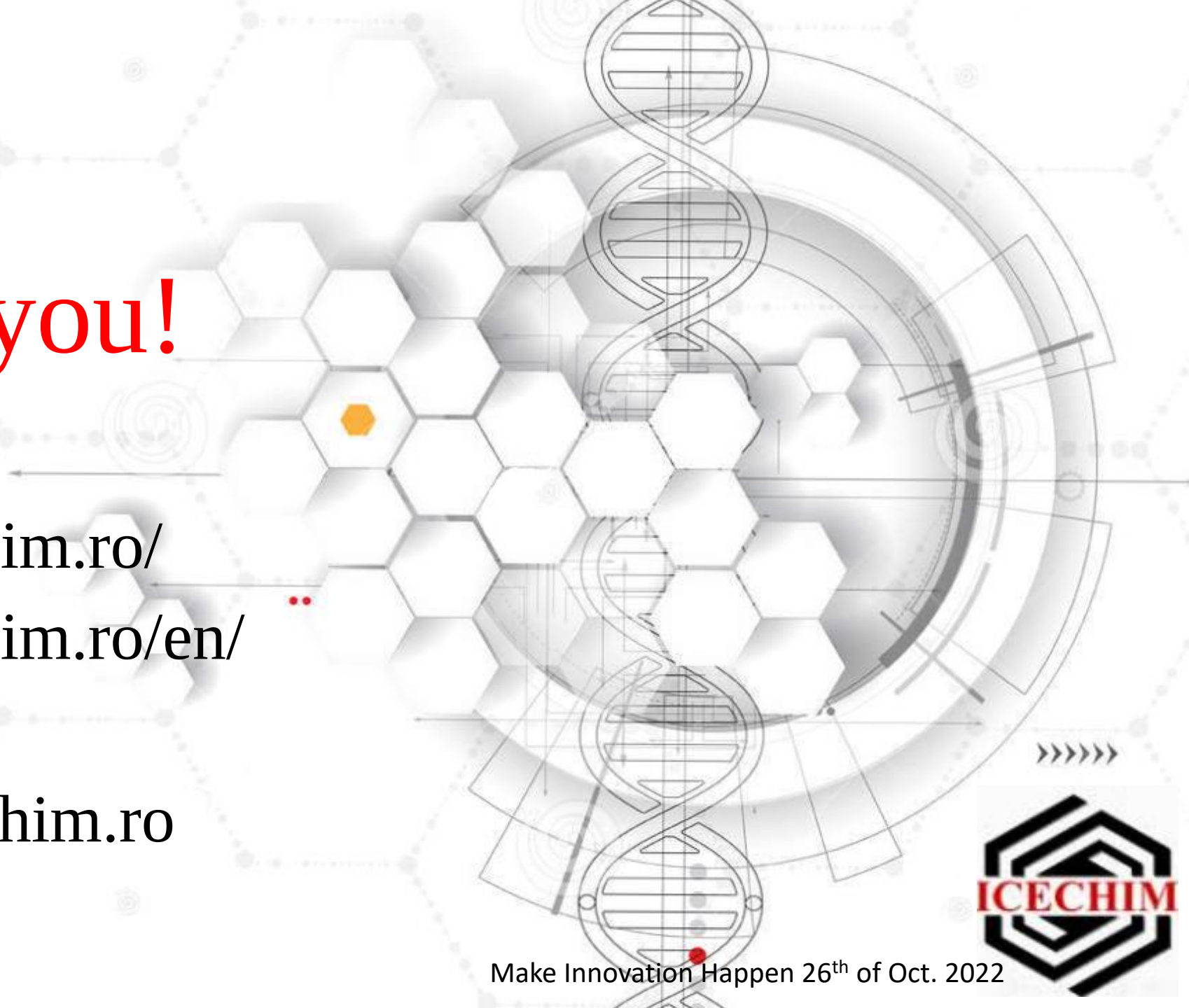
- Cooperation in EU / international projects
- Networking
- Twinning / training
- Sharing experience / good practices / lesson learned

Thank you!

https://icechim.ro/

https://icechim.ro/en/

office@icechim.ro



Design of Experiment

Best practice example from automotive for a robust design

Dr. Nicolae Varachiu, ICECHIM Bucharest, Romania

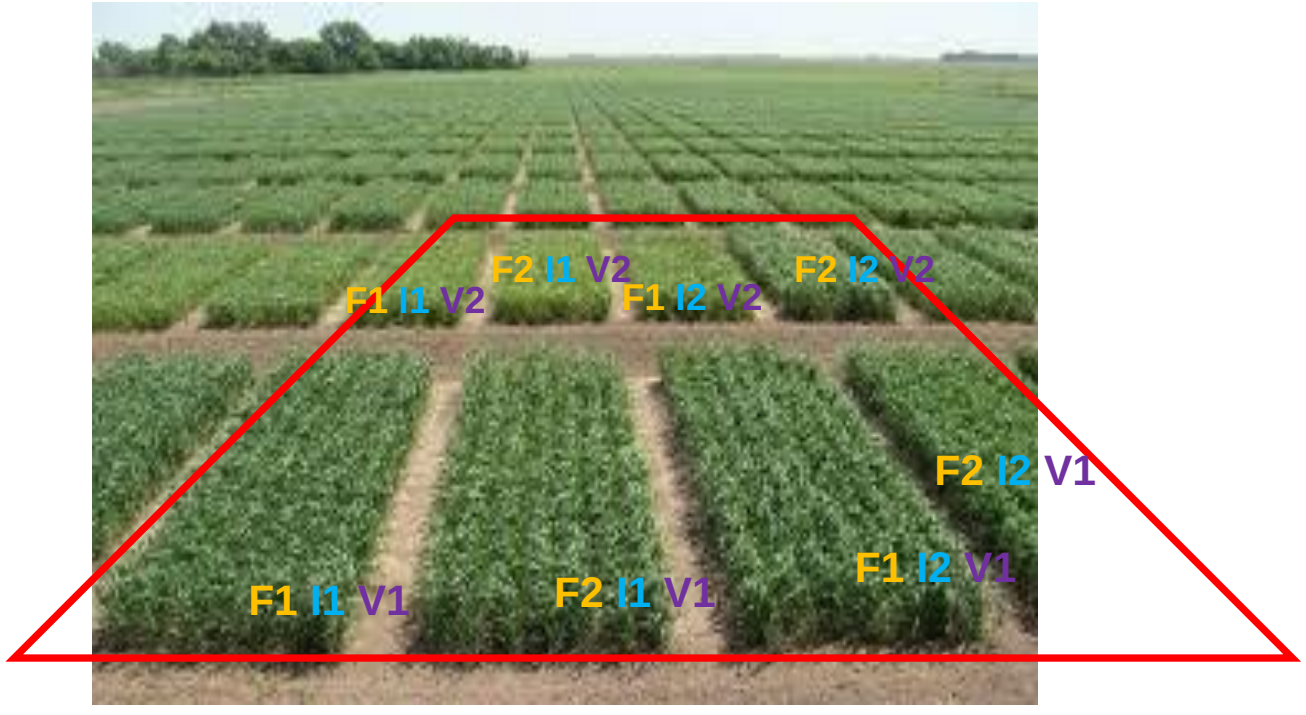
PRIOCHEM – XVIII-th Edition, 2022,

Round table **Make innovation happen,** 26th Oct 2022

Design Of Experiment – DOE

input factors considered in the experiment **are varied together** instead of just “one factor at a time-OFAT”

Together = all possible combinations of the considered input levels are considered



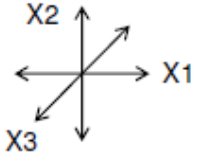
E.g. **three factors, c**onsidering **two levels** for each factor

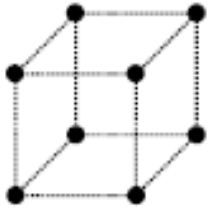
-**Fertilizer: F1 F2**

-**Irrigation: I1 I2**

-**Variety: V1 V2**

→ 2 x 2 x 2= 2^3 = 8 trials





OFAT vs **DOE**

- **three input** factors and **two levels** for each

  denoted **Low** (**L**) and **High** (**H**) respectively for each)

4 trials:

L L L
H L L
L H L
L L H

2x2x2 = 2^3 = 8 trials:

L L L
H L L
L H L
H H L
L L H
H L H
L H H
H H H

Factorial experiment capture also the **Interactions** between inputs

(standard order)

Design of Experiment plan:

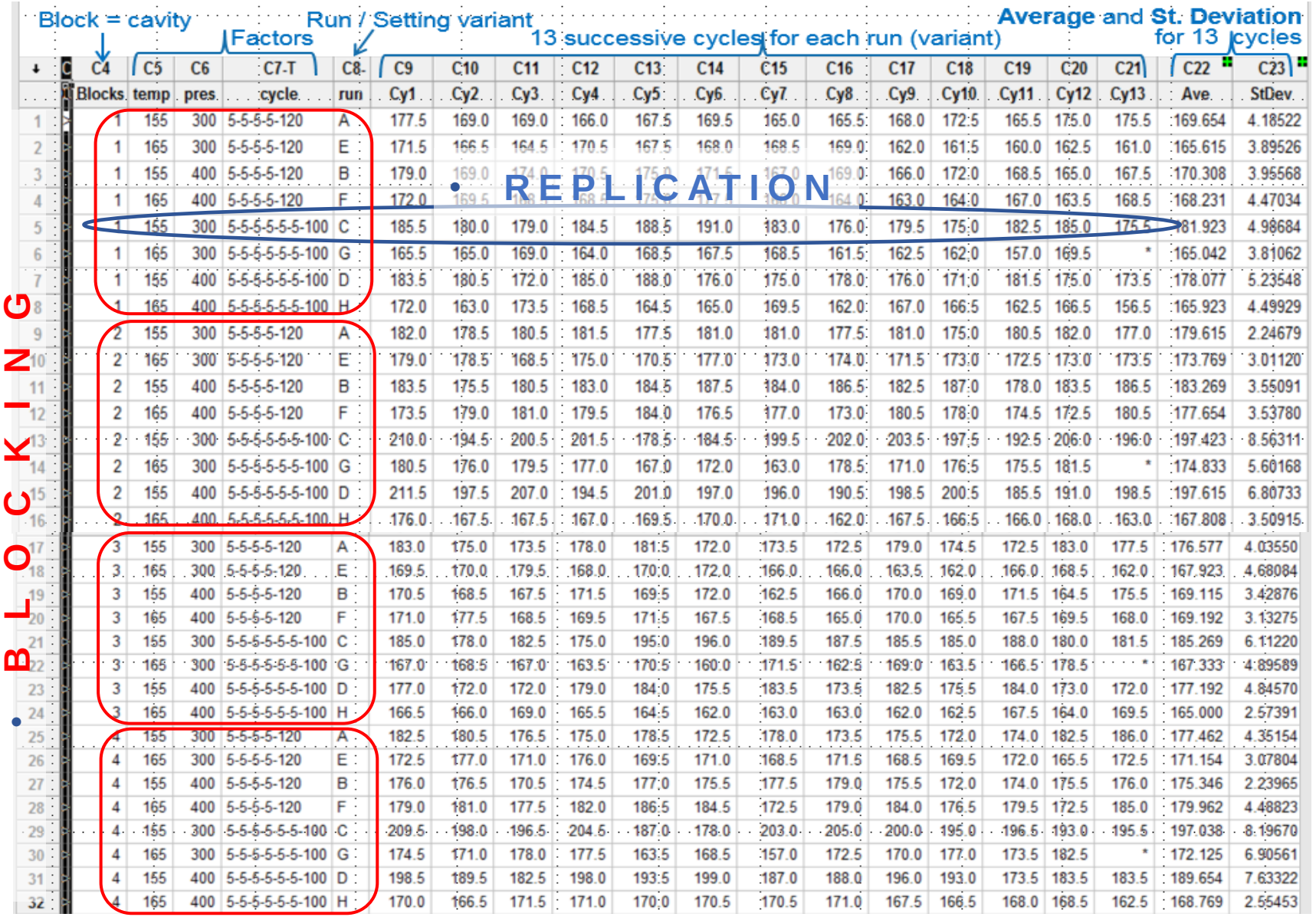
- Input factors settings:

1. **Pressure**
   Low = 300 kPa;
   High = 400 kPa
2. **Cycle** *(attribute data)*
   Low = 5-5-5-5-120
   High = 5-5-5-5-5-5-100
3. **Temperature**
   Low = 155 ºC
   High = 165 ºC

- Outputs: Average &
  St. Deviation *of*
  Compressibility

Run variant	Pressure [KPa]	Cycle	Temp. [ºC]
A	300	5-5-5-5-120	155
B	400	5-5-5-5-120	155
C	300	5-5-5-5-5-5-100	155
D	400	5-5-5-5-5-5-100	155
E	300	5-5-5-5-120	165
F	400	5-5-5-5-120	165
G	300	5-5-5-5-5-5-100	165
H	400	5-5-5-5-5-5-100	165

DOE trials



	C4	C5	C6	C7-T	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23
	Blocks	temp	pres	cycle	run	Cy1	Cy2	Cy3	Cy4	Cy5	Cy6	Cy7	Cy8	Cy9	Cy10	Cy11	Cy12	Cy13	Ave	StDev
1	1	155	300	5-5-5-5-120	A	177.5	169.0	169.0	166.0	167.5	169.5	165.0	165.5	168.0	172.5	165.5	175.0	175.5	169.654	4.18522
2	1	165	300	5-5-5-5-120	E	171.5	166.5	164.5	170.5	167.5	168.0	168.5	169.0	162.0	161.5	160.0	162.5	161.0	165.615	3.89526
3	1	155	400	5-5-5-5-120	B	179.0	169.0	174.0	170.5	175.0	171.5	167.0	169.0	166.0	172.0	168.5	165.0	167.5	170.308	3.95568
4	1	165	400	5-5-5-5-120	F	172.0	169.5	168.5	176.5	167.5	169.0	164.0	164.0	163.0	164.0	167.0	163.5	168.5	168.231	4.47034
5	1	155	300	5-5-5-5-5-5-100	C	185.5	180.0	179.0	184.5	188.5	191.0	183.0	176.0	179.5	175.0	182.5	185.0	175.5	181.923	4.98684
6	1	165	300	5-5-5-5-5-5-100	G	165.5	165.0	169.0	164.0	168.5	167.5	168.5	161.5	162.5	162.0	157.0	169.5	*	165.042	3.81062
7	1	155	400	5-5-5-5-5-5-100	D	183.5	180.5	172.0	185.0	188.0	176.0	175.0	178.0	176.0	171.0	181.5	175.0	173.5	178.077	5.23548
8	1	165	400	5-5-5-5-5-5-100	H	172.0	163.0	173.5	168.5	164.5	165.0	169.5	162.0	167.0	166.5	162.5	166.5	156.5	165.923	4.49929
9	2	155	300	5-5-5-5-120	A	182.0	178.5	180.5	181.5	177.5	181.0	181.0	177.5	181.0	175.0	180.5	182.0	177.0	179.615	2.24679
10	2	165	300	5-5-5-5-120	E	179.0	178.5	168.5	175.0	170.5	177.0	173.0	174.0	171.5	173.0	172.5	173.0	173.5	173.769	3.01120
11	2	155	400	5-5-5-5-120	B	183.5	175.5	180.5	183.0	184.5	187.5	184.0	186.5	182.5	187.0	178.0	183.5	186.5	183.269	3.55091
12	2	165	400	5-5-5-5-120	F	173.5	179.0	181.0	179.5	184.0	176.5	177.0	173.0	180.5	178.0	174.5	172.5	180.5	177.654	3.53780
13	2	155	300	5-5-5-5-5-5-100	C	210.0	194.5	200.5	201.5	178.5	184.5	199.5	202.0	203.5	197.5	192.5	206.0	196.0	197.423	8.56311
14	2	165	300	5-5-5-5-5-5-100	G	180.5	176.0	179.5	177.0	167.0	172.0	163.0	178.5	171.0	176.5	175.5	181.5	*	174.833	5.60168
15	2	155	400	5-5-5-5-5-5-100	D	211.5	197.5	207.0	194.5	201.0	197.0	196.0	190.5	198.5	200.5	185.5	191.0	198.5	197.615	6.80733
16	2	165	400	5-5-5-5-5-5-100	H	176.0	167.5	167.5	167.0	169.5	170.0	171.0	162.0	167.5	166.5	166.0	168.0	163.0	167.808	3.50915
17	3	155	300	5-5-5-5-120	A	183.0	175.0	173.5	178.0	181.5	172.0	173.5	172.5	179.0	174.5	172.5	183.0	177.5	176.577	4.03550
18	3	165	300	5-5-5-5-120	E	169.5	170.0	179.5	168.0	170.0	172.0	166.0	166.0	163.5	162.0	166.0	168.5	162.0	167.923	4.68084
19	3	155	400	5-5-5-5-120	B	170.5	168.5	167.5	171.5	169.5	172.0	162.5	166.0	170.0	169.0	171.5	164.5	175.5	169.115	3.42876
20	3	165	400	5-5-5-5-120	F	171.0	177.5	168.5	169.5	171.5	167.5	168.5	165.0	170.0	165.5	167.5	169.5	168.0	169.192	3.13275
21	3	155	300	5-5-5-5-5-5-100	C	185.0	178.0	182.5	175.0	195.0	196.0	189.5	187.5	185.5	185.0	188.0	180.0	181.5	185.269	6.11220
22	3	165	300	5-5-5-5-5-5-100	G	167.0	168.5	167.0	163.5	170.5	160.0	171.5	162.5	169.0	163.5	166.5	178.5	*	167.333	4.89589
23	3	155	400	5-5-5-5-5-5-100	D	177.0	172.0	172.0	179.0	184.0	175.5	183.5	173.5	182.5	175.5	184.0	173.0	172.0	177.192	4.84570
24	3	165	400	5-5-5-5-5-5-100	H	166.5	166.0	169.0	165.5	164.5	162.0	163.0	163.0	162.0	162.5	167.5	164.0	169.5	165.000	2.57391
25	4	155	300	5-5-5-5-120	A	182.5	180.5	176.5	175.0	178.5	172.5	178.0	173.5	175.5	172.0	174.0	182.5	186.0	177.462	4.35154
26	4	165	300	5-5-5-5-120	E	172.5	177.0	171.0	176.0	169.5	171.0	168.5	171.5	168.5	169.5	172.0	165.5	172.5	171.154	3.07804
27	4	155	400	5-5-5-5-120	B	176.0	176.5	170.5	174.5	177.0	175.5	177.5	179.0	175.5	172.0	174.0	175.5	176.0	175.346	2.23965
28	4	165	400	5-5-5-5-120	F	179.0	181.0	177.5	182.0	186.5	184.5	172.5	179.0	184.0	176.5	179.5	172.5	185.0	179.962	4.48823
29	4	155	300	5-5-5-5-5-5-100	C	209.5	198.0	196.5	204.5	187.0	178.0	203.0	205.0	200.0	195.0	196.5	193.0	195.5	197.038	8.19670
30	4	165	300	5-5-5-5-5-5-100	G	174.5	171.0	178.0	177.5	163.5	168.5	157.0	172.5	170.0	177.0	173.5	182.5	*	172.125	6.90561
31	4	155	400	5-5-5-5-5-5-100	D	198.5	189.5	182.5	198.0	193.5	199.0	187.0	188.0	196.0	193.0	173.5	183.5	183.5	189.654	7.63322
32	4	165	400	5-5-5-5-5-5-100	H	170.0	166.5	171.5	171.0	170.0	170.5	170.5	171.0	167.5	166.5	168.0	168.5	162.5	168.769	2.55453

Analysis of variance for **Ave** (reduced model)

Cavities (Blocks) strongly significant

Between cavities **variation** explains **24% of the total variation** (= 2749.9 / 658.9)

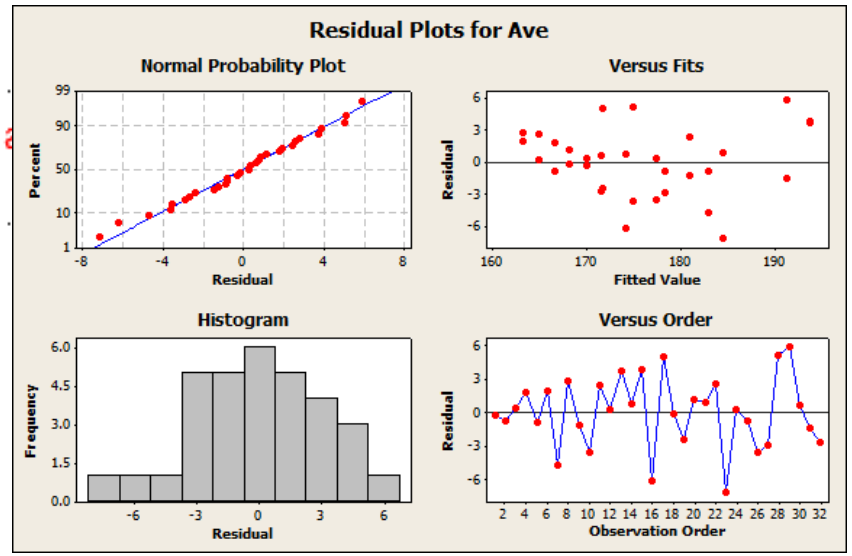
It should be reduced !!! (press setting issue!!!)

Analysis of Variance for Ave (coded units)

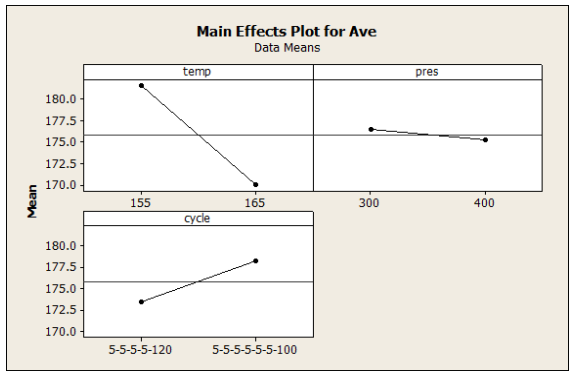
Source	DF	Seq SS	Adj SS	Adj MS	F	P
Blocks	3	658.9	658.9	219.62	17.51	0.000
Main Effects	2	1253.3	1253.3	626.63	49.96	0.000
temp	1	1071.9	1071.9	1071.90	85.46	0.000
cycle	1	181.4	181.4	181.35	14.46	0.001
2-Way Interactions	1	524.2	524.2	524.17	41.79	0.000
temp*cycle	1	524.2	524.2	524.17	41.79	0.000
Residual Error	25	313.6	313.6	12.54		
Lack of Fit	9	125.3	125.3	13.93	1.18	0.368
Pure Error	16	188.2	188.2	11.77		
Total	31	2749.9				

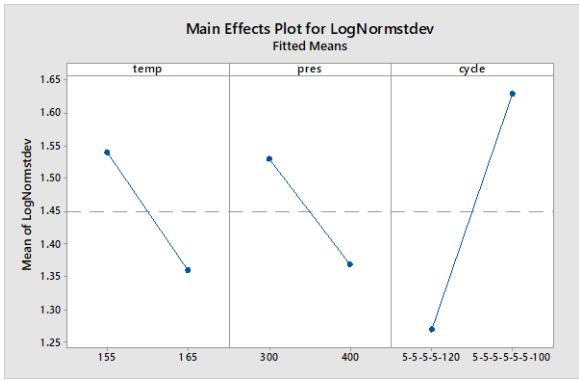
Together with **Cavities (Blocks)** only 2 factors **Temp** and **Cycle** a
interaction **Temp*Cycle** are statistical significant

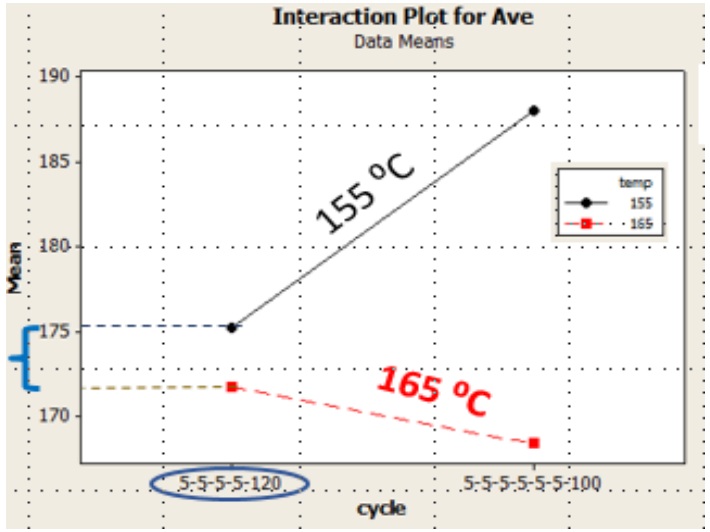
NO Press for these settings

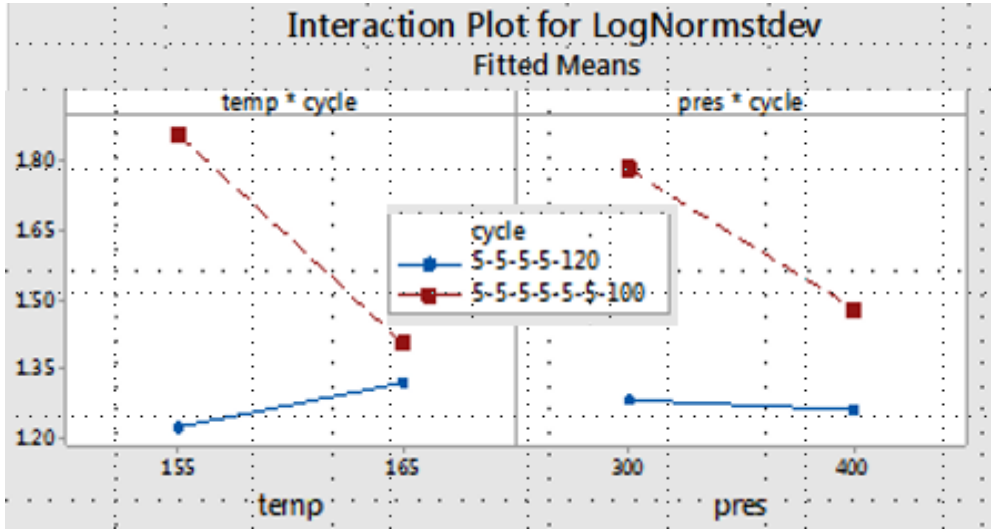


Main effects & interaction plots, linear transfer functions for **Ave** and **LogNormStDev** of **Compresibility**







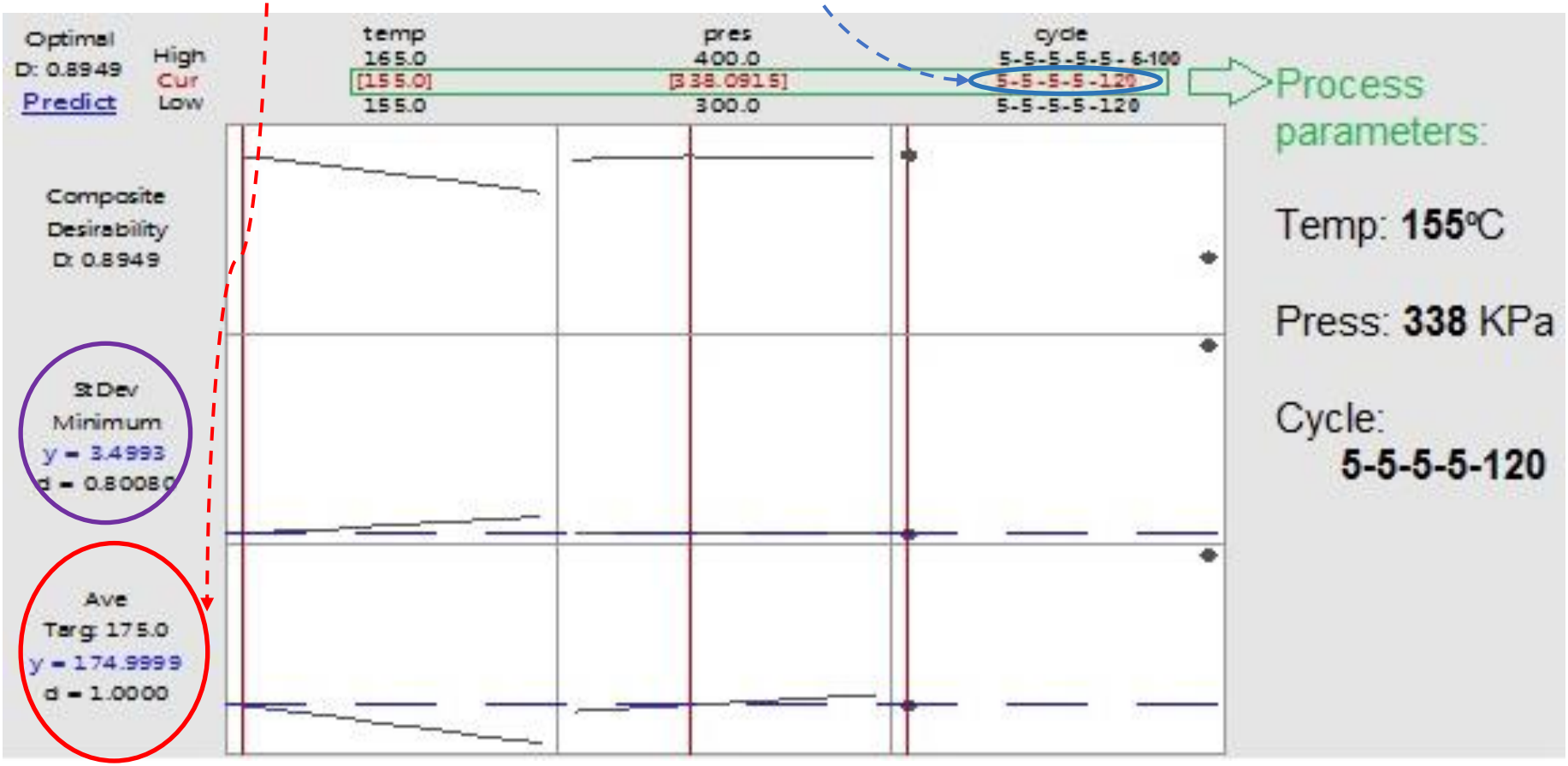


Ave = 163.25 – 2.4 Temp +
*+ 0.67 Cycle - 27.58 Temp * Cycle*

LogNormstdev = 4.89 – 0.01 Temp –
0.0016 Pres + 0.05 Cycle –
*-0.27 Temp.*Cycle – 0.0014 Pres*Cycle*

Robust design and further optimization

Choose **5-5-5-5-120** setting of **Cycle** input for a **R O B U S T D E S I G N** and **optimize** the other input settings for a **target** (& TOLs) of **Average** *and* for a **minimum** of **Standard Deviation** outs



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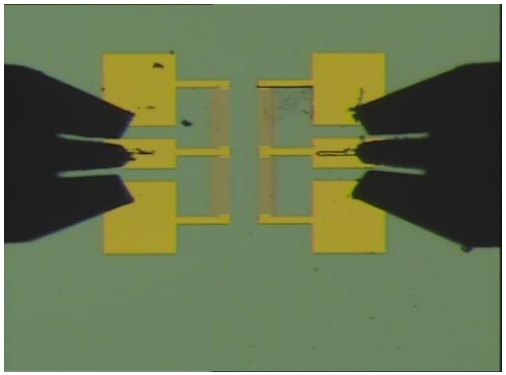
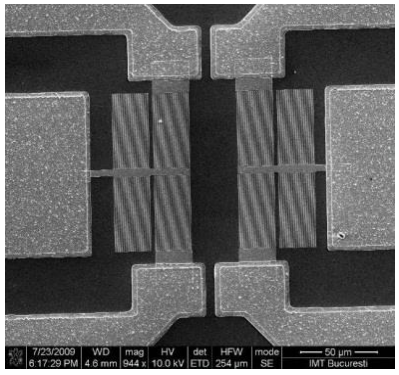
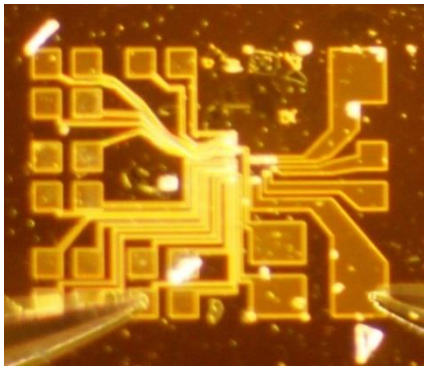
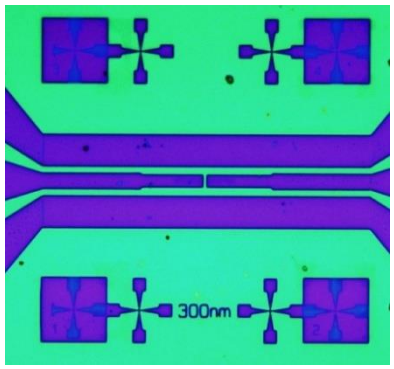
Facilities and expertise in KETs and space technologies

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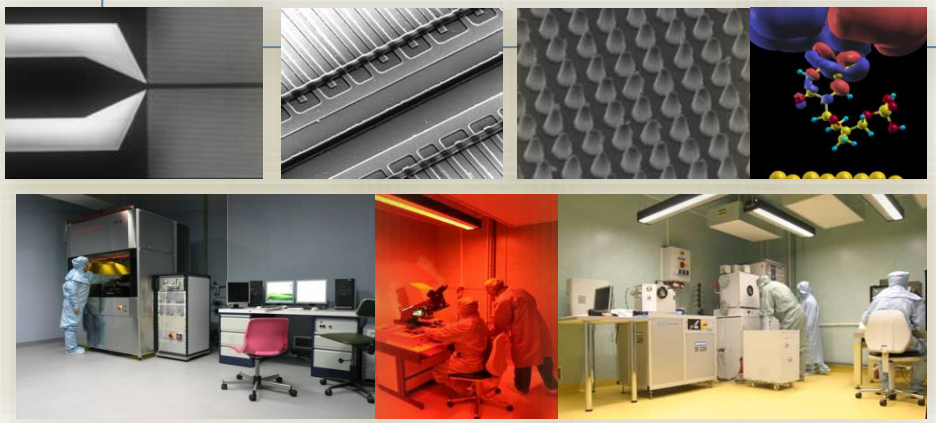
National Institute for Research and Development in Microtechnologies IMT- Bucharest

126A, Erou Iancu Nicolae str., Voluntari, Ilfov, 077190, Romania



- Non-budgetary public research unit supervised by the Romanian Ministry of Education and Scientific Research.
- Founded: **1993**
- National R&D institute- **1996**
- **The field of activity:**
  - ✓ ***micro and nano-fabrication technologies and new materials,***
  - ✓***computer-aided design, simulation, microsystems including MOEMS and RF-MEMS, micro/nano photonic structures and systems,***
  - ✓***carbon-based nanomaterials and devices***

Participation in EU projects the fields of micro-nano-technologies, nanoelectronics, photonics, MEMS, nanoelectronics

- 2 H2020
- 16 FP6 projects (IPs, STREPs, NoEs, RTNs),
- 12 FP7 projects,
- 4 ENIAC and
- 8 ERA-NET and MANUNET
- 4 ESA

IMT is active in four KETS

- ❑ Nanotechnology
- ❑ Micro- and nanoelectronics
- ❑ Photonics
- ❑ Advanced materials

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IMT Bucharest – main infrastructures

1. ***The IMT Centre for Micro- and NanoFABrication (IMT-MINAFAB)*** is an experimental facility (renovated since 2009) covering the full development cycle for micro- and nano systems and devices: design-modeling-simulation, nano and microtechnology processing, complex characterization, micro and nanosystem integration. It consists of clean rooms (class 100 to 10000, 400 sqm), grey room areas (300 sqm) and specialized labs (100 sqm
The services provided are ISO certified.

2. **Research Center for Integrated Systems Nanotechnologies and Carbon based Nanomaterials"- CENASIC** new infrastructure dedicated to carbon based technologies
Main equipment: clean room, class 100 to 1000, PECVD growth/deposition of graphene, CNT, nanocrystalline diamond, SiC; ALD deposition of HfO_2 and Al_2O_3; MBE growth of III-V nitrides.

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IMT Bucharest – main facilities

Micro and nano fabrication services:

-Oxidation and diffusion

-Thin film deposition: CVD, PVD, MBE, ALD

-Patterning technologies: photo and e-beam lithography, NIL; dry etching: RIE, DRIE

-Wafer bonding, Chip dicing, wire bonding

Characterization services:

-Optical and scanning electron microscopy

-Scanning probe microscopy

-Nanoindentation

-Ellipsometry

-Spectroscopic methods: Raman, FTIR, UV-ViS, XRD

-Electrical measurements – from DC up to 110GHz

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IMT Bucharest - processing facilities

Furnaces, RTP, CVD, PECVD, PVD, DWL, RIE, DRIE, wafer bonding, etc.










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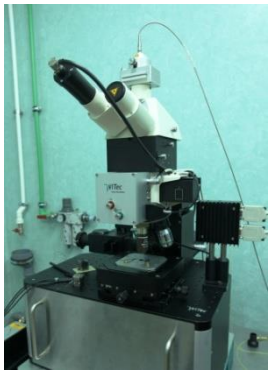
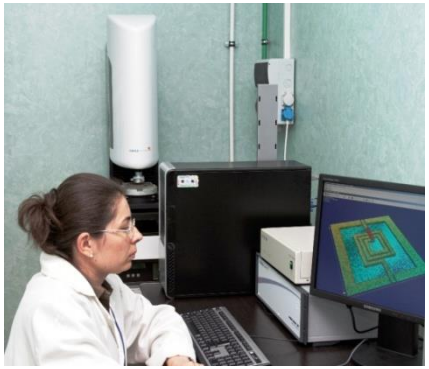
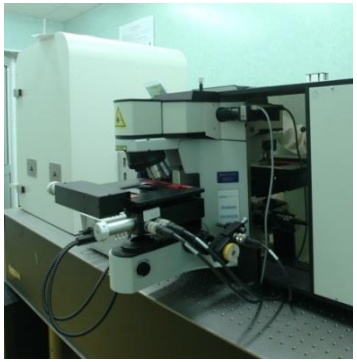
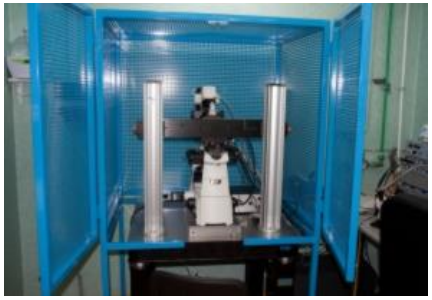
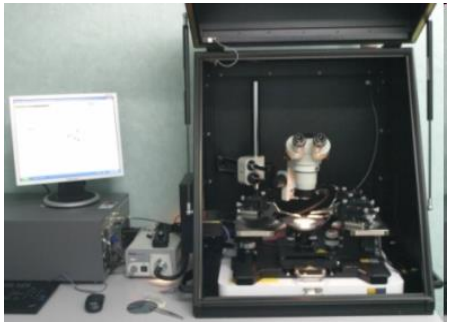
IMT Bucharest – characterization facilities

Ellipsometry, NSOM, WLI, micro Raman and TERS, XRD, SECM, FTIR, on wafer probing stations, network analyzer

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Nanoscale Structuring and Characterization Laboratory

Raith - e_Line - dedicated EBL equipment

NanoInk Nscriptor - DPN

NT-MDT Ntegra Aura - AFM & STM

Tescan Vega LMU II - SEM

FEI Nova NanoSEM630 - FEG-SEM

Agilent G200 - Nanoindenter

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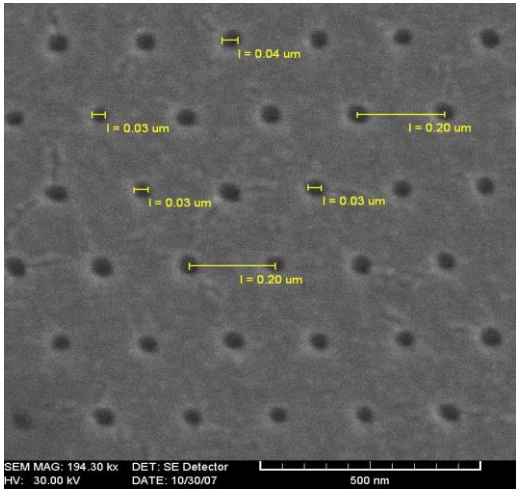
Electron Beam Lithography equipment in IMT Bucharest

First EBL equipment in IMT - Tescan Vega LMU II and Raith Elphy Plus – installation 2006

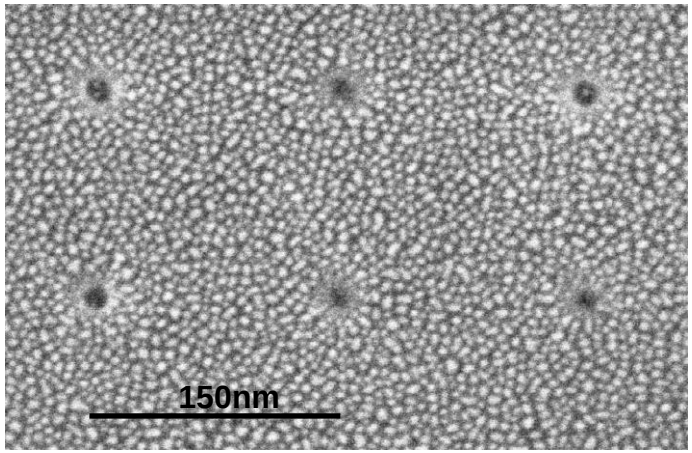
Smallest beam diameter : 5nm @ 3pA beam current and 30kV



30nm diameter holes in PMMA 950k

Raith e-Line – installation 2008

Smallest beam diameter: 1.5nm @ 200pA



~ 10nm diameter holes in PMMA 950k

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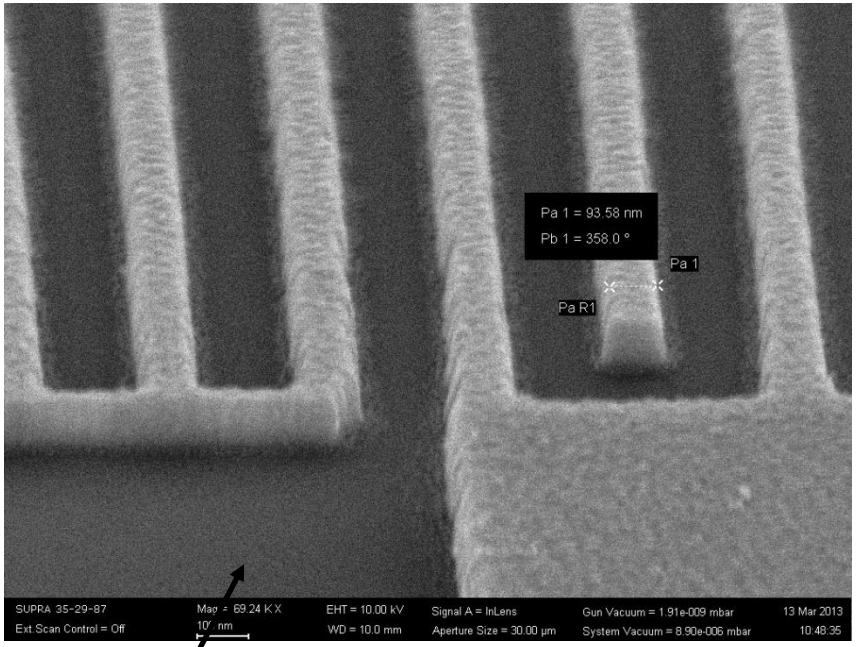
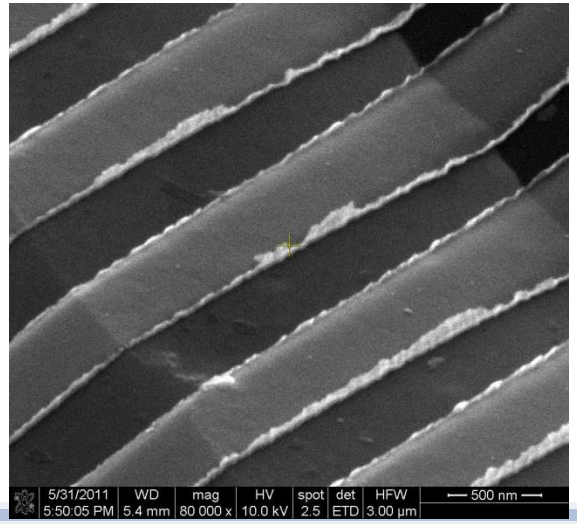


Temescal FC 2000 is a clean-room compatible, bell-jar shaped, load locked PVD system equipped with both e-beam ant thermal evaporation sources

Interdigitated electrodes with <100nm width, fabricated by e-beam lithography and highly directional metal evaporation of 10nm Cr and 100nm Au.



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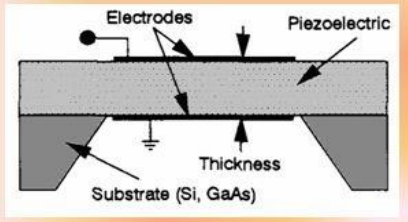
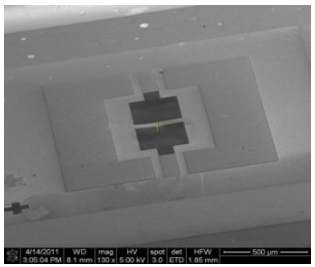
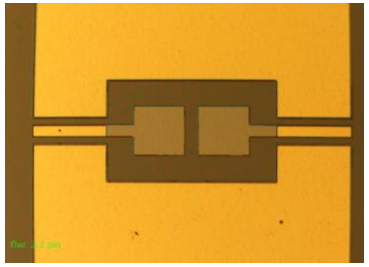
Acoustic devices for GHz applications

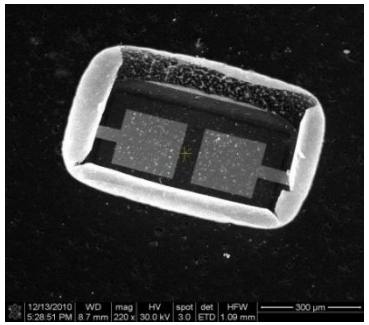
Acoustic resonators

FBAR

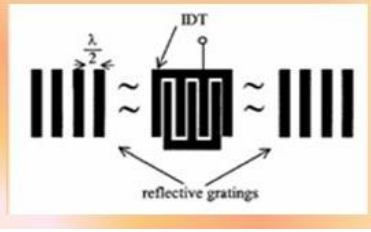


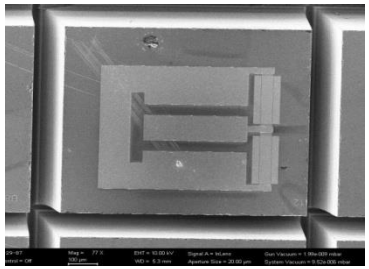


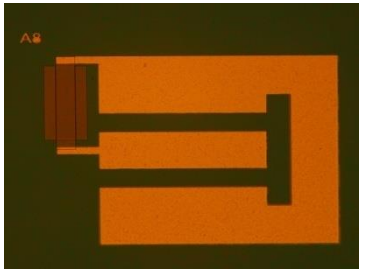


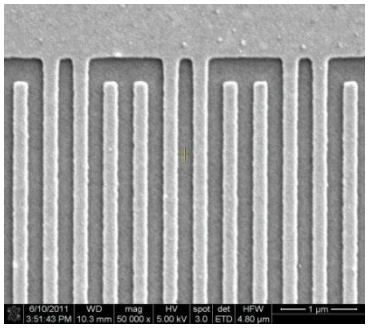


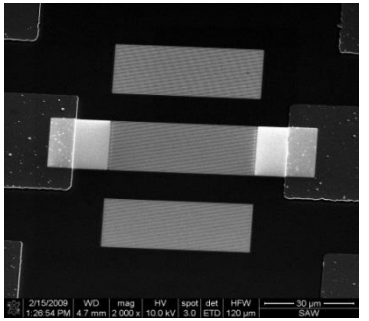
SAW







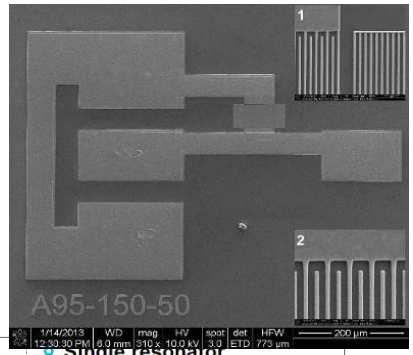


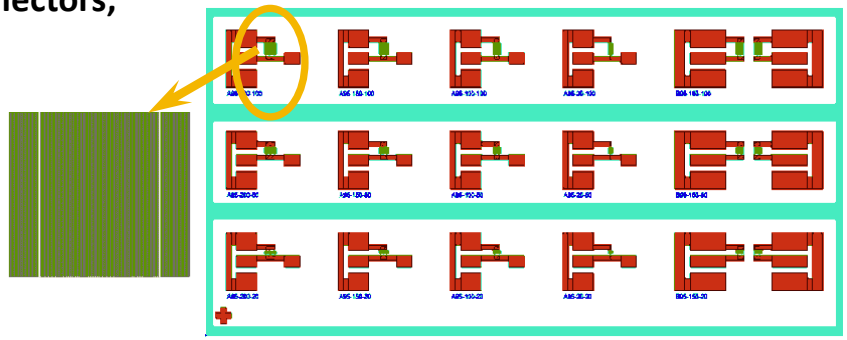


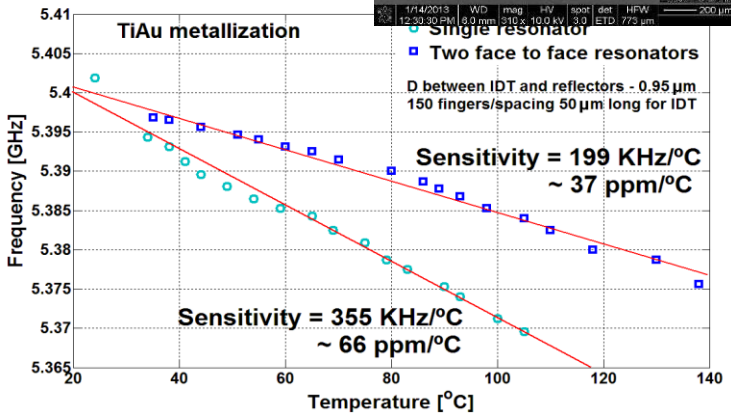
Temperature sensors based on SAW devices

SmartPower (FP7 project) - Temperature sensor based on GaN/Si SAW resonators foperating in the GHs fequency range

- Resonators f abricated, based on new mask design in order to minimize the return loss at resonance and maximize Q
- SAW structures having the IDT with 200 nm wide finger and interdigit spacing;
- Finger heights: 100 µm; 50 µm; 20 µm;
- 200 fingers; 150 fingers; 100 fingers; 20 fingers and 50 reflectors;
- Distance between IDT and reflectors: 0.95 µm







The temperature dependence of the resonance equency obtained for the SAW single and face to face sonators (RUN 3 "on wafer" hot plate measurements)

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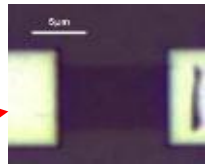
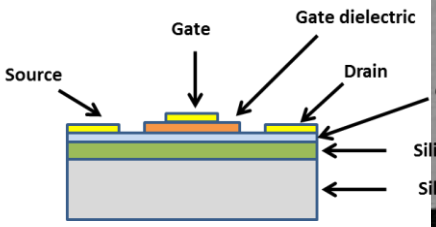
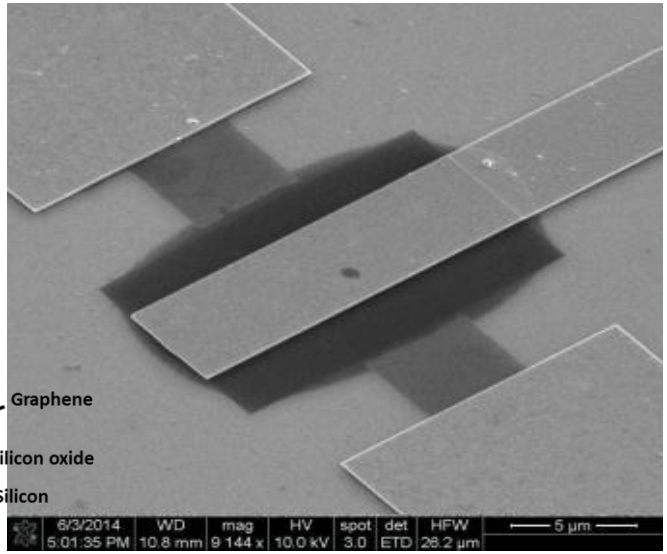
Back gated field effect transistors on exfoliated SLG

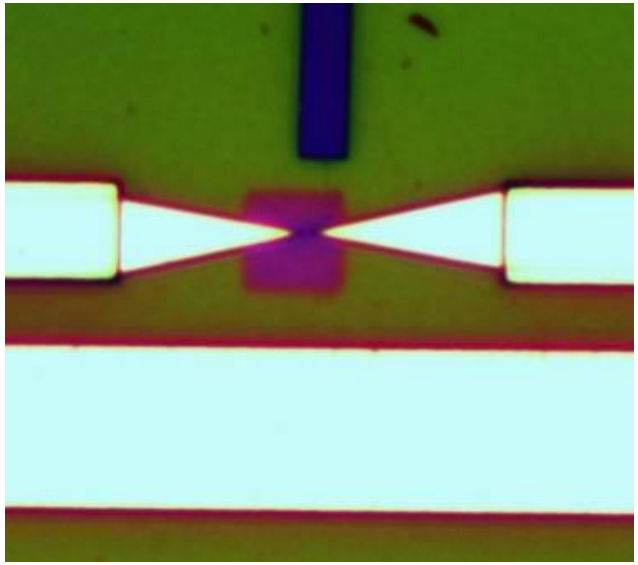
Array of 18 BG-FETs on graphene



A back gated FET on graphene ribbon







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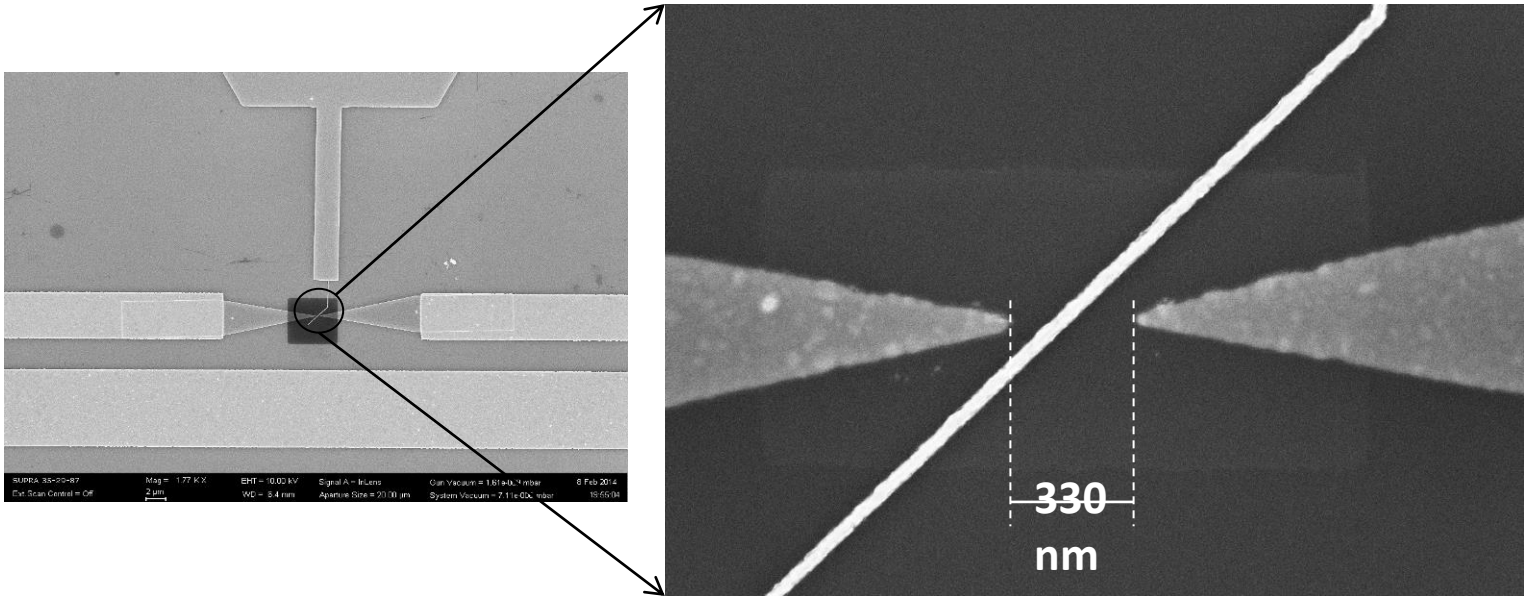
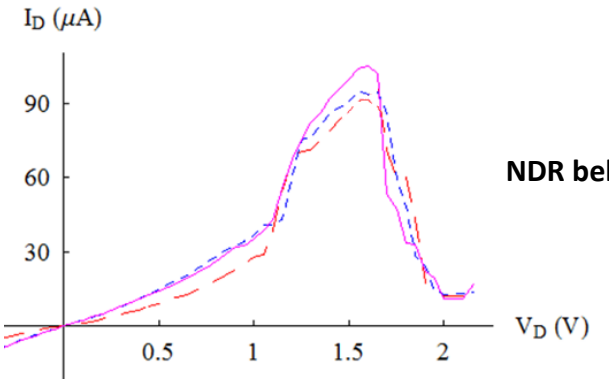
Ballistic FET on graphene featuring strong NDR





NDR behavior of the graphene FET with oblique gate at VTG = 0.5 V (dashed red line), 1 V (dotted blue line), and 1.5 V (solid red line).

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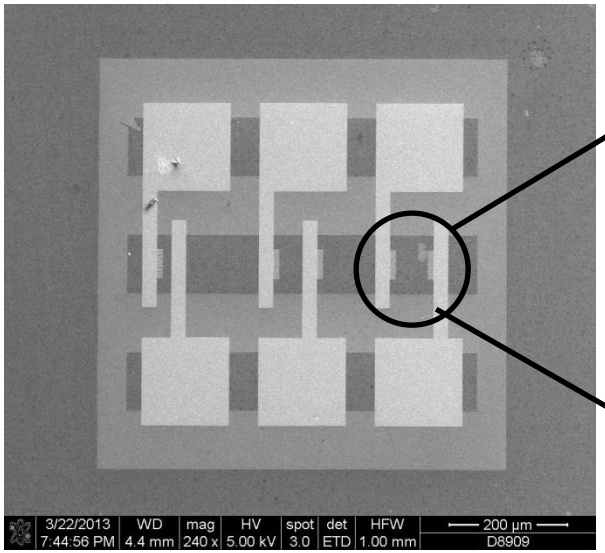
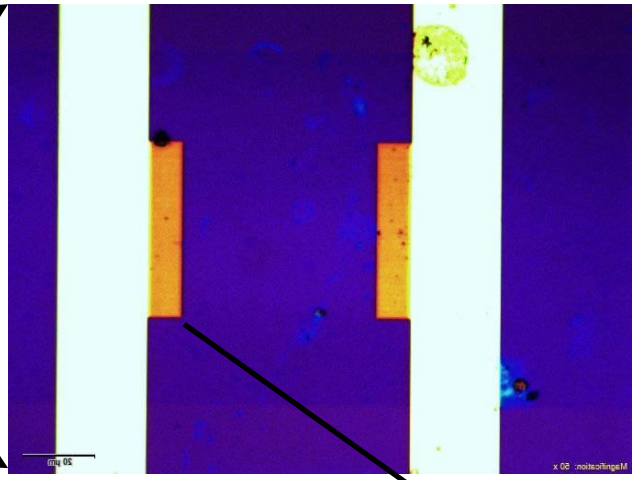
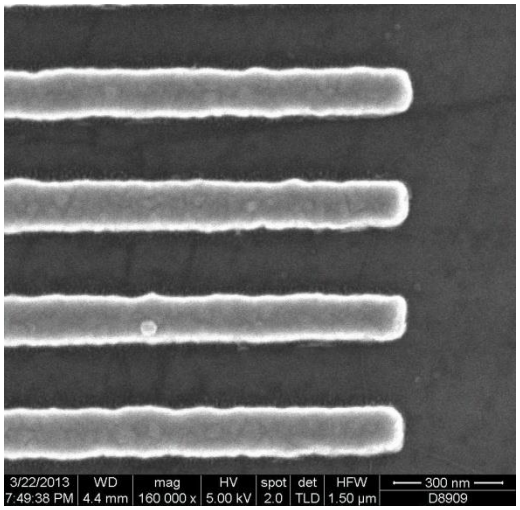
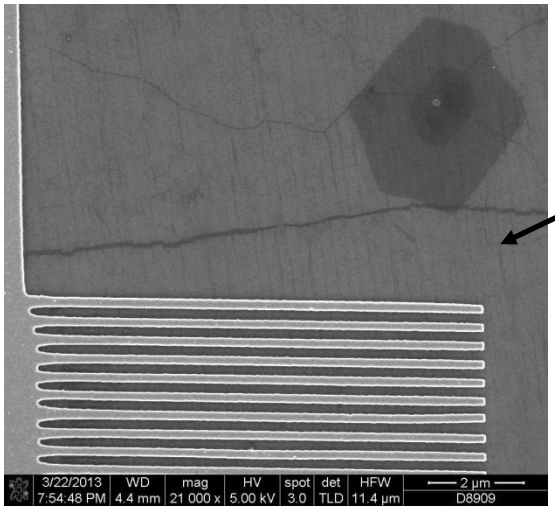
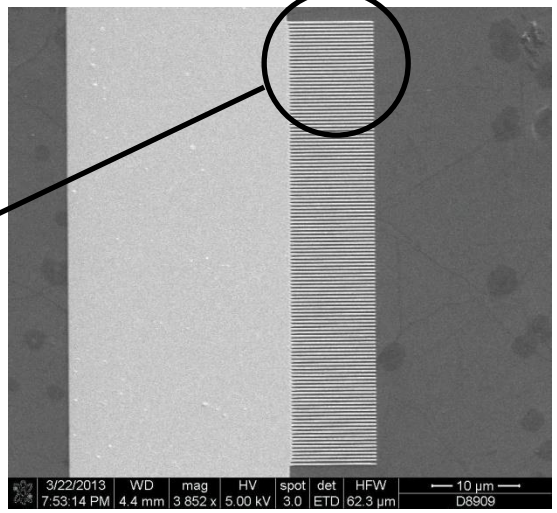
Plasmonic Nanostructure Enhanced Graphene -Based Photodetectors











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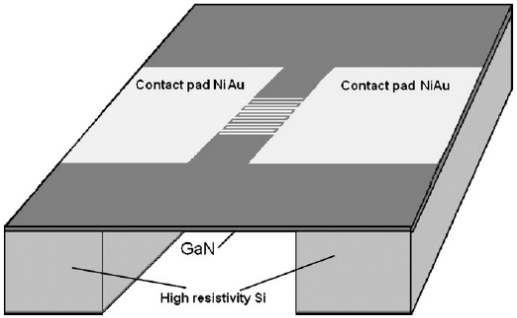
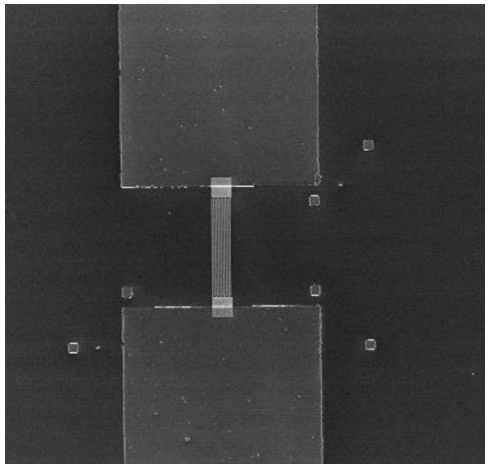
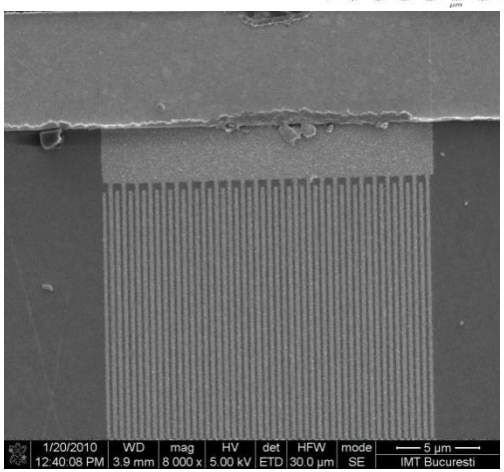
MSM photodetectors on silicon supported GaN membranes



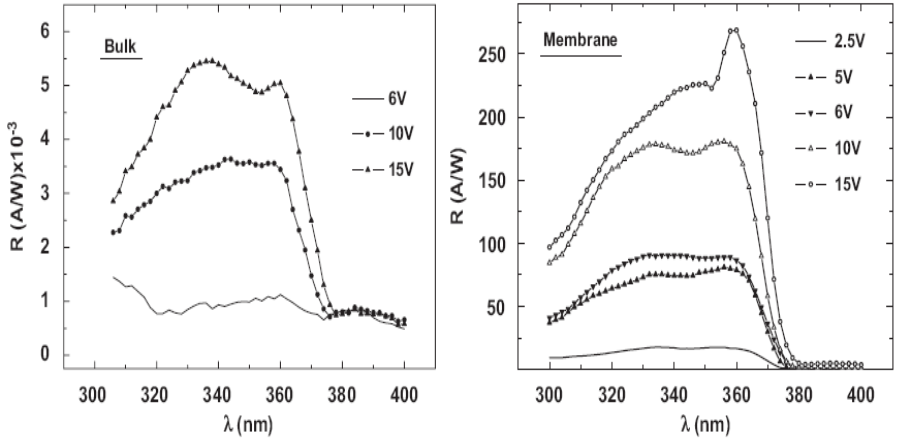
Schematic cross-section of the membrane MSM UV detector structure.



Top view of the detector



Detail of the interdigitated contacts



a) Responsivity vs wavelength for the 0.5µm finger/interdigit UV GaN detector before the silicon substrate removal.

b) Responsivity vs wavelengthfor the 0.5 µm finger/interdigit UV detectorst manufactured on thin GaN membrane.

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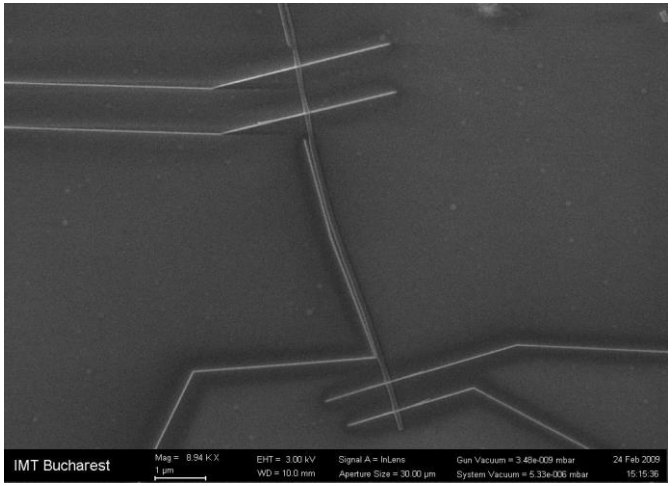
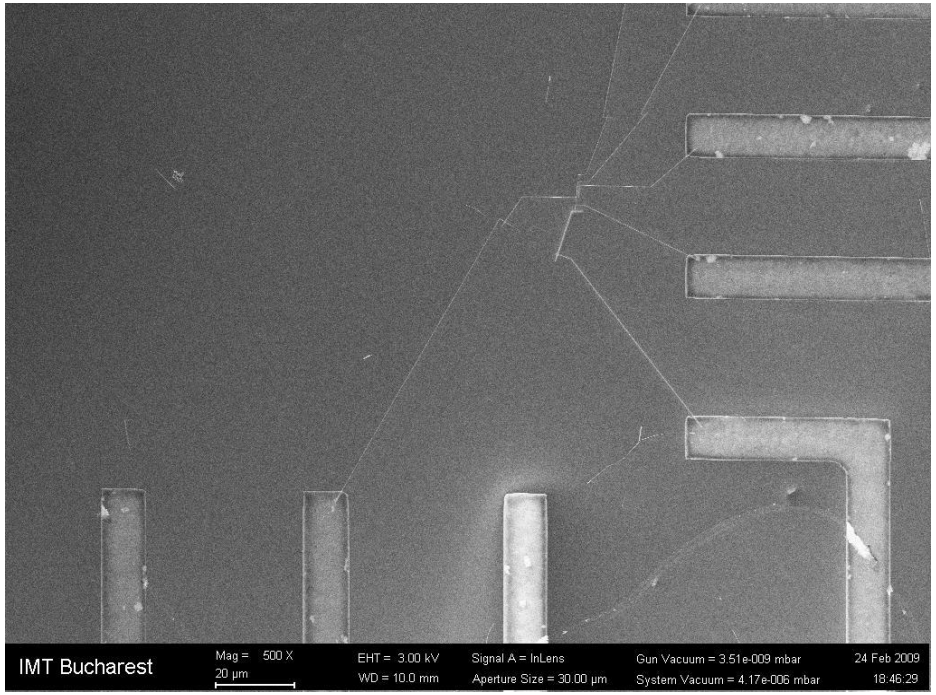
Electron Beam Induced Deposition





SEM micrographs showing platinum lines connecting a polymer nanowire to the electrical pads

L. Gence, V. Callegari, **A Dinescu**, S. Melinte and S. Demoustier-Champagne, “Hybrid Polymer nanowire based electronic devices correlated characterization” 14-th International Conference of Modulated Semiconductor Structures (MSS 14), 19-24 July 2009, Kobe, Japan

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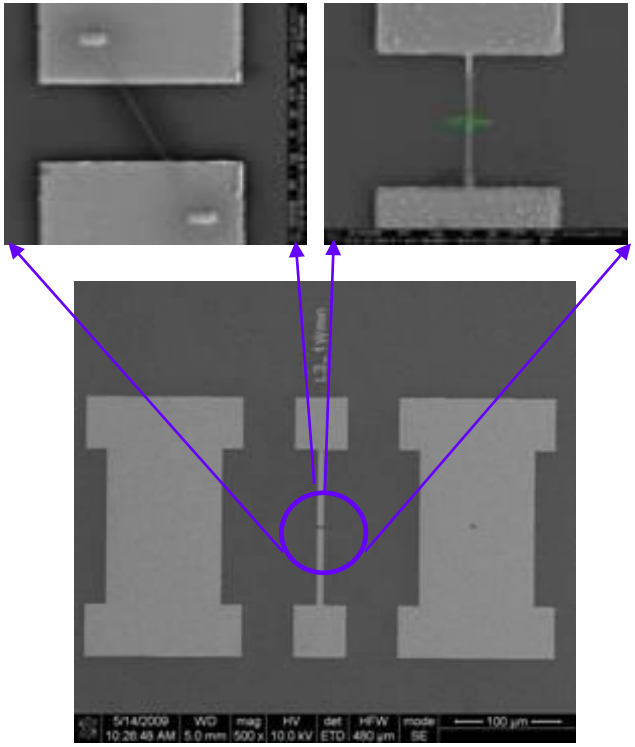
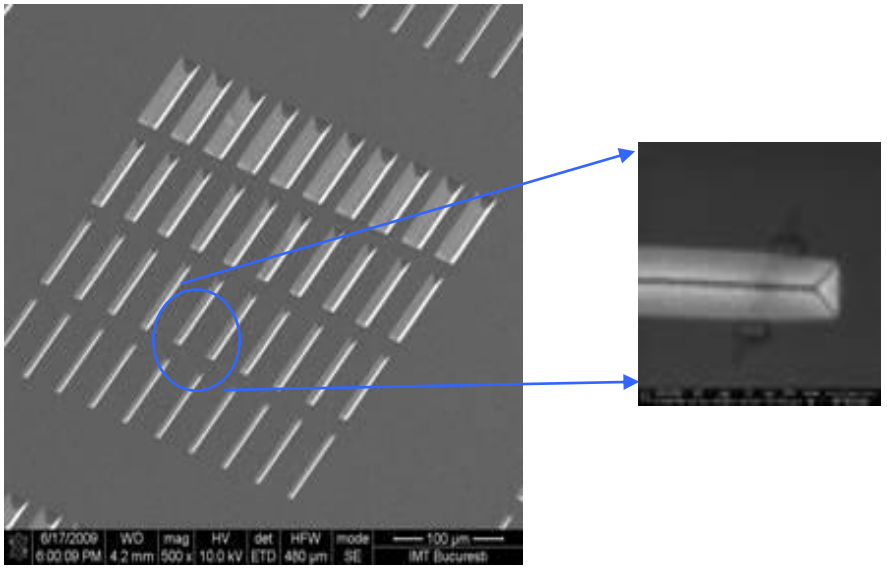
Electron Beam Induced Deposition

FP7 Project: **Carbon nAnotube Technology for High-speed nExt-geneRation nano-InterconNEcts – CATHERINE** (FP7/STREP, 2008-2010)



Structure used for electrical characterization of CNTs at high frequencies. EBL was used for patterning the small calibration line and EBID technique for fixing the CNTs



Platinum deposition was used for fixing the CNTs across V-shaped trenches in order to measure their mechanical properties

ESA Projects

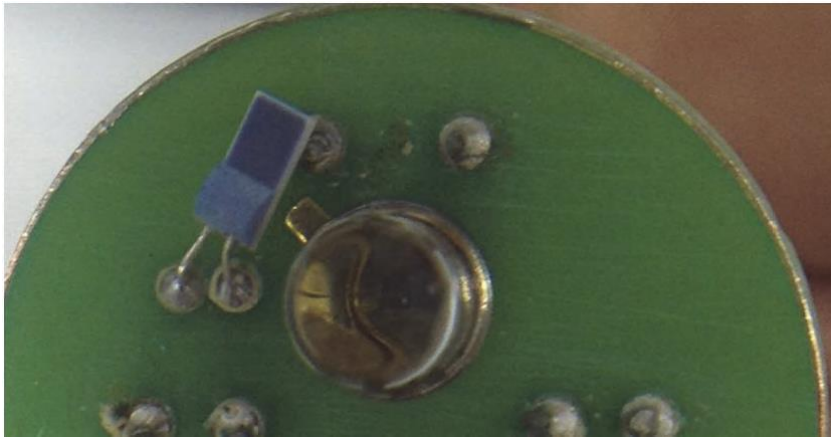
PROBA-3 Coronagraph System

Prime Contractor: Centre Spatial de Liège (www.csl.ulg.ac.be3).

Subcontractor for OPSE: National Institute for R&D in Microtechnologies- IMT Bucharest. Contact person: Dr. Ileana Cernica (ileana.cernica@imt.ro).

Supplier ROMAERO (www.romaero.com)

IMT role: design (optical, thermo-mechanical), fabrication and characterization of the "Occulter Position Sensor Emitters Heads (OPSE)" for the mission **PROBA-3 Coronagraph System**



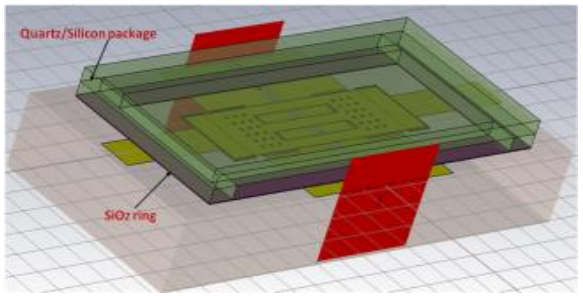
ESA Projects

0-level encapsulation of reliable MEMS switch structures for RF applications

ESA Contract No. 4000110819/14/NL/CBi, 2014- 2016;

Prime Contractor: IMT Bucharest.

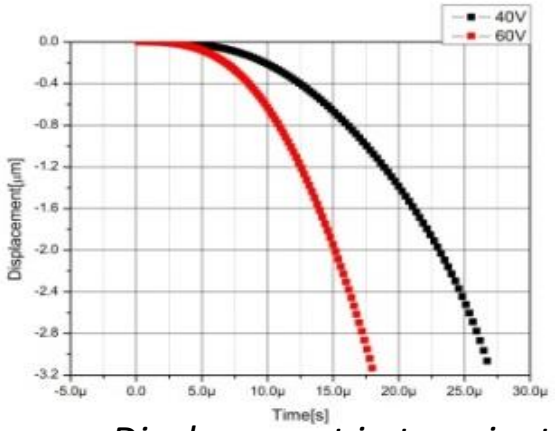
Contact person: Dr. Dan Vasilache (dan.vasilache@imt.ro)



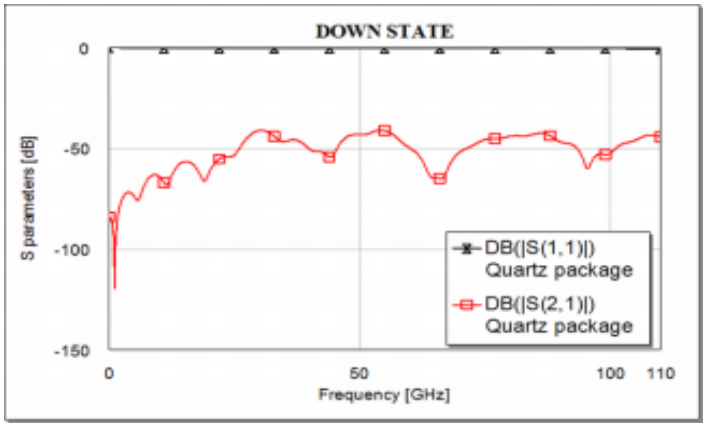
RF-MEMS switch packaged (CST simulations)

Technical objectives:

- design and manufacturing of MEMS switch structures for K-band to W-band (20-110GHz);
- the development of the encapsulation method of MEMS switch structur



Displacement in transient simulation for the second type of membrane, for 40V and 60V



Simulated S parameters in down-state for the packaged RF-MEMS switch

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ESA Projects

Atypical Reliability Testing

ESA contract no: 4000116436 / 16 / NL / CBi

Prime Contractor:

Manager: Eng. Dragos Varsecu,

Aim: reliability tests for devices developed by EU companies in the frame of ESA projects via a system of Call-Off Orders for devices and developed by EU companies in the frame of ESA projects
(focus on "Atypical Reliability Testing" that cover a series of reliability tests that are not standard qualification tests, but they are more effective in simulating the real life of the components / devices than the standard tests).

Main equipment

- **HAST chamber- Highly Accelerated Stress Test System**
- **Climatic chamber + Vibration test system**
- **Thermal shock chamber (two chambers hot/cold**
- **Free Fall Shock Machine**
- **Universal Ovens with electrical testing (4 Chambers)**

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STAR Projects

Thin film photodetectors - new concepts and studies for aerospace applications- CONDAS STAR Project, 2012- 2015

Web page: http://www.imt.ro/condas/

The aim of this project is to *design and experiment new type of photodetectors*, with increased *photoresponse over a wide wavelength range (UV-VIS-NIR-SWIR)*, based on thin film semiconducting materials/composites and to investigate the applicability of these device for space applications.

Active MICRO-SHIELDS systems for protection of space infrastructures

STAR Project, 2012- 2014

Web page: http://www.imt.ro/micro-shields/

This project is part of a scientific development of innovative concept for Active Micro-Shields Method and System, with the purpose to improve protection against the high velocity micro-space debris, partides and solar flares dust, including the capability to decrease radiation exposure using the synergy with advanced nano- and micro-technologies, and will be produced based on micro-materials fabrication.

Investigation of semiconductor oxide materials performance for space environment applications-MATSPACE

STAR Project, 2013- 2015

Web page: http://www.imt.ro/matspace/

The project aims at the examination, understanding and description of the radiation response of widely investigated types of materials, through a combination of experimental, theoretical, and modeling methods

Adaptive-charger technology for space battery systems- ADAPTIVE CHARGER

STAR Project, 2013- 2015

Millimetre and sub-millimetre wave GaAs Schottky diodes, detectors and mixers detectors- M3GAAS

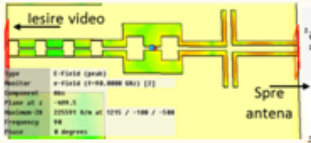
STAR Project, 2013- 2016

Web page: http://www.imt.ro/m3gaas/

The concept of this project is *to fabricate* millimetre and submillimetre wave GaAs Schottky *diodes detectors* and mixers using advanced micro and nano-technologies.

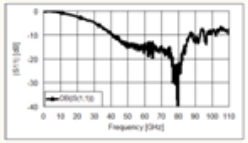
Implementation status of the project/Results

W band (75-110 GHz) detector with zero bias diode

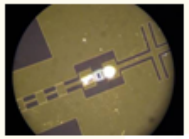


Electric field distribution at 90 GHz

Hybrid integration of the detector structure with a GaAs zero bias diode



Reflection parameter at the input port of the detector



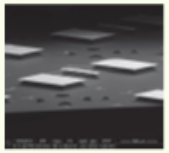
Reliability design of RF-MEMS switches for space applications -REDEMS

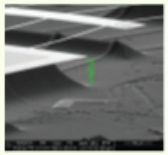
STAR Project, 2012- 2015

Web page: http://minas.utcluj.ro/Project-STAR_1/

The main objective of this project is the accuracy determination of the mechanical and tribological properties of MEMS switches in different operating conditions. The scope is to predict the MEMS switch behavior in space applications, to improve their reliability and lifetime.

IMT role: partner





SEM pictures of chevron-based thermal actuator

Bolometers for space applications in middle and long infrared -BOLOSPACE

STAR Project, 2012- 2015

Web page: http://www.imt.ro/bolospace/

This project aims to *investigate, optimize and practically realize a high sensitivity Transition Edge Sensor* (TES) bolometers based on thin layers of the high temperature superconductor Yttrium-Barium-Copper-Oxide YBCO, which operates in the middle and long infrared. Estimated results: Functional model of bolometer –sensor integrated with the read-out circuits.

Bolometer sensor based on patterned YBCO layer

MICRO-CPVS Space systems and technology

STAR Project, 2013- 2015

Web page: http://www.imt.ro/micro-cpvs/

MICRO-CPVS is the short name of *MICRO-CONCENTRATOR with Photo Voltaic Cell Systems designated for all space applications* including an innovative design system architecture and system assembly based on the patented micro-technologies.

Microsensors matrix for air quality control in human space missions habitable areas- SAFEAIR

STAR Project, 2013- 2016

Web page: http://www.imt.ro/safeair

Tribomechanical Characterization of MEMS Materials for Space Applications under harsh environments

STAR Project, 2013- 2015

Web page: http://minas.utcluj.ro/Project-STAR_2/

IMT role: partner

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Instrumente Structurale 2014 - 2020

PRIOCHEM – XVIII-th Edition, round table **Make innovation happen**

Bucharest, 26th Oct. 2022

Example of DOE (Design of Experiment) **application at the nanometric level**

within the project financed by structural funds (2016-2021):

"Parteneriat în exploatarea Tehnologiilor Generice Esenţiale (TGE), utilizând o PLATformă de interacţiune cu intreprinderile competitive (TGE-PLAT)"
Cod SMIS2014+ 105623.

Dr. Cătălin Pârvulescu IMT București

Proiect cofinanțat din Fondul European de Dezvoltare Regională prin Programul Operațional Competitivitate 2014-2020

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Contract C77 / 08.09.2016 cod SMIS 2014+ 105623

Activitatea A. **Stimularea transferului de cunoștințe**

Activitatea B. **Accesul întreprinderilor la facilități, instalatii, echipamente**

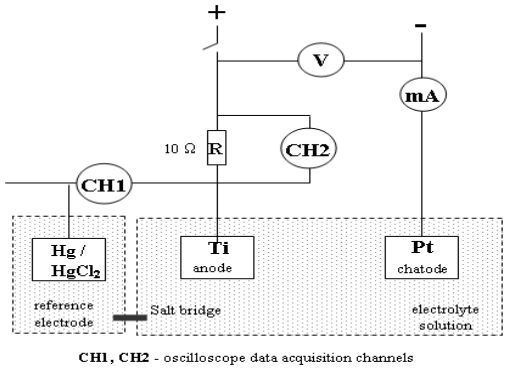
Activitatea C. **Activități de transfer de abilități/ competente CD si de sprijinire a inovării**

Activitatea D. **Activități de cercetare-dezvoltare în colaborare efectivă**

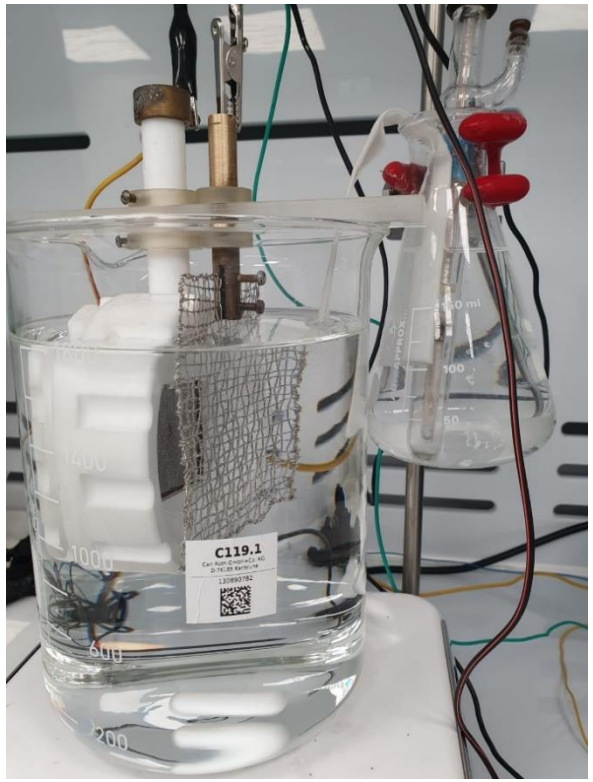
Instrumente Structurale 2014 - 2020

C77.8D/09.08.2020
intre **IMT- București** si
SC SITEX 45 SRL
”Dezvoltarea tehnologiei de realizare a senzorilor pentru gaze de combustie cu materiale hibride nanocompozite bazate pe nanotuburi de bioxid de titan şi grafenă”

Proiectare experiment **(Design of Experiment)** structuri TiO2 NT si analiza datelor experimentale



CH1, CH2 - oscilloscope data acquisition channels



Factor	Description [unit]	Low	High
C	Water Concentration [%]	1	3
V	Voltage [V]	20	40
D	Distance electrodes [cm]	2	4
T	Time of anodization [min]	30	90

Outputs:

L – lengh of nanotubes

D – diameter of nanotubes

and

W *–wall thickness of nanotubes*

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Designul factorial fracționat (1/2)

$2^{4-1} = 2^3 = 8$ run-uri, cu **2 replicate**

adică

8 x 2 = 16 run-uri

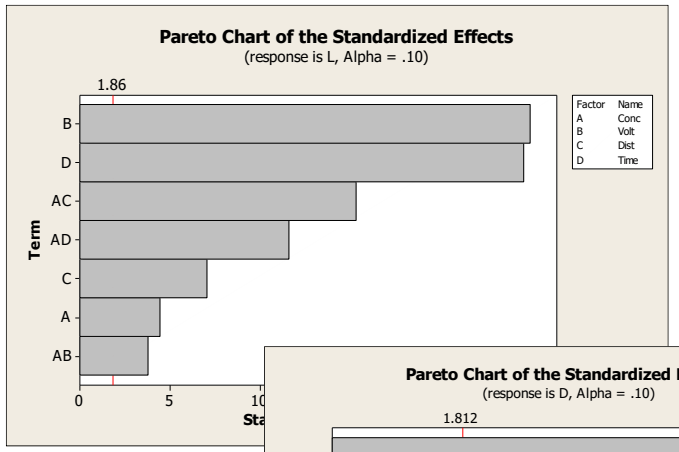
+

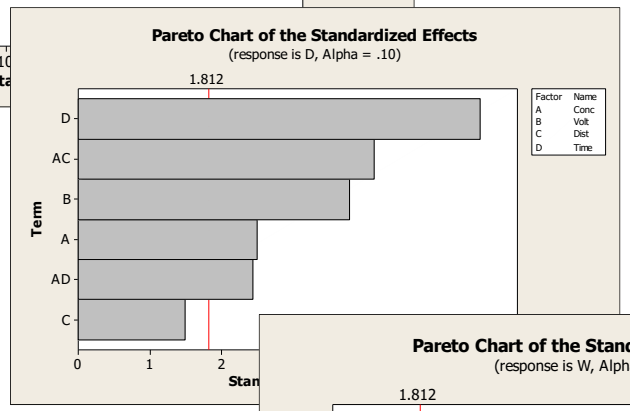
un punct central

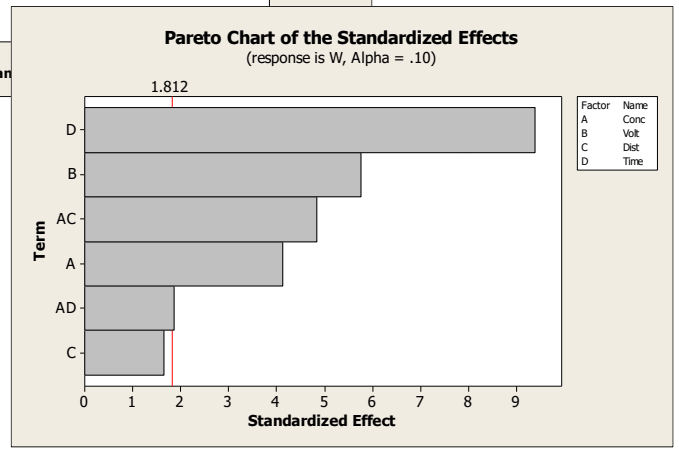
=

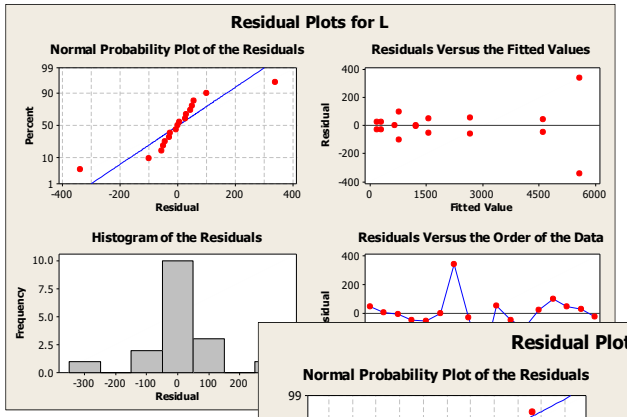
16 + 1 = 17 run-uri

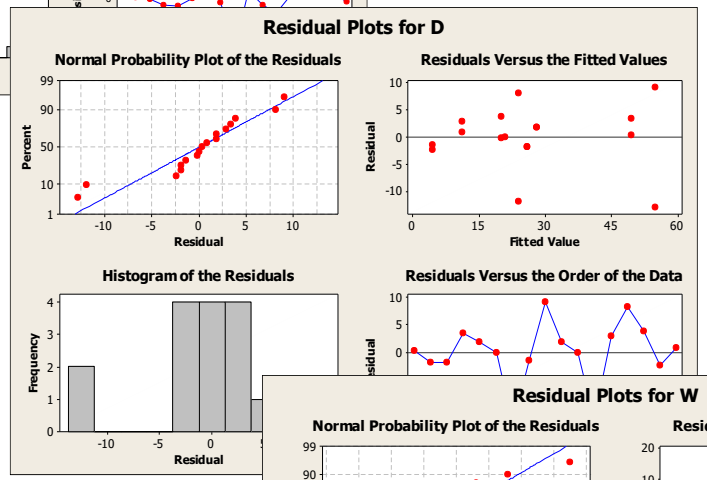
Run	Conc	Volt	Dist	Time	L	D	W
1	1	20	2	30	312	14	20
2	3	20	2	90	1210	24	59
3	1	40	2	90	5220	64	105
4	3	40	2	30	2700	30	50
5	1	20	4	90	1510	20	40
6	3	20	4	30	870	32	56
7	1	40	4	30	210	2	16
8	3	40	4	90	4560	53	103
9	1	20	2	30	260	12	18
10	3	20	2	90	1200	24	60
11	1	40	2	90	5900	42	91
12	3	40	2	30	2590	30	52
13	1	20	4	90	1610	24	42
14	3	20	4	30	670	12	23
15	1	40	4	30	150	3	14
16	3	40	4	90	4650	50	98
17 *ct.pt*	2	30	3	60	650	21	39

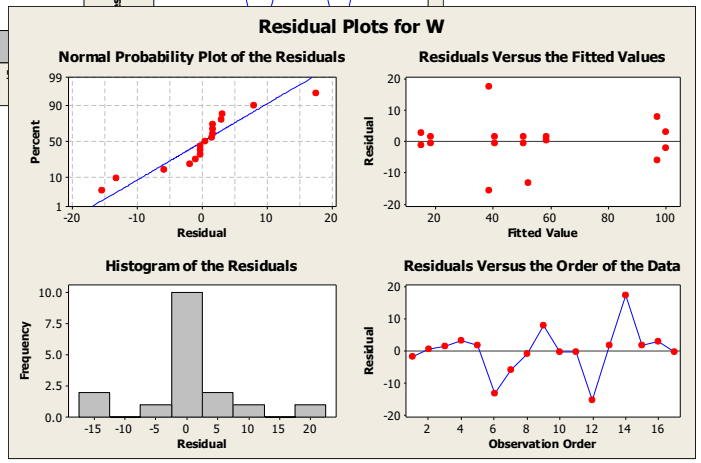












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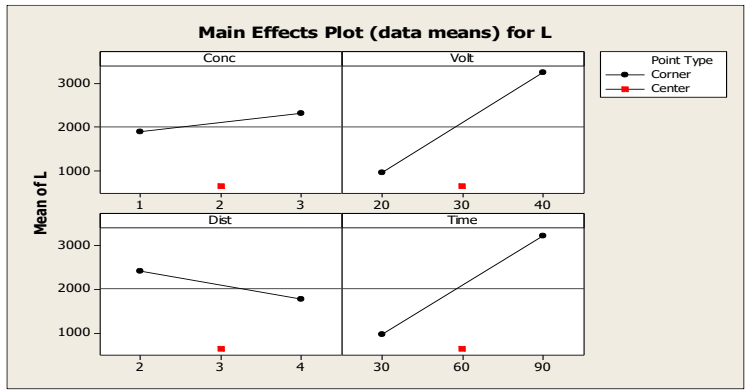

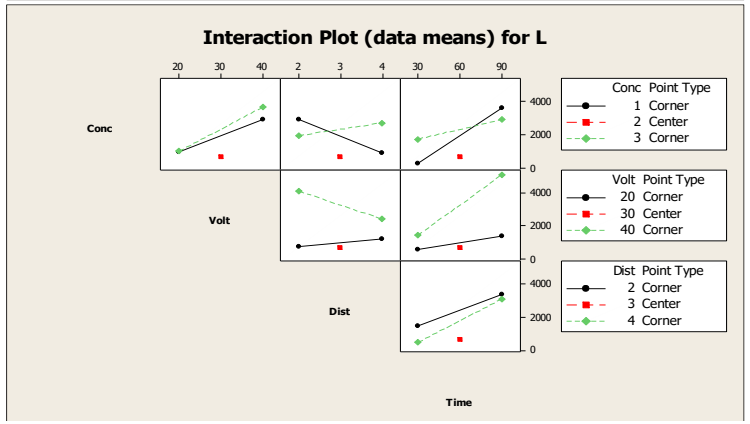

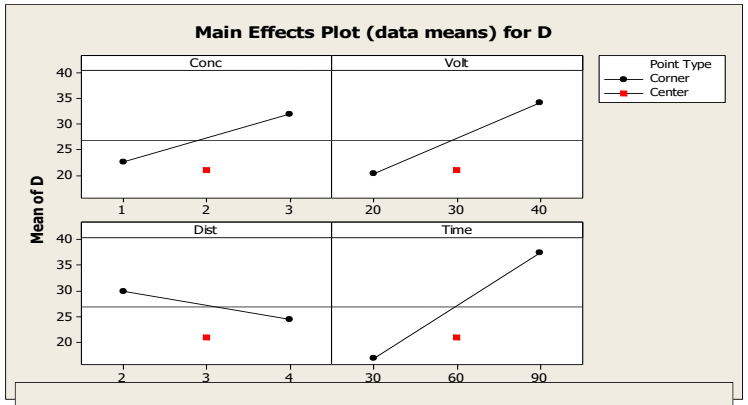

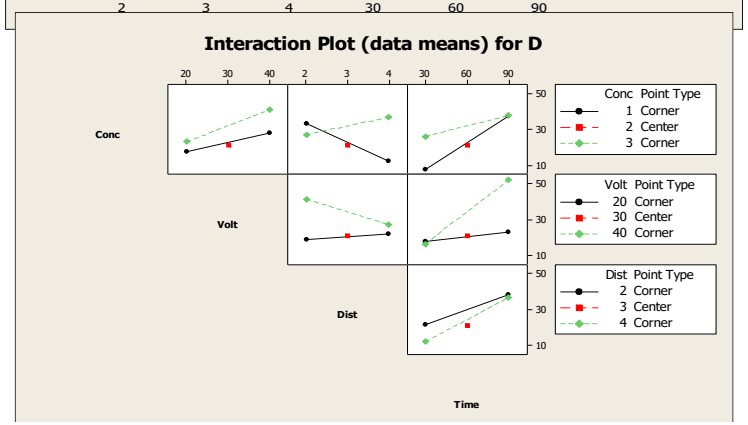

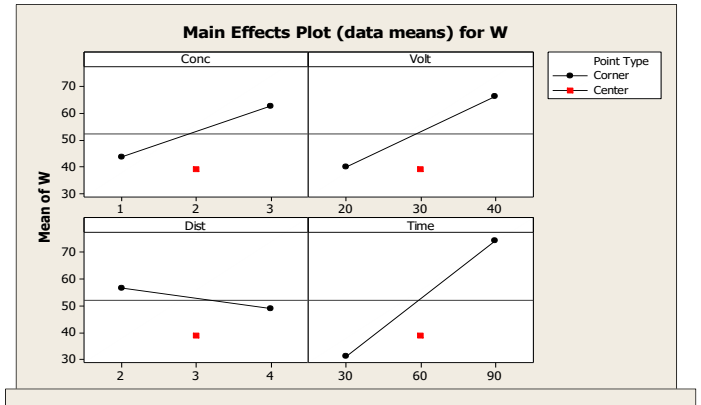

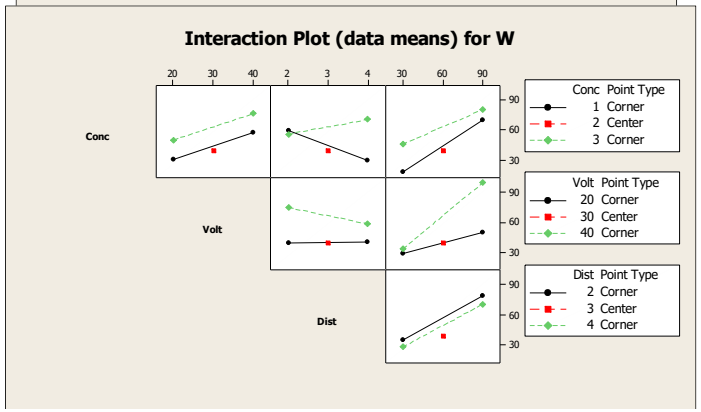

$$L = 3.00 - 1359.87*Conc + 80.09*Volt - 1730.37*Dist + 73.20*Time + 17.26*Conc*Volt + 03.87*Conc*Dist - 17.74*Conc*Time$$

$$D = 11.88 - 9.25*Conc + 0.70*Volt - 18.00*Dist + 0.65*Time + 7.63*Conc*Dist - 0.15*Conc*Time$$

$$W = 11.11 - 15.38*Conc + 1.33*Volt - 26.19*Dist + 1.01*Time + 11.19*Conc*Dist - 0.14*Conc*Time$$

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Factor	Description [unit]	Low	High
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V	Voltage [V]	20	40
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Outputs:

L – lengh of nanotubes

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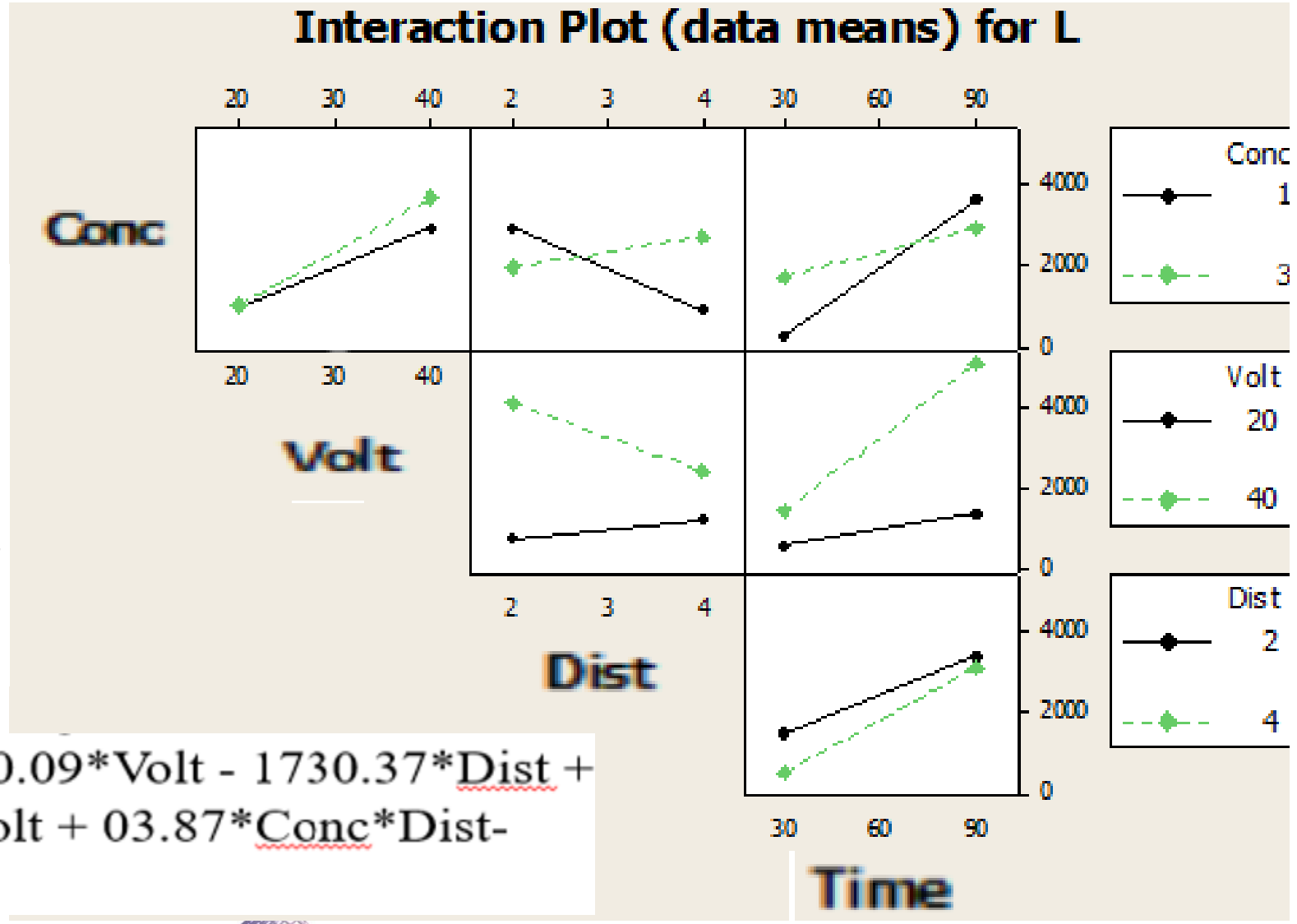
and

W *–wall thickness of nanotubes*



$$L = 3.00 - 1359.87*Conc + 80.09*Volt - 1730.37*Dist + 73.20*Time + 17.26*Conc*Volt + 03.87*Conc*Dist - 17.74*Conc*Time$$

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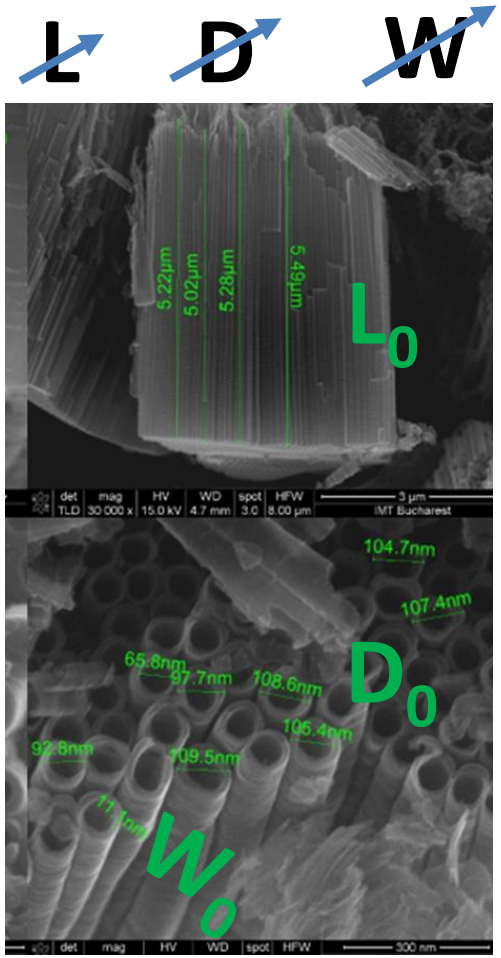
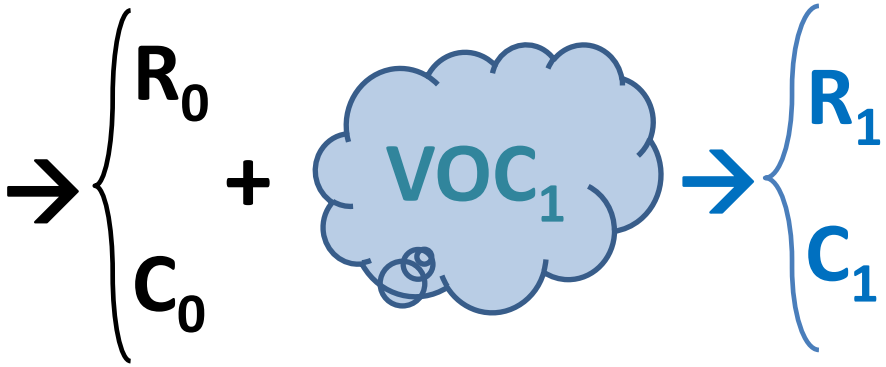
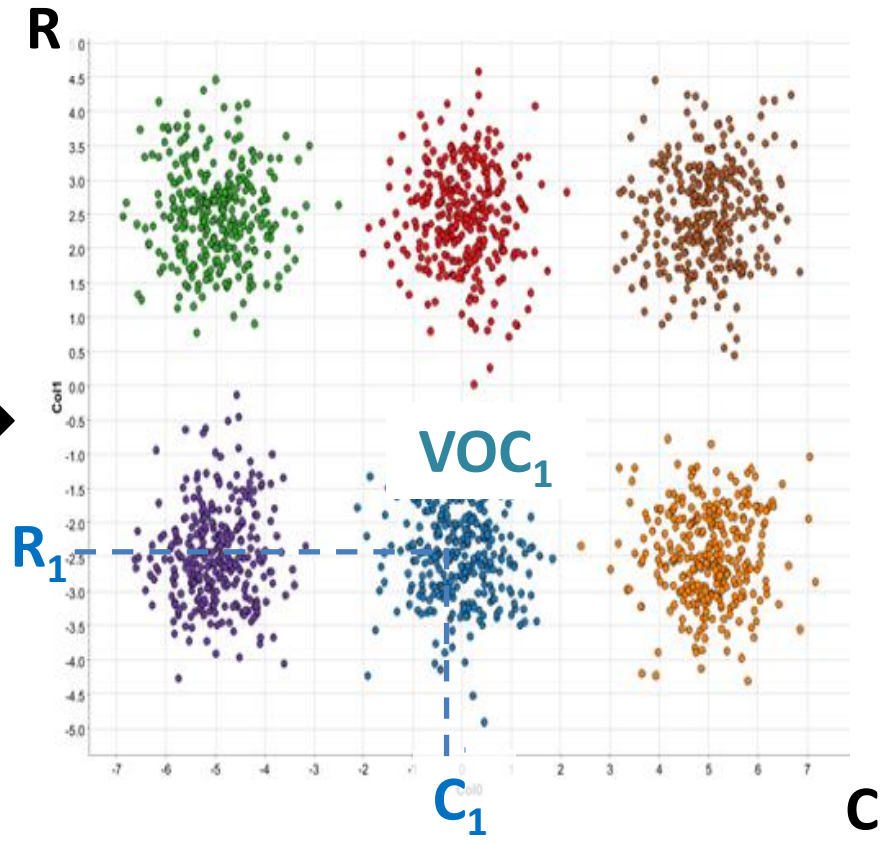
Contract C77 / 08.09.2016 cod SMIS 2014+ 105623

Detecția gazelor de combustie (VOC)







Proiect cofinanțat din Fondul European de Dezvoltare Regională prin Programul Operațional Competitivitate

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Instrumente Structurale 2014 - 2020

DOE (Design of Experiment) for TiO2 nanotubes for VOCs applications

C. Parvulescu, N. Varachiu, R. Tomescu, V. Anastasoaie, D. Cristea
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Abstract: The arrays of TiO_2 nanotubes obtained using electrochemical anodization of titanium metal layers (foils or thin layers deposited on silicon substrate) are promising for VOCs sensors applications. The formation of these nanotube structures takes place simultaneously between the anodic reaction and the chemical dissolution due to the fluoride present in the electrolyte bath.

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Vă mulţumesc pentru atenţie !

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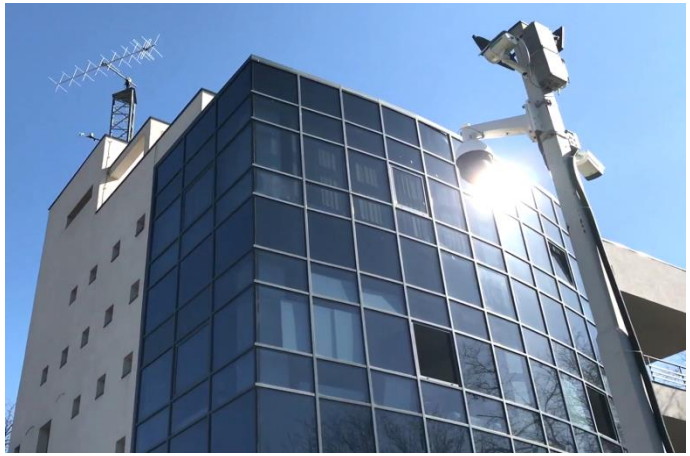
The **Institute of Space Science (ISS)** from Magurele, Romania is carrying out fundamental and advanced technological research in Space Physics and related fields based on previously acquired experience, and international collaborations.

The opportunity of participating in *in situ* space research missions, as well as in major ground based experiments has a major impact on the competence level of staff.



The main domains of activity of ISS are:

- Space related sciences and technology,
- Applications of space communication techniques,
- Hardware for on-board,
- Ground segment and ground based experiments,
- Appropriate computing technologies.

The Institute of Space Science has six laboratories:

- The High Energy Physics, Astrophysics and Advanced Technologies Laboratory
- The Cosmology and Astroparticle Physics Laboratory
- The Theoretical Physics Laboratory
- The Space Plasma and Magnetometry Laboratory
- The Space Applications for Health and Safety Laboratory
- The Gravity, Microgravity and Nanosatellites Laboratory

The main directions for the Research & Development activity are:

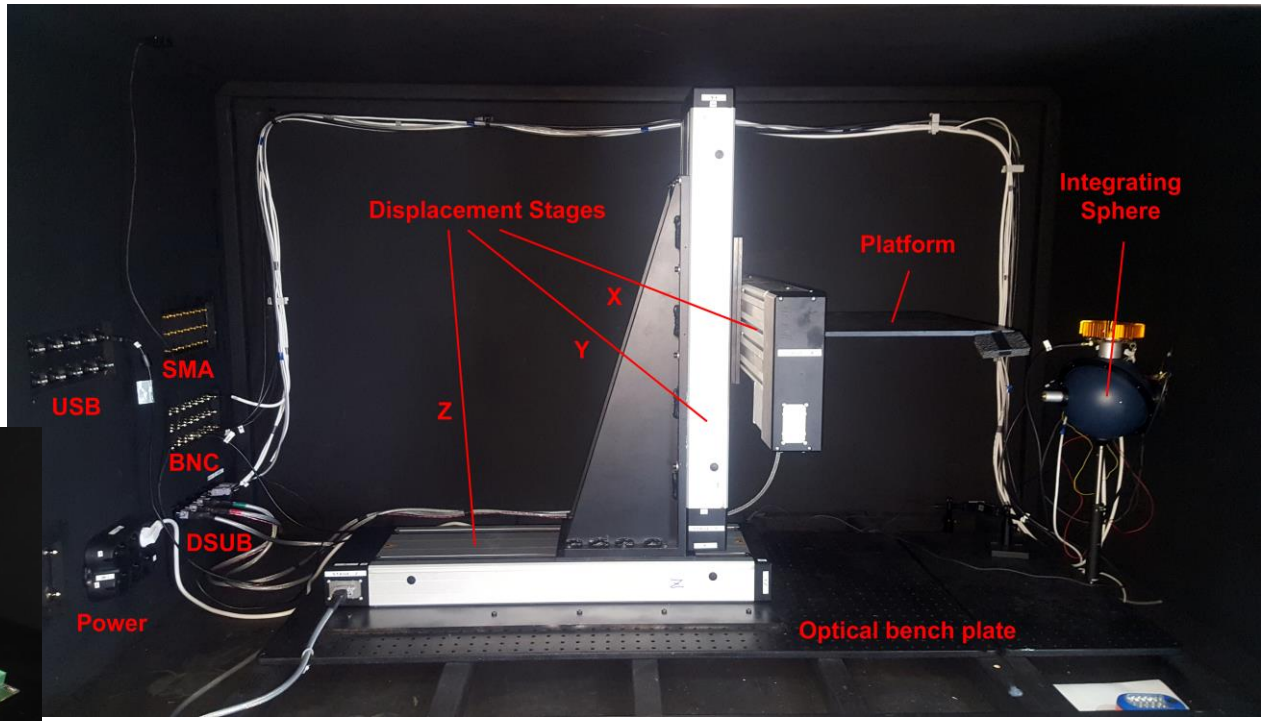
- Theoretical Physics and Mathematical Physics
- High Energy Physics and Astrophysics
- Astro-particle Physics and Cosmology
- Space Technology and Hardware for Space Experiments (on-board and ground segment) and Satellite Data Processing
- Experiments, Data Analysis, and Theoretical Developments on Space Plasma
- Microgravity, Space Dynamics and Microsatellites
- Distributed and Parallel Computing in Space and Terrestrial Researches and Applications.
- Applications of Space and Communication Technologies

Since 2014, the **High Energy Physics, Astrophysics and Advanced Technologies Laboratory** participated in several projects involving the development of:

- Optoelectronic systems and devices,
- Various optical configurations,
- Optical sensor characterization,
- Constellation acquisition using SWIR camera and frame grabbing systems,
- Software applications for image acquisition and processing.

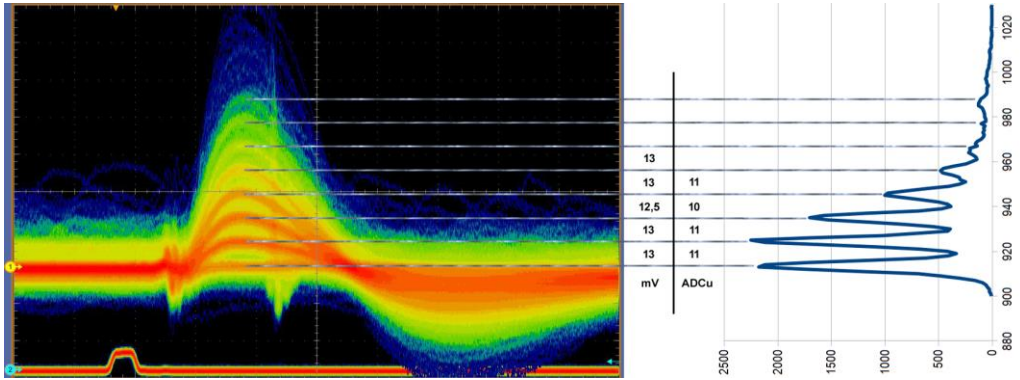
The acquired experience in these projects could prove useful in future projects involving optical communications applications in optical inter-satellite links. Some of our achievements are presented as follows, with possible use in HydRON project, further highlighted in red coloured text.

Dark room with displacement stages for the characterization of photodetector arrays (SiPM arrays)

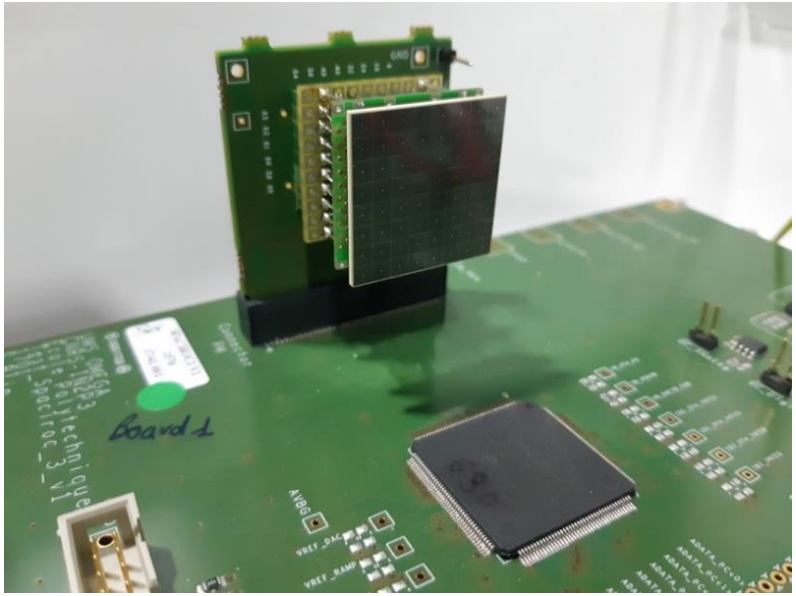


Testing multiple path optical communication receivers.

SiPM array characterization setup in photon-counting mode



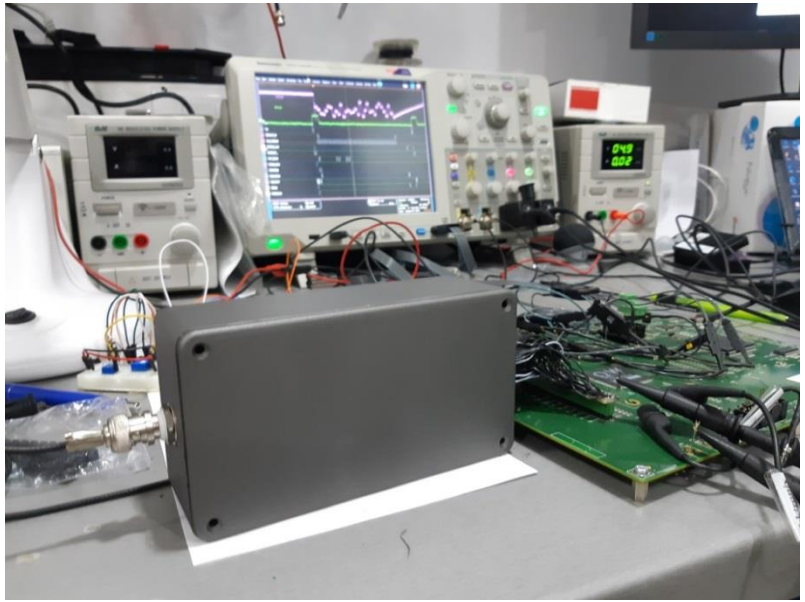
High speed detectors characterization at very low levels of optical intensity of incoming laser data carrier



SiPM arrays characterization as replacement for MAPMT for the detection of UV high and low energy illumination levels

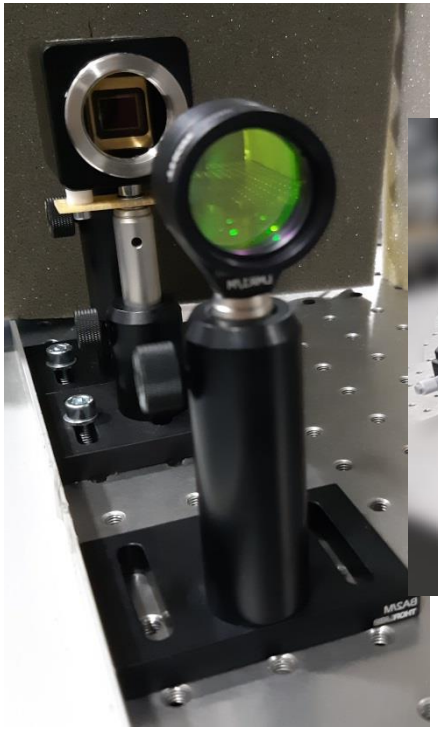
Fast prototyping and testing

"UV shower" simulation and detection with a 32 channel SiPM array

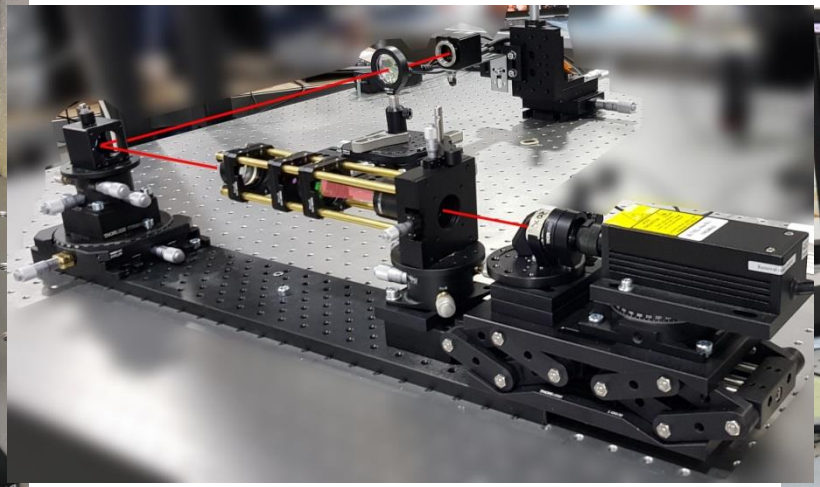


SWIR camera and optics for Constellation Acquisition System

CAS configuration testing for LISA project



Optical setup for laser 1064 nm beam shaping



Software for centroid determination in star base calibration and laser tracking mode

Optical design, optical testing and frame grabbing software for spacecraft positioning and orientation for both star base calibration (star tracking mode) and remote laser tracking mode.

IR FSO solutions from 100Mbps to 10Gbps

Previous acquired experience in optoelectronic communications systems and detection systems (for both military and commercial applications):

- Laser communication system for secure voice communication in tactical field
- Data laser communication system with pulsed diode laser
- Point to Point laser data link with Fast and Giga Ethernet interface (FSO)
- Optical proximity detector for ground-to-air missiles.
- Laser based barriers for border surveillance
- Optoelectronic simulators
- Camera system for remote vision in tactical field

Point to point and point to multipoint data communication solutions and various optoelectronic solutions for ancillary equipment

Thank you!

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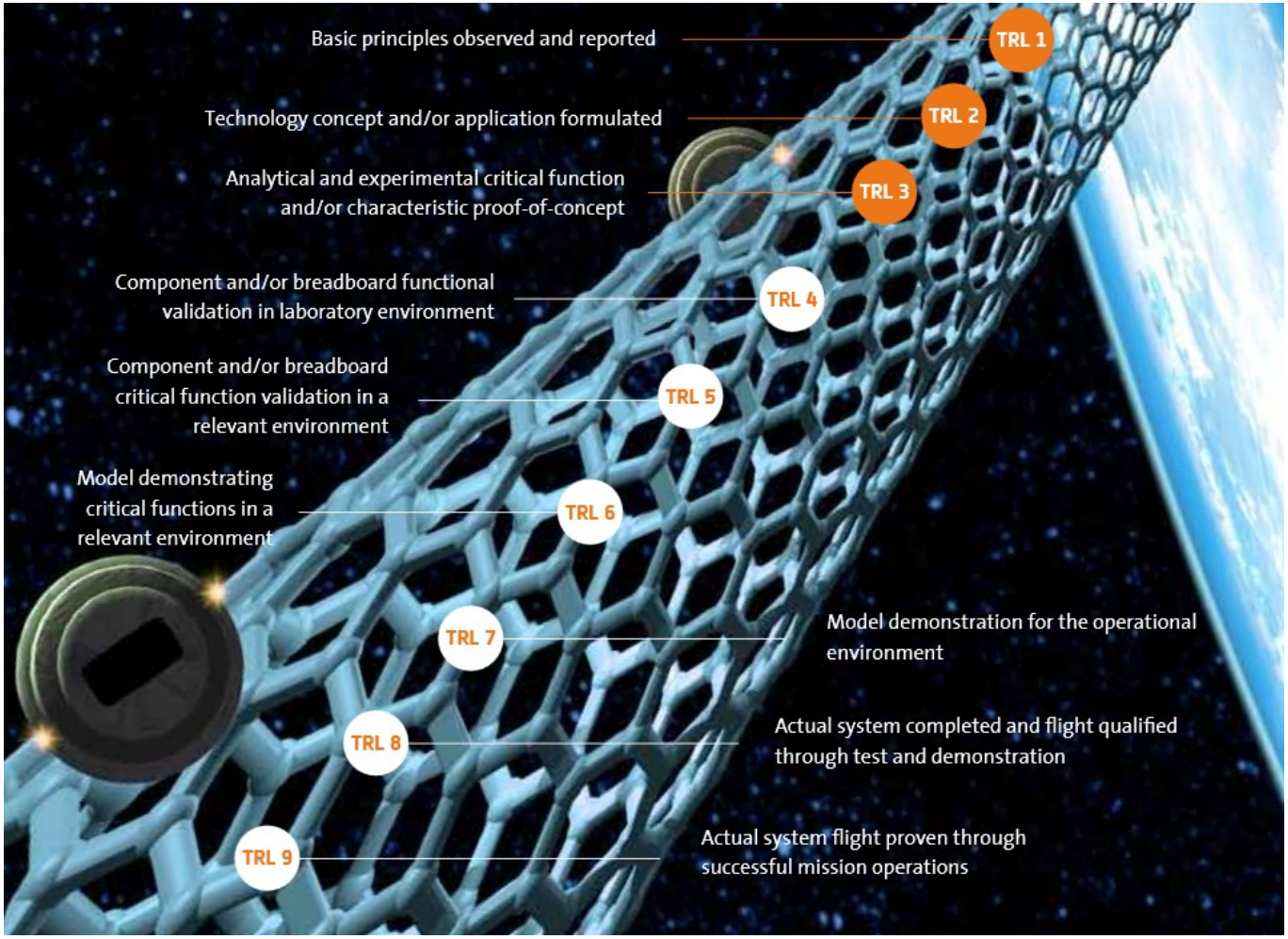
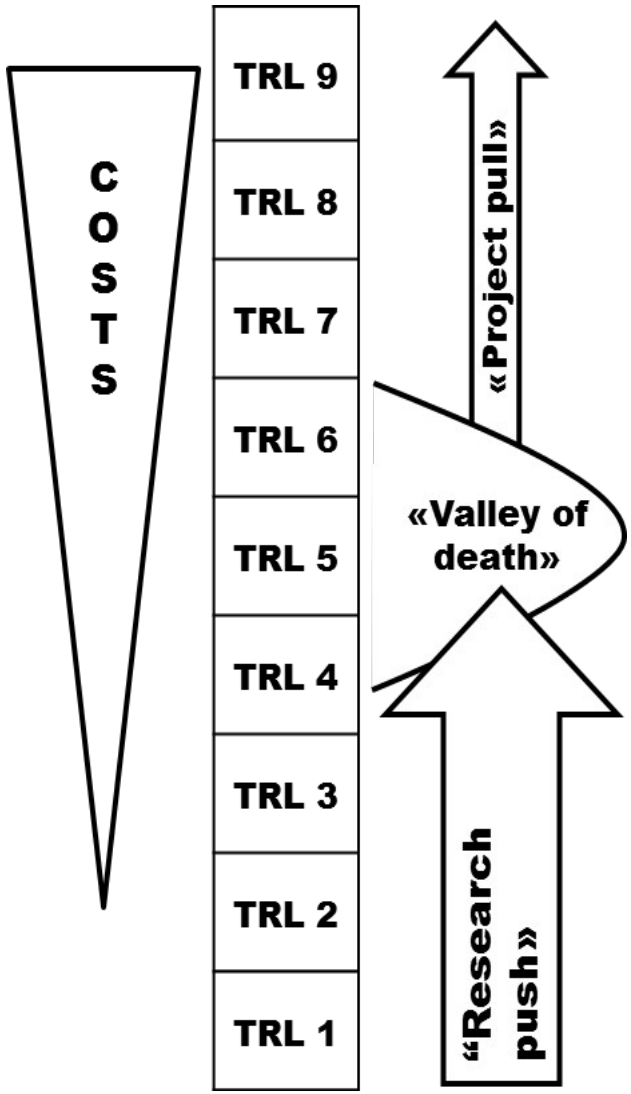
ISO 16290:2013 defines Technology Readiness Levels (TRLs). It is applicable primarily to space system hardware, although the definitions could be used in a wider domain in many cases. The definition of the TRLs provides the conditions to be met at each level, enabling accurate TRL assessment.



Technology Readiness Level Summary

TRL 1:Basic principles observed and reported
TRL 2:Technology concept and/or application formulated
TRL 3:Analytical and experimental critical function and/or characteristic proof-of-concept
TRL 4:Component and/or breadboard functional verification in laboratory environment
TRL 5:Component and/or breadboard critical function verification in relevant environment
TRL 6:Model demonstrating the critical functions of the element in a relevant environment
TRL 7:Model demonstrating the element performance for the operational environment
TRL 8:Actual system completed and accepted for flight ("flight qualified")
TRL 9:Actual system "flight proven" through successful mission operations



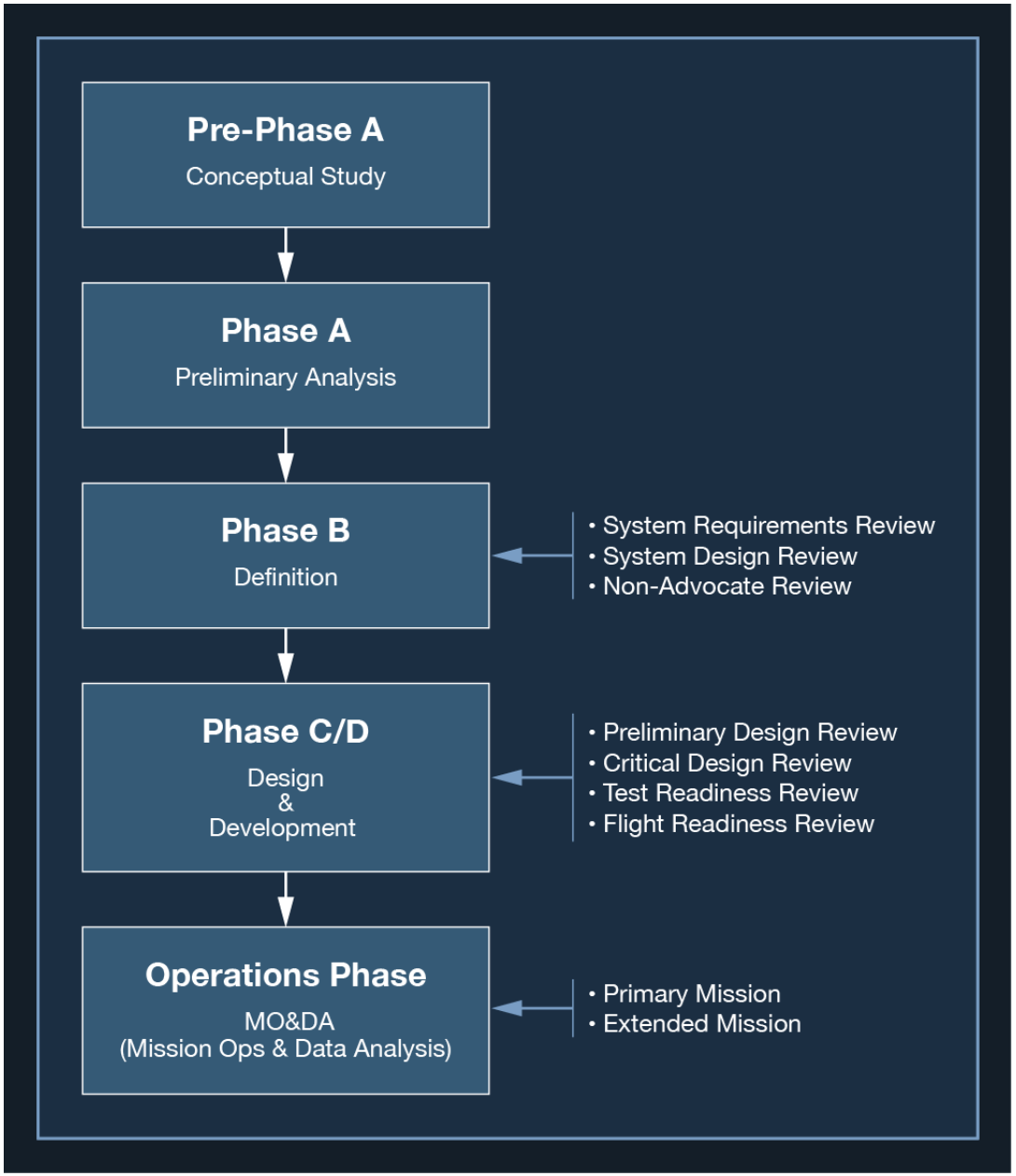
During Research and Development, or Research and Technology (R&T&D) activities, TRL can be used by the specialists developing the technologies to present their development plans (e.g. technology roadmaps) and to communicate with non-specialists or project managers, the costs or risks involved in taking particular technology choices with different TRLs.

In the framework of projects, TRL is used during preliminary phases (0, A, B) as a tool supporting the decision whether or not to use or integrate specific technology in a space mission, and allowing such decision to be taken with sufficient knowledge of any risk relating to the degree of maturity.

Generally R&T&D programs push ("research push") the technologies maturity as far as the intermediate TRLs. Projects then pull some technologies and develop these to the higher levels of maturity.

The intermediate levels of maturity (typically TRLs 4, 5 and 6) are sometimes called "valley of death" since some technologies are developed until TRL 4 or below, however they are not developed beyond this achieved level (i.e. in the absence of a project "pull"), noting that projects are normally interested in TRL 6 or above (see Figure 4-2).

The costs associated with a specific technology achieving a higher level of TRL are generally increasing with each level attained.



Project "Early" Phases

Phase 0 (Mission Definition Review)

• Establish the Technology Readiness Status List - TRSL – listing candidate technologies for the same critical functions
• Re-orient the system concept for optimizing technology readiness and technology selection decision schedule
• TRSL also provides a connection from the project to the technology developers (R&T&D programmes)

Phase A (Preliminary Requirements Review- PRR)

• Contribution to the technology plan (TP)
• Consolidate TRSL within the TP
• Refine list of candidate technologies for the same critical function

Phase B (up to System Requirements Review- SRR)

• Consolidate TRSL within the TP.
• Preliminary identification of items for transfer to critical item list (CIL)

Phase B (from SRR to Preliminary Design Review - PDR)

• Inputs from TRSL to the Critical Item List - CIL
• TRSL provides risk data supporting the decision to move to detailed design phase (C)
• Final selection of (suppliers for) candidate technologies for the critical functions

TRL summary: Milestones and work achievement (reproduced from ISO 16290:2013)

Technology Readiness Level	Milestone achieved for the element	Work achievement (documented)
TRL 1 - Basic principles observed and reported	Potential applications are identified following basic observations but element concept not yet formulated.	Expression of the basic principles intended for use. Identification of potential applications.
TRL 2 - Technology concept and/or application formulated	Formulation of potential applications and preliminary element concept. No proof of concept yet.	Formulation of potential applications. Preliminary conceptual design of the element, providing understanding of how the basic principles would be used.
TRL 3 - Analytical and experimental critical function and/or characteristic proof-of-concept	Element concept is elaborated and expected performance is demonstrated through analytical models supported by experimental data/characteristics.	Preliminary performance requirements (can target several missions) including definition of functional performance requirements. Conceptual design of the element. Experimental data inputs, laboratory-based experiment definition and results. Element analytical models for the proof-of-concept.
TRL 4 - Component and/or breadboard functional verification in laboratory environment	Element functional performance is demonstrated by breadboard testing in laboratory environment.	Preliminary performance requirements (can target several missions) with definition of functional performance requirements. Conceptual design of the element. Functional performance test plan. Breadboard definition for the functional performance verification. Breadboard test reports.
TRL 5 - Component and/or breadboard critical function verification in a relevant environment	Critical functions of the element are identified and the associated relevant environment is defined. Breadboards not full-scale are built for verifying the performance through testing in the relevant environment, subject to scaling effects.	Preliminary definition of performance requirements and of the relevant environment. Identification and analysis of the element critical functions. Preliminary design of the element, supported by appropriate models for the critical functions verification. Critical function test plan. Analysis of scaling effects. Breadboard definition for the critical function verification. Breadboard test reports.

Technology Readiness Level	Milestone achieved for the element	Work achievement (documented)
TRL 6: Model demonstrating the critical functions of the element in a relevant environment	Critical functions of the element are verified, performance is demonstrated in the relevant environment and representative model(s) in form, fit and function.	Definition of performance requirements and of the relevant environment. Identification and analysis of the element critical functions. Design of the element, supported by appropriate models for the critical functions verification. Critical function test plan. Model definition for the critical function verifications. Model test reports.
TRL 7: Model demonstrating the element performance for the operational environment	Performance is demonstrated for the operational environment, on the ground or if necessary in space. A representative model, fully reflecting all aspects of the flight model design, is build and tested with adequate margins for demonstrating the performance in the operational environment.	Definition of performance requirements, including definition of the operational environment. Model definition and realisation. Model test plan. Model test results.
TRL 8: Actual system completed and accepted for flight (“flight qualified”)	Flight model is qualified and integrated in the final system ready for flight.	Flight model is built and integrated into the final system. Flight acceptance of the final system.
TRL 9: Actual system “flight proven” through successful mission operations	Technology is mature. The element is successfully in service for the assigned mission in the actual operational environment.	Commissioning in early operation phase. In-orbit operation report.

Important aspects in the application of TRL:

• TRL assessment is not intrinsic to a technology: if a new target environment has different constraints or performance requirements, a TRL needs to be reduced (e.g. a TRL 9 in one application falls even as far as TRL 4 in another).
• TRL 5 and higher are assessed to a specific mission environment. When an element at a TRL higher than 5 is intended to be used in a different environment, in this case there is a potential that the TRL is downgraded.
• TRL does not take into account industrial capacities of production or technology access constraints (e.g. export control regulations).
• TRL does not take into account technology obsolescence, however conversely obsolescence can drive the need for a TRL re-assessment.
• If the production of anything inside an element is discontinued, the TRL of the element can be affected (see example "Heritage category C" in Table 7-3).
• TRL does not replace development cycle or quality rules.
• TRL is not mandatorily incremental: it is not mandatory to achieve level 5 (sub-scale) before proceeding to level 6. More generally, it is not mandatory to go systematically through all levels.
• A TRL can only be reached by an element if all of the sub-elements are at least at the same level.
• An R&T&D action does not necessarily lead to an increment in TRL.
• The time or effort to move from one TRL to another is technology dependent and cannot be linearly projected along the TRL scale.
• The proof necessary for the assessment of TRL is as follows:
− For TRL 7 and 8, when the derivation of the evidence for the assessment of TRL is based on testing, the test is performed using the requirements of ECSS-E-ST-10-03. It is important to note that testing alone is not sufficient when assessing a product for TRL 7 and TRL 8.
− However, for TRL 1 to 6 where the derivation of the evidence for the assessment of TRL is selected to be based on testing, the test is performed using the state-of-the-art rules relevant to the TRL being assessed. For further details of the expected documentation see clause 5.