A satellite event of the International Symposium

PRIOCHEM 2023 - **Priorities of Chemistry for a Sustainable Development**

organized by National Institute for Research & Development in Chemistry and Petrochemistry - **ICECHIM**

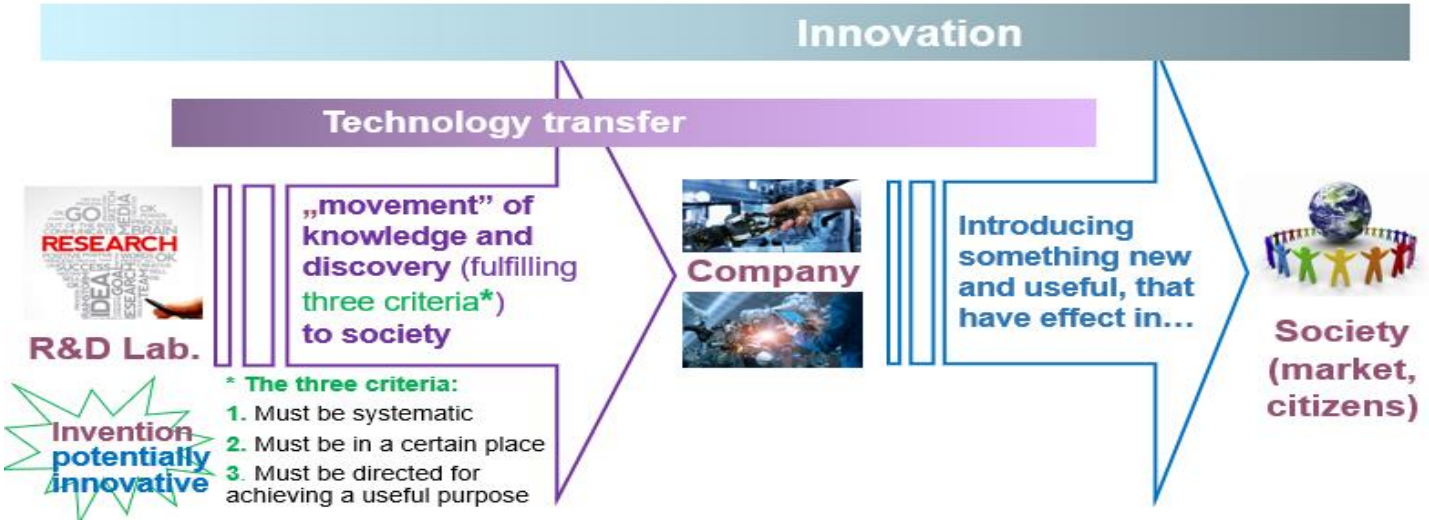
the round table:

Innovation way

from wishful thinking to real-life applications

Wednesday **11th** of October 2023, **9:00-10:00** hours (EET),

ICECHIM, Splaiul Independenței 202, Bucharest, ROMANIA,



Round table moderator: dr. Nicolae Varachiu, Innovation Manager – ICECHIM Bucharest

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

International Symposium

PRIORITIES OF CHEMISTRY FOR A SUSTAINABLE DEVELOPMENT

PRIOCHEM XIXth Edition

Round Table

Innovation way

*from wishful thinking **to** real-life applications*

Moderator:

Dr. Nicolae Varachiu, Innovation Manager ICECHIM

11th of October 2023, Bucharest, Romania

Innovation “way”

the first occurrence of an idea for a **new product** or **process**

the first attempt to **carry it out into practice**

Creativity

new ideas: **invention***

"bringing ideas to life“: **innovation**

Innovation is typically understood as the **successful introduction** of something **new** *and* **useful,** ***i.e. it has effect in society***

*patentable or not;
further implemented, it could generate a **new product** or **process**
potentially innovative, able to became
an **innovation** when **successfully introduced** for the benefit of the society

Innovation process

out of **3000 ideas** for new products

only one becomes a success in the marketplace

Innovations that fail are often **potentially** 'good' **ideas but have been** rejected **or** 'shelved' **due to:**

- budgetary constraints,
- lack of skills
- bad operational execution *or*
- poor fit with current goals

Good-to-great ideas is the easy part in **innovation process**

Selecting *the right ideas* and implementing them is the hard stuff

From an invention To a famous (world) innovation

Ana Aslan, using procaine (teeth anesthetic) in antiaging treatments, preparing vitamin H3, patented in 1952, in 30 countries:

Konrad Adenauer, Charlie Chaplin, Kirk Douglas, Salvador Dali, Marlene Dietrich, Indira Gandhi, Charles de Gaulle, N.S. Hrusciov, J.F. Kennedy,, Imelda Marcos, Tito,

Coca Cola, a huge step from **invention** to **innovation**

- In **1886** the curiosity of an Atlanta pharmacist, **Dr. John S. Pemberton**, led him to create a distinctive tasting soft drink that could be sold at soda fountains.

Dr. Pemberton's partner and bookkeeper, *Frank M. Robinson*, is credited with naming the beverage "Coca-Cola" as well as designing the trademarked, distinct script, still used today.

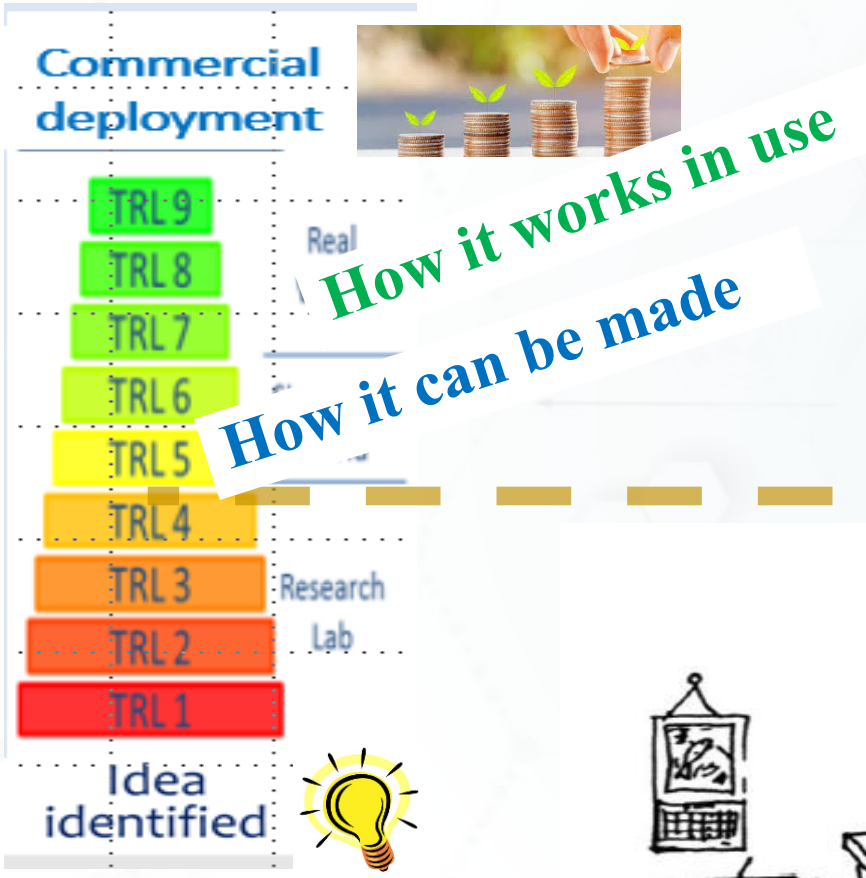
in **1888**, Dr. Pemberton sold to Atlanta businessman, **Asa G. Candler**. Under Mr. Candler's leadership,

Large scale bottling in **1899:** three enterprising businessmen in Chattanooga, Tennessee secured **exclusive rights to bottle and sell Coca-Cola** by *purchasing the bottling rights from Asa Candler* **for just $1.**

Benjamin Thomas, **Joseph Whitehead** and **John Lupton** *developed what* **became the Coca-Cola worldwide bottling system.**

https://www.worldofcoca-cola.com/about-us/coca-cola-history/

Technology Readiness Level TRL 4 wall



How it works in use

How it can be made

Innovation

Technology Transfer

R&D Lab

Movement of knowledge and discovery (that fulfill the **three criteria***) **to …**

Company

Introduce something new and useful that has effect in ….

Society (market, citizens)

Inventions
potential
innovative

*

1. systematic
2. in a certain place
3. directed for achieving a useful purpose

one of the earliest known uses of nanomaterials by the Romans, AD 300s

KUNGL. VETENSKAPS-AKADEMIEN
THE ROYAL SWEDISH ACADEMY OF SCIENCES

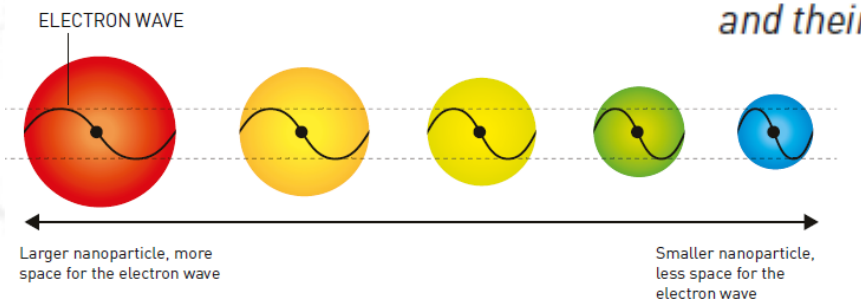
THE NOBEL PRIZE IN CHEMISTRY 2023

POPULAR SCIENCE BACKGROUND

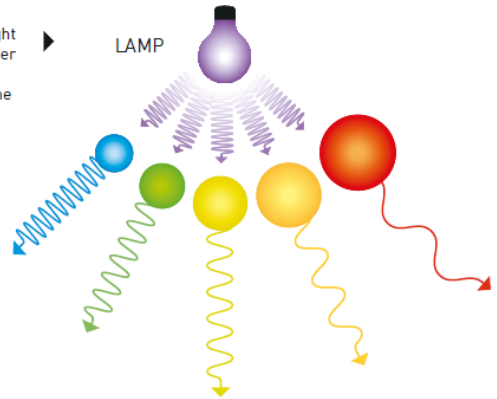
***Moungi G. Bawendi**, **Louis E. Brus** and **Alexei I. Ekimov** are awarded the Nobel Prize in Chemistry 2023 for the discovery and development of quantum dots. These tiny particles have unique properties and now spread their light from television screens and LED lamps. They catalyse chemical reactions and their clear light can illuminate tumour tissue for a surgeon.*

Quantum effects arise when particles shrink

When particles are just a few nanometres in diameter, the space available to electrons shrinks. This affects the particle's optical properties.



Quantum dots absorb light and then emit it at another wavelength. Its colour depends on the size of the particle.



They added colour to nanotechnology

Quantum dots have given us new opportunities for creating coloured light.

Alexei Ekimov maps the mysteries of coloured glass

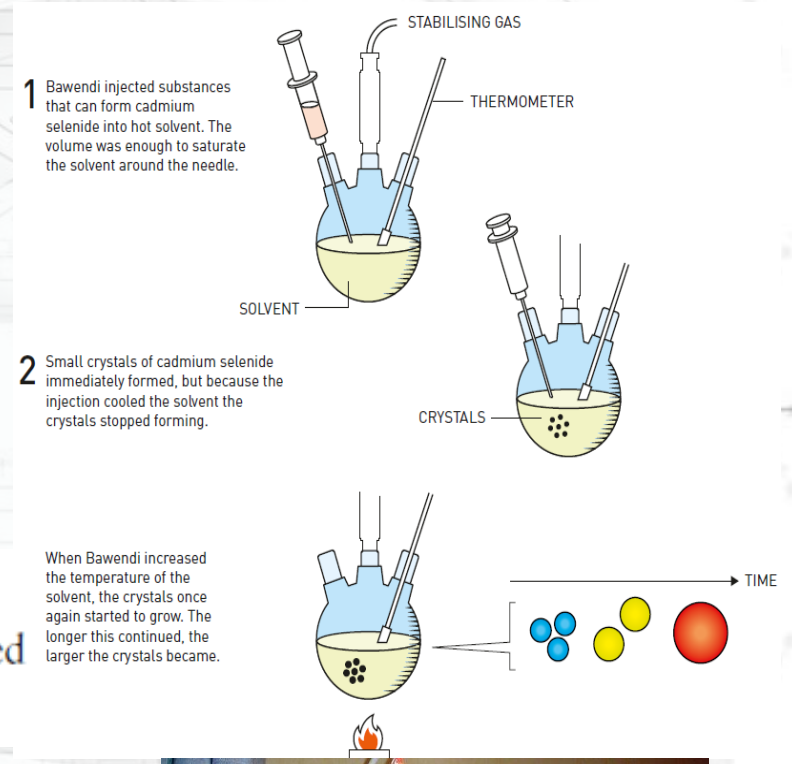
This was the first time someone had succeeded in deliberately producing quantum dots – nanoparticles that cause size-dependent quantum effects. In 1981, Ekimov published his discovery in a Soviet scientific

Brus shows that the strange properties of particles are quantum effects

Just like Ekimov, Brus understood that he had observed a size-dependent quantum effect. He published his discovery in 1983 and then started investigating particles made from a range of other substances. The pattern was the same – the smaller the particles, the bluer the light they absorbed.

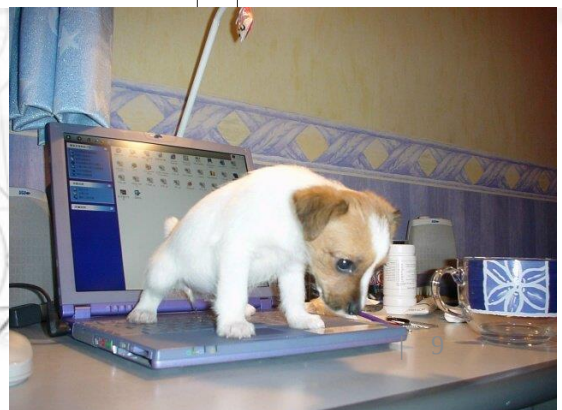
Moungi Bawendi revolutionises the production of quantum dots

The nanocrystals that Bawendi produced were almost perfect, giving rise to distinct quantum effects. Because the production method was easy to use, it was revolutionary – more and more chemists started working with nanotechnology and began to investigate the unique properties of quantum dots.



The luminous properties of quantum dots find commercial uses

The luminous properties of quantum dots are utilised in computer and television screens based on QLED technology, where the Q stands for quantum dot. In these screens, blue light is generated using the energy-efficient diodes that were recognised with the Nobel Prize in Physics 2014. Quantum dots



Thank you !

nicolae.varachiu@icechim.ro

Innovation way 11th of Oct. 2023

Rize

Clarity & evidence
on your regeneration efforts

x

regen insight

Rize - 3 years of R&D

Start-up **founded late 2020**

20 people

Platform (v3 released in 2022)

Proprietary **R&D**

FUTURE 40 by STATION F

400+ farms

Pilot project

Launch

Two brands

Project development

Rize

MRV platform

regen insight

The MRV solution to enable your carbon projects

regen insight

Our mission

Enabling the scalability of your carbon farming projects

Carbon project developer

Farming industry

Food industry

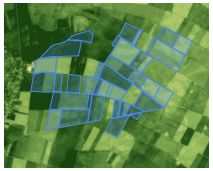
Drive your own regenerative agriculture programme

Prove your scope 3 reductions

Offer insetting or offsetting opportunities

The applications

Digitally enabled monitoring



Robust MRV* system

Modular framework

*Monitoring, Reporting and Verification

Fast scaling with streamlined onboarding

regen insight

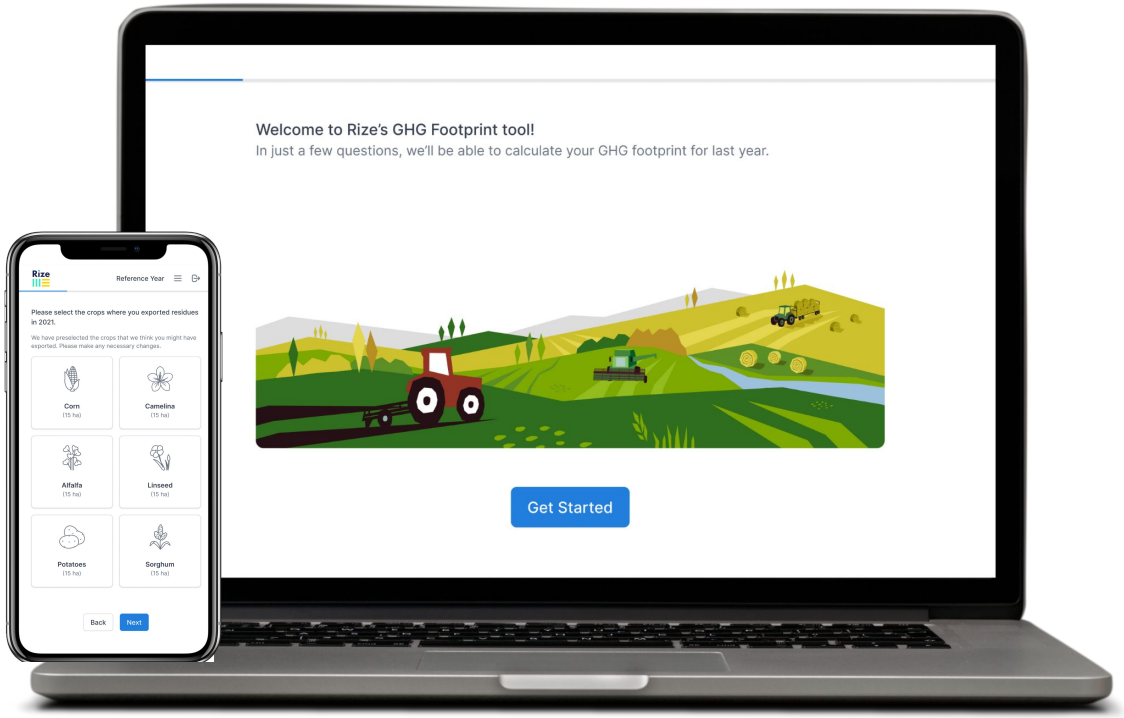
Focus your time on value-adding activities

1h

Farmer onboarding time

20x

faster than industry standards



High-quality environmental assessments

regen insight

Meet the highest scientific standards available - using 1000s of data points per calculation

Cropland carbon calculator

GHG emissions model

Tier 3 soil model

Soil samples

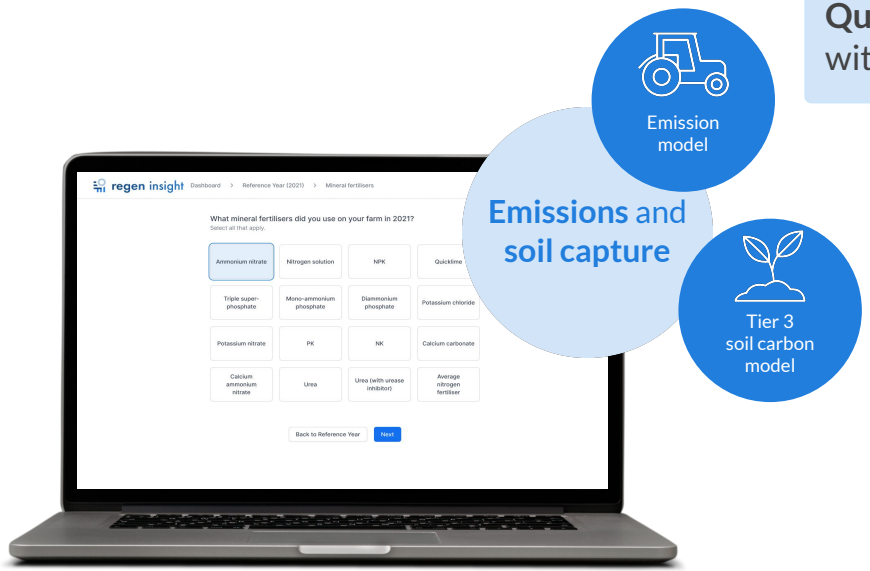
Improve the analytics with the sample results you have

Embedded certification protocol

Compliance with GHG leading standards

Now collaborating with low carbon fertilisers

Enabling farmers to value gains from new fertiliser ranges



Quantify carbon gains from fertilisers
within an ISO-compliant assessment

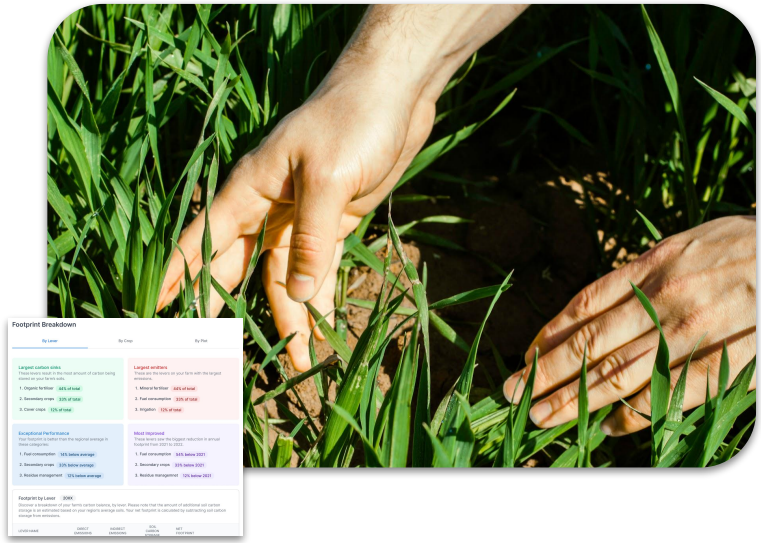
Generate value
from carbon credits or scope 3 reduction

Accelerate adoption
of low carbon fertilisers

Insightful results

regen insight

Capitalise on actionable insights to better achieve your objectives



Results granularity

Results breakdown:

- GHG emissions
- Carbon storage
- By plot
- By set of practices

Cobenefits

Comparable results

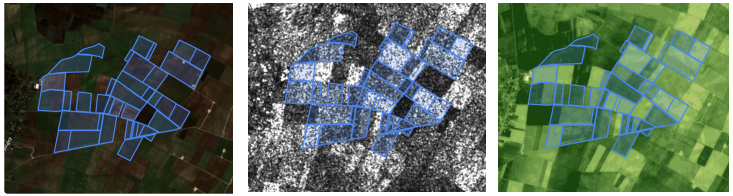
Assisted verification process

regen insight

Efficiently manage your verification process, and reduce process costs

Audit tool

Straightforward, lean and explicit verification processes



Satellite based verification

Crop analytics

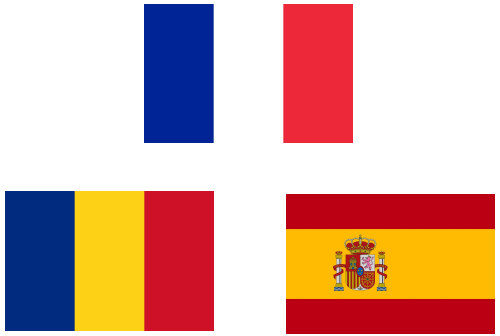
Farm dataroom

Farm data verification

Regen Insight: the powerhouse of success stories

regen insight

The infrastructure behind Rize, now launching new partnerships across Europe



projects in 3 countries

Book a demo

Visit our website
www.regeninsight.com

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DDS DIAGNOSTIC

Andreea Mirică
Junior 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

- ✓ Development of selective and ultra-sensitive microsensors with electrochemical detection, easy to use, portable and suitable for mass production, which can electrochemically detect residues of pesticides, anticancer drugs, proteins.
- ✓ Biofunctionalization of the micro or nanoparticles of various materials: polymers, paramagnetic or gold particles. These are used in the detection of certain antigen or antibody, biomarkers from biological human samples.
- ✓ Development of lateral flow immuoassays for rapid and sensitive detection of cardiac bio-markers in acute myocardial infarction (AMI), viral infectios and microorganisms.
- ✓ Development of molecular diagnostic kits (RT-PCR) for viral infectios.
- ✓ Develop production and international sales
- ✓ Fund expansion via private & EU funds

DDS DEPARTMENTS

Production

Sales and Marketing

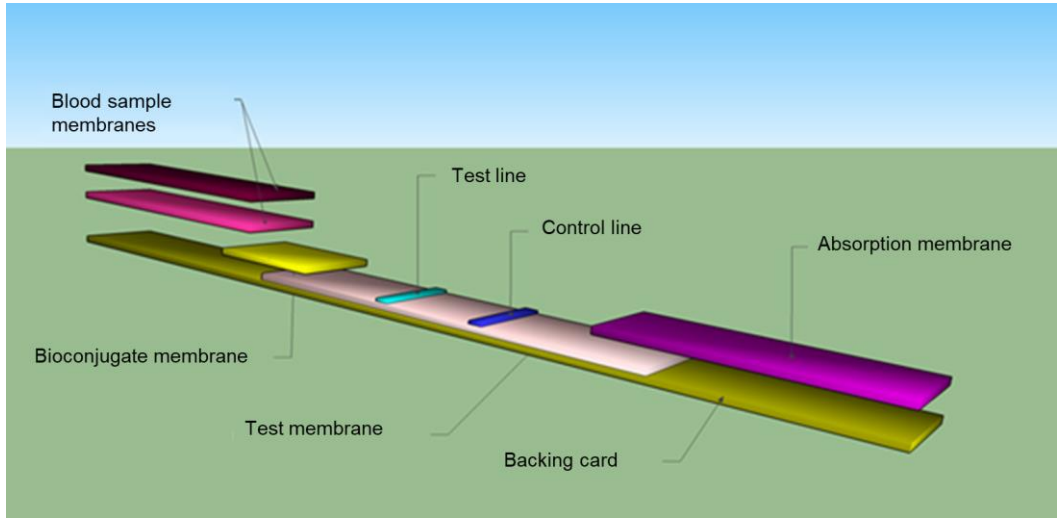
Logistics

Research and Development

Technical Support

Regulation

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 and Molecular Biology product, offering*** into additional segments, building on high awareness and rapid adoption.

OUR PURPOSE

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

OUR PROJECTS

PROJECT	STATUS
Implementation of the biomedical research expertise by transfer of knowledge to the private environment for the validation of products and services in the fields of medical and health biotechnologies, INTELBIOMED, Fondul European de Dezvoltare Regională prin Programul Operațional Competitivitate 2014-2020 (POC).	COMPLETED
Electrochemical microsensors for drug detection: codeine and morphine, DROGSENSE, Proiect cofinanţat din Fondul European de Dezvoltare Regională prin Programul Operaţional Competitivitate 2014-2020	COMPLETED
Increasing competitiveness by innovation and improvement of the manufacturing process through gamma irradiation, GAMMAPLUS, Fondul European de Dezvoltare Regională prin Programul Operaţional Competitivitate 2014-2020, Axa Prioritară 1 – Cercetare, Dezvoltare tehnologică și inovare (CDI) în sprijinul competitivității economice și dezvoltării afacerilor.	COMPLETED
Innovative approaches in the treatment and control of patients infected with SARS-COV-2 virus, SOLUȚII, Unitatea Executiva Pentru Finantarea Invatamantului Superior a Cercetarii Dezvoltarii si Inovarii -UEFISCDI, in cadrul PNIII, Programul 2- Creşterea competitivităţii economiei româneşti prin cercetare-dezvoltare şi inovare, domeniul de prioritate publică “Sănătate”, Competiţia SOLUŢII -2020 -1.	COMPLETED
Technology for the fabrication of microbiosensors prototypes with rapid detection through förster resonance (fret) for early diagnosis of acute myocardial infarction, CardioFRET, Proiect finantat din bugetul de stat și cofinanțat de DDS Diagnostic.	COMPLETED
Plamonic and dielectric metasurfaces as platforms for fluorescence enhancement, MetaFLEN, Executive Agency for Higher Education, Research, Development and Innovation Funding – UEFISCDI	COMPLETED
Impedimetric biosensor based on vertical graphene, integrated with a microfluidic system for monitoring the plasma levels of anti-tumoral agents, NEOPLACIP, Unitatea Executivă pentru Finanțarea Învățământului Superior, a Cercetării, Dezvoltării și Inovării.	ONGOING
Specific RDI Project 4: Sustainable bio-products, added-value products and energy from marine macroalgal: a step toward circular economy (MARALTECH).	ONGOING
Unlocking data content of Organ-On-Chips, Call: HORIZON-KDT-JU-2023-1-IA	PROPOSAL

Innovation way: from wishful thinking to real-life applications

THE IDEA: project "Innovative approaches in the treatment and control of patients infected with the SARS-CoV-2 virus" - SOLUŢII -2020 -1, a project financed by UEFISCDI and co-financed by DDS Diagnostic.

The OBJECTIVE: Development of a "lab-on-a-chip", "Point-of-care" device for controlling SARS-CoV-2 infection and testing the effectiveness of the treatment applied in hospitals to patients with moderate and severe forms of COVID 19.

THE RESULT: a new RT-PCR kit for the qualitative and quantitative detection (qRT-PCR) of SARS-COV-2 virus. It is a multiplex type reaction, the kit simultaneously detecting 3 genes, namely: the N gene, which codes for the viral nucleoprotein, which lines the nucleus of the virus; the nsp 10 gene, which codes for a "growth factor" type protein and the RNase P gene, which codes for an exonuclease, originates from the patient and serves as an internal control. In addition to the primers, 3 fluorescently labeled probes related to each gene were also constructed: FAM for the N gene, Cy5 for the ORF1ab sequence and HEX for the internal control.

The RT-PCR kit produced by DDS Diagnostic has CE marking and specific technical characteristics highly relevant compared to the best similar products on the market.

THANK YOU!

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Innovation in Space Technologies

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Innovation in Space Technologies

- **What is innovation?** (OECD)

  The implementation of a new or significantly improved product (good or service) or process, a new marketing method or a new organizational method in business practices, workplace organization or external relations.

  How many types of innovation are there? (OECD)

  1. **Incremental innovation**, also known as continuous improvement, refers to improving a product or service that already exists. It is less 'spectacular' and disruptive than other types of innovation, but incremental innovation is effective when addressing transformation issues within the company.
  2. Adjacent innovation, is a typical example of a successful expansion. It refers to using existing capabilities (like technology or knowledge) to appeal to a new audience or enter a new market. This provides a competitive advantage to the original product or service that allows it to be differentiated in the market.
  3. Disruptive innovation, refers to the actions taken by a smaller company to shake up an industry by targeting its large, existing competitors' overlooked segments.
  4. Radical innovation, is the creation of a brand new product or service that nobody expected and that tends to impose itself on the life of users. Television and the smartphone are two typical examples of radical innovations that have changed our daily lives.

Innovation in Space Technologies

Where are we?

- Organizations everywhere are facing mounting pressure to transform – to shift from product-centric business models to new models focused on creating and capturing different sources of new value. As a result, **innovation is becoming more complex**.
- At the heart of this transformation is **the fourth industrial revolution (4IR)**. Here, manufacturing is fast becoming the digital manufacturing enterprise (DME) which is designed to increase response rate and manage in more efficient, connected, and effective ways.
- We are all becoming **more connected** in the way we work, collaborate, and manage. Organizations are attempting to "fuse" different technologies to manage the existing physical world differently and are preparing themselves for the interplay between the physical and virtual world.
- The **4IR and space** have a positive, mutually reinforcing relationship: Scientific advancements and the convergence of technologies are leading to advances in space exploration, while advances in space are leading to the creation of new technologies and applications. Advances in blockchain technology, artificial intelligence (AI), 3D printing, materials science, nanotechnology, and biotechnology have led to two key trends—decreasing launch costs and increasing capabilities of smaller satellites—both of which are leading to new capabilities for the sake of exploration and with direct benefit to society on Earth.

Innovation in Space Technologies

Innovation for Space exploration is fueling the 4IR

- **Advanced materials**, such as carbon fiber and advanced composites, are also being used for rockets, significantly decreasing their overall weight and saving millions of dollars in the fuel needed for launch.
- **3D printing** is lowering spacecraft manufacturing costs, especially for rocket engines—oxygen and kerosene engines now take only 24 hours to produce using 3D printing.
- Going forward, companies and governments are exploring how 3D printing in orbit can be expanded to take **advantage of the microgravity** in space to print fiber optic cables, tools, and construction materials in new, more effective ways.
- **Reusable rockets** are also becoming a reality, making trips to the lower Earth orbit more sustainable and accessible going forward for individuals and for companies in industries
- Decreasing launch costs are increasing the popularity of **small satellites**. Compared to constellations of fewer, larger satellites, these constellations of small satellites are significantly cheaper to make, faster to produce, and easier to troubleshoot due to advances in 3D printing and materials science coupled with improvements in processing power, data storage, camera technology, solar array efficiency, miniaturization, and propulsion.
- The increase in small satellites has led to a huge growth in **sensors** which is shepherding the entry of new companies that leverage remote sensors in space to be able to capture images and power technologies on Earth

Innovation in Space Technologies

Key players in the Space 4IR

- The decreasing costs coupled with more widespread technological adoption underpinned by the 4IR has led to an **unprecedented era of accessibility for new players in the space industry**, from state actors to private companies. As of 2021, the global space industry was made up of over 10,000 private space technology companies, 5,000 large investors, 130 state organizations, and 20 business sectors.
- The **United States** is the leader in both public space investment (at $54.6 billion in 2021—almost 60 percent of global government investment in space) and private space investment in terms of the number of companies in the industry (the United States has almost ten times as many space companies as the next country—the **United Kingdom**).
- **China**'s commitment to space investment as a driver for economic competitiveness has quickly catapulted the country to global leadership in space. Second to the U.S. in space investment and innovation, China spent $10.3 billion on space programs in 2021, increasing satellite launches, applications, and imagery.
- 20 countries across four continents have civil space budgets of more than $100 million, while 70 countries have active space programs including more recent additions like the Philippines in 2019 and Rwanda and Costa Rica in 2021.
- India, South Korea, Israel, and EU members are increasingly investing in space missions, while Pakistan, Laos, Belarus, and Venezuela are purchasing satellites in collaboration with China.

Innovation in Space Technologies

Key players in the 4IR (cont'd)

- African countries have also invested in their space industry, now having launched the first satellite to be entirely developed in Africa.
- The United Arab Emirates was applauded for being the first country of its scale to launch a scientific mission to Mars.
- Regional organizations are investing in space as well, with the recent addition of the Latin American and Caribbean Space Agency (ALCE) joining the European Space Agency (ESA) and the Asia-Pacific Space Cooperation Organization (APSCO).
- Commercial space activity is at the center of the "modern space race," having tripled from $110 billion to almost $357 billion from 2005 to 2020. Ex.: SpaceX, Blue Origin, and Virgin have been competing to become leaders in space tourism and communications. (See: https://universemagazine.com/en/how-private-money-changed-the-space-industry/ , "How private money changed the space industry")

Innovation in Space Technologies

Opportunities

- The trends in space technology are leading to groundbreaking capabilities from space-to-Earth activities to space-to-space activities that could be of direct benefit to more players.
- As more players are able to invest in space, they will have potential to engage in meaningful diplomacy on a global stage.
- The potential for space to become an area where countries and regions can come together to advance common goals despite ongoing economic, geopolitical, or social conflicts on Earth.

Key Challanges Ahead

- Geopolitical tensions also thwart attempts at partnerships leading to the duplication of efforts and the rise of security concerns as major powers such as the United States, China, and Russia become more polarized.
- Economic, geopolitical, and social problems on Earth would not disappear in the context of space, but there are still areas of common interest among different partners that space technology can help with, such as developing of vaccines, tracking natural disasters, and assessing water quality.

Innovation in Space Technologies

Key Challanges Ahead (Cont'd)

- The rise of private companies in space, while presenting major opportunities, also presents major risks. Right now, there is a lot of first-mover advantages as some space exploration and space technology applications are at the initial stages of development. There is thus a risk that private entities could establish monopolies on certain areas—for example broadband—whose incentives may not align with those of governments or society.

Innovation in Space Technologies

European Space Agency's OPEN SPACE INNOVATION PLATFORM

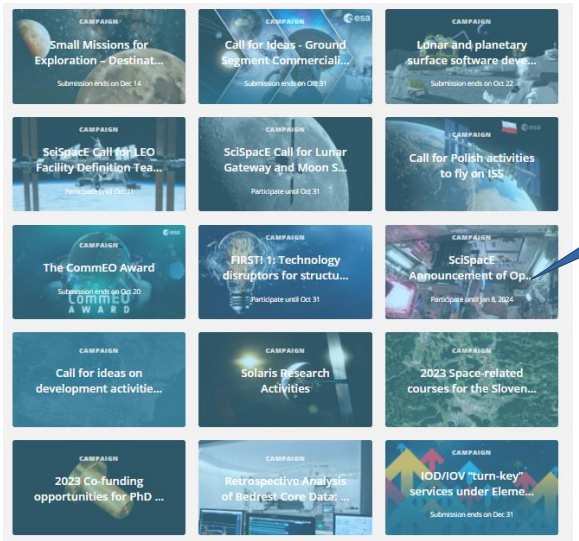
In 2019, ESA launched OSIP to better serve the emerging needs of the modern space sector. The platform is now the main entry point for novel ideas into ESA, both in response to specific problems and through open calls for ideas.

Anybody is welcome to submit ideas for new space technologies and applications via OSIP. The platform supports individuals who wish to contribute to European space research and interact with space industry experts. It also encourages ideas from legal entities interested in interacting with ESA and gaining funding or support for new research activities.

Innovation in Space Technologies

European Space Agency's OPEN SPACE INNOVATION PLATFORM (Cont'd)

OSIP sources ideas through two routes – Campaigns and Channels. Campaigns search for solutions to specific questions and typically have a well-defined, relatively short timeline. Channels seek ideas and collaboration on more general topics and have a more open timeframe. Campaigns and Channels can be run by all ESA programmes and partners to collect new ideas.



Campaigns

Channels

International Symposium: **PRIOCHEM** XIXth Edition, 2023

Round Table: **Innovation way *from*** *wishful thinking* ***to*** *real-life applications*

Innovation way: an example of seed coating using the Wurster process

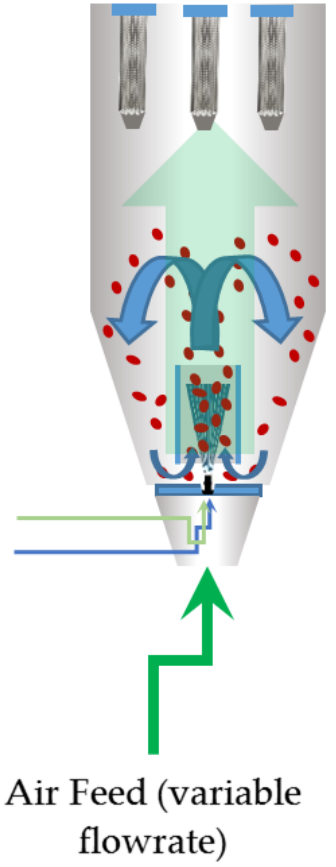
Dr. Bogdan Trică, ICECHIM

11th of October 2023, Bucharest, Romania

The **Wurster process** is a method **to coat seeds** for various purposes in an efficient, cost-effective method: we used a sodium alginate/glycerol film to coat Mung seeds at micrometric scales.

¤	¤	¤	Min¤	Max¤	X_{med}¤	ΔX¤	Min¤	Max¤
Liquid·flow·rate·(FA)¤	mL/min¤	¤	2¤	4¤	3¤	1¤	−1¤	1¤
Seed·mass·(FB)¤	g¤	¤	20¤	40¤	30¤	10¤	−1¤	1¤
Backpres-sure·period·(Fc)¤	s¤	¤	2¤	10¤	6¤	4¤	−1¤	1¤
Nozzle·pres-sure·(FD)¤	bar¤	¤	1.2¤	2¤	1.6¤	0.4¤	−1¤	1¤

Exp.¤	Liquid·Flow·Rate·¶ (A)¤	Seed·Mass (B)¤	Backpressure·Pe-riod·¶ (C)¤	Nozzle·Pres-sure·(D)¤	Final·Pressure¤	Final·Time¤	Final·¶ Volume¤
¤	mL/min¤	g¤	s¤	bar¤	bar¤	min¤	mL¤
1¤	4·[1]¤	40·[1]¤	2·[−1]¤	1.2·[−1]¤	0.9¤	16.5¤	74.73¤
2¤	4·[1]¤	20·[−1]¤	10·[1]¤	1.2·[−1]¤	0.9¤	11.73¤	50.75¤
3¤	2·[−1]¤	40·[1]¤	2·[−1]¤	2·[1]¤	0.21¤	47.9¤	100¤
4¤	2·[−1]¤	20·[−1]¤	2·[−1]¤	1.2·[−1]¤	0.36¤	47.7¤	100¤
5¤	4·[1]¤	40·[1]¤	10·[1]¤	2·[1]¤	0.9¤	9.96¤	44.12¤
6¤	2·[−1]¤	40·[1]¤	10·[1]¤	1.2·[−1]¤	0.26¤	47.4¤	100¤
7¤	2·[−1]¤	20·[−1]¤	10·[1]¤	2·[1]¤	0.37¤	48.5¤	100¤
8¤	4·[1]¤	20·[−1]¤	2·[−1]¤	2·[1]¤	0.9¤	23.75¤	67.5¤



The Wurster process involves controlling complex phenomena that depend greatly on variable inputs

Seed coating using the Wurster process

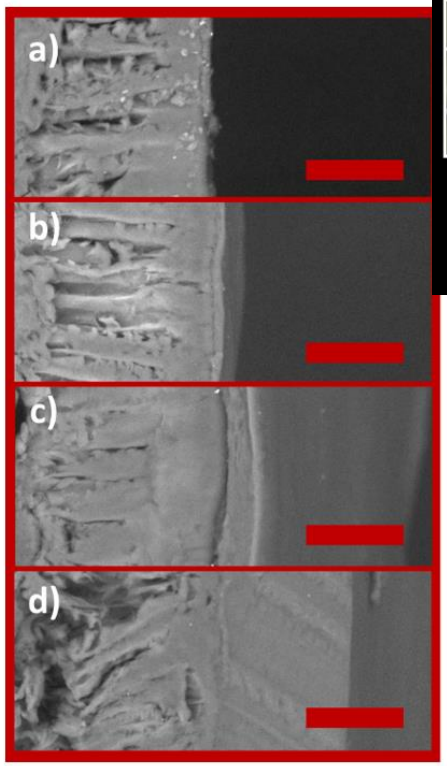
	Final Pressure (bar)	Final Time (min)	Final Volume (mL)
Model	<0.0001	<0.0001	0.0003
Liquid flow rate (A)	<0.0001	<0.0001	<0.0001
Seed mass (B)	0.007	-	-
Backpressure period (C)	-	-	0.0085
AB	0.007	-	-
AC	-	-	0.0085

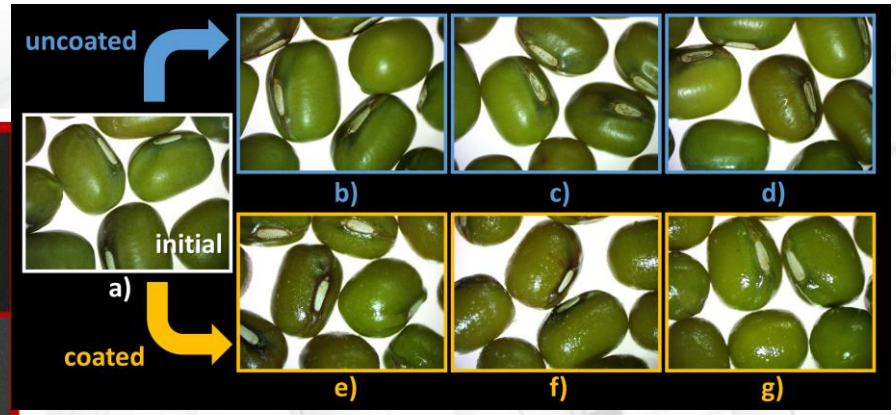
	Final Pressure (bar)	Final Time (min)	Final Volume (mL)
Model	<0.0001	<0.0001	0.0003
Liquid flow rate (A)	<0.0001	<0.0001	<0.0001
Seed mass (B)	0.007	-	-
Backpressure period (C)	-	-	0.0085
AB	0.007	-	-
AC	-	-	0.0085

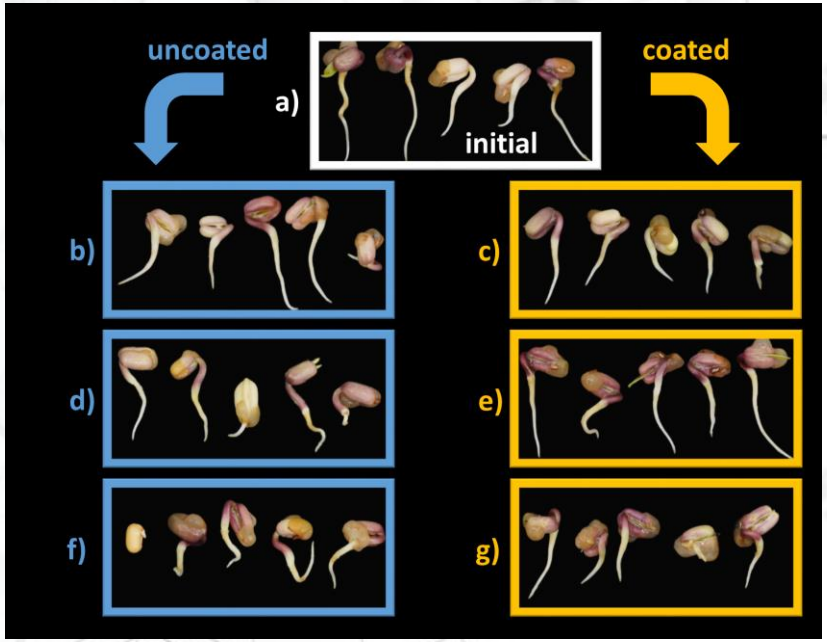
$$Final\ pressure\ [bar] = f(A,B) = 0.6 + 0.3 \times A - 0.0325 \times B + 0.0325 \times A$$

$$Final\ time\ [min] = f(A) = 31.68 - 16.2 \times A$$

$$Final\ volume\ [mL] = f(A,C) = 79.64 - 20.36 \times A - 5.92 \times B - 5.92 \times A \times C$$







The red scale bar is at 20 µm

Seed coating using the Wurster process.
Follow-up to biostimulate Mung seeds growth using laser radiation

Commercial Alginate (CA)

Uncoated Mung beans

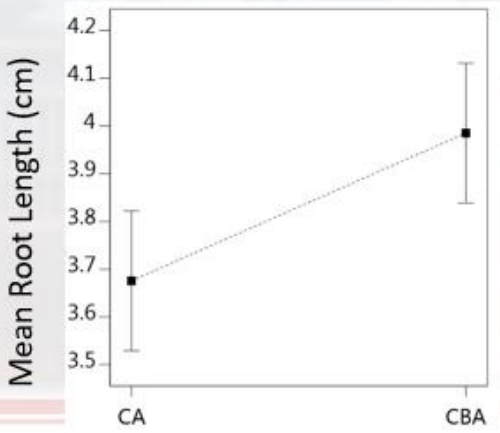
C. Barbata alginate, purified by ultrafiltration (CBA-UF)

	Max	Mean	$N_{viabile}$
Model	0.075	0.041	0.0230
A-Alginate	0.19	0.041	-
B-Irr. Time	-	-	0.0587
C-Iradiance	0.54	-	-
D-Wavelength	-	-	0.0189
AC	0.0248	-	-

	Max	Medie	$N_{viabile}$
Model	5.55	3.83	8.21
A-Tip alginat	0.1031	0.1547	-
B-Timp iradiere	-	-	0.2083
C-Iradiantă	-0.0433	-	-
D-Lungime de undă	-	-	0.2917
AC	-0.2267	-	-

		Min	Max
Alginate type	mL/min	CA	CBA
Exposure time	min	1	5
Irradiance	$\mu mol_{fotoni} \cdot s^{-1} \cdot m^{-2}$	1	30
Wavelength	Nm	400	660

Exp.	A:Alginate type	B: Exposure time	C:Irradiance	D:Wavelengh	Max	Mean	$N_{viabile}$
		min	$\mu mol_{fotoni} \cdot s^{-1} \cdot m^{-2}$	nm	cm	cm	-
1	CA	1	30	660	5.57	3.66	8.33
2	CA	5	1	660	5.02	3.53	8.33
3	CBA	5	1	400	5.89	4.13	8.33
4	CBA	1	1	660	5.96	4.08	8.33
5	CA	1	1	400	5.50	3.71	7.67
6	CBA	5	30	660	5.45	4.06	9.00
7	CA	5	30	400	5.69	3.79	8.00
8	CBA	1	30	400	5.31	3.67	7.67



- **Thank you for your attention!**

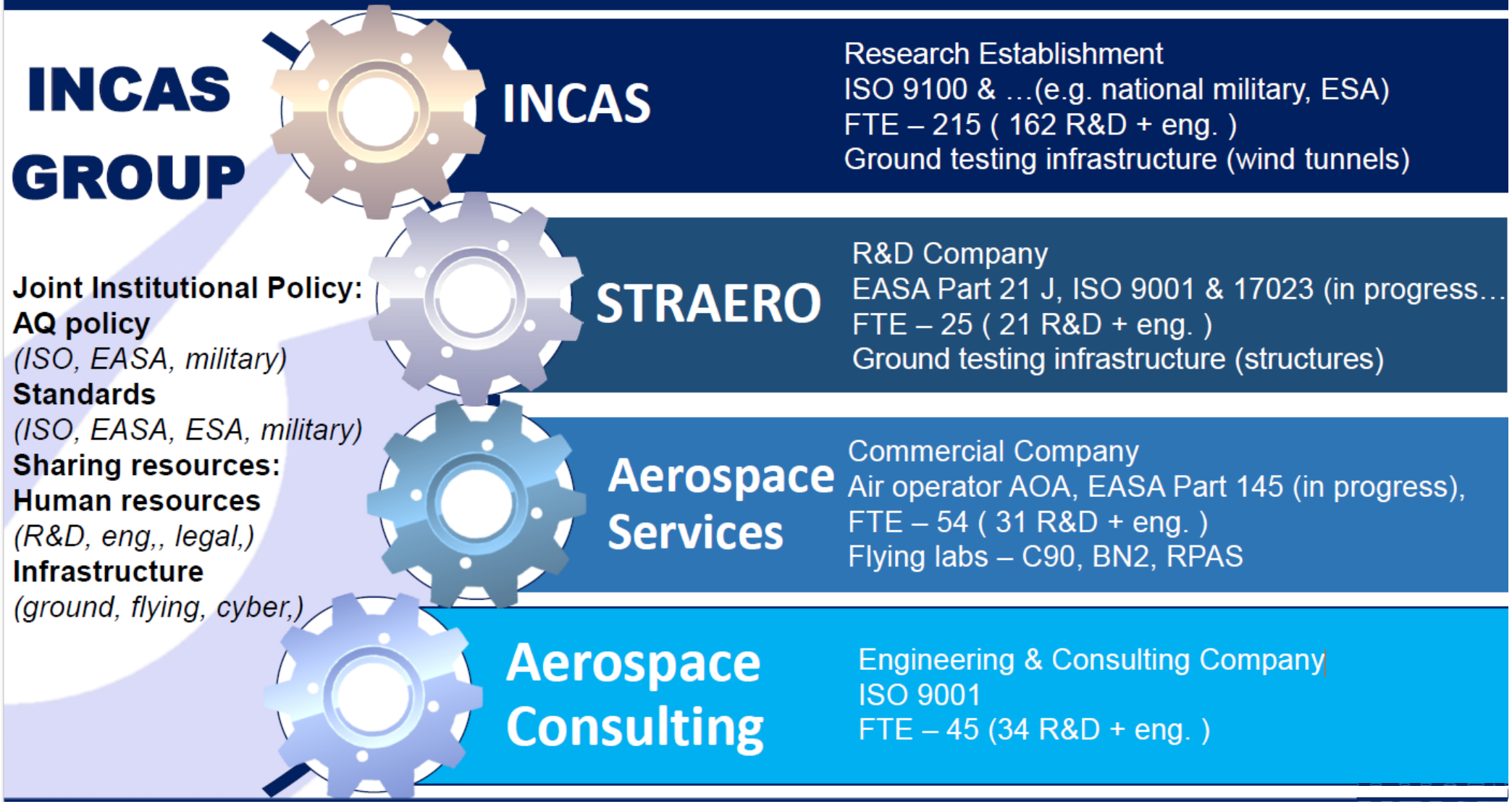
Applicative innovations in aerospace research in Romania

PhD Chem Eng Cristina-Elisabeta Pelin

Head of Material Team
National Institute for Aerospace Research „Elie Carafoli”-
I.N.C.A.S. Bucharest

www.incas.ro

THE INSTITUTE



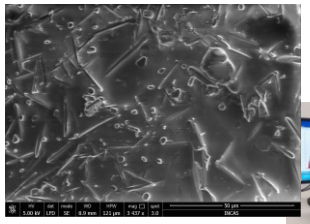
INCAS Structures and Materials Department

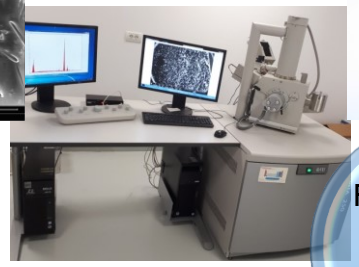
Aero-structures Unit

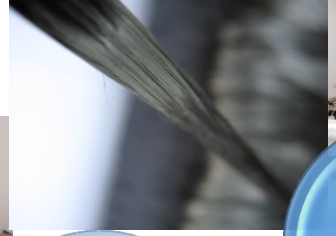
- Advanced design capabilities, using CATIA environment and an integrated set of tools for structural analysis, complex mechanical and kinematic simulations
- In-house code development for structural analysis, mainly with respect to composite materials and structural integrity evaluation.

Materials & Tribology Unit

- R&D actions on structural materials like CFRP/GFRP, sandwich composites, nanocomposites, ceramic composite materials, ablative materials etc.
- Composite materials development & testing on laboratory scale: mechanical, tribological and thermal tests for aerospace and transport industry



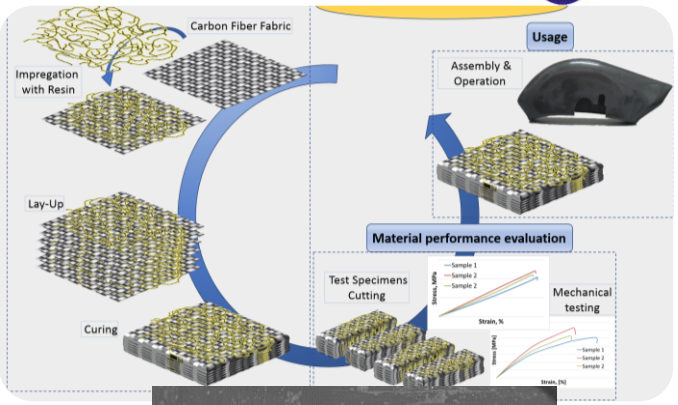


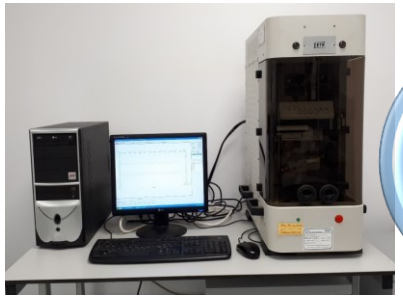


Carbon fiber lab technology

Fractography & morpho structural analyses

CFRP technology

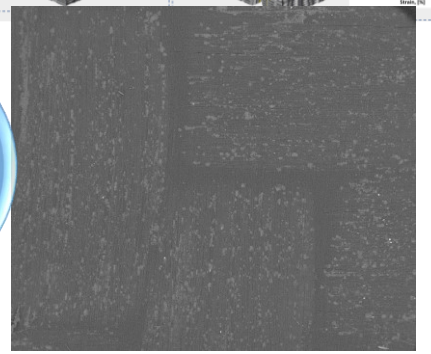


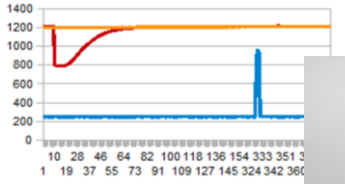


Tribological testing

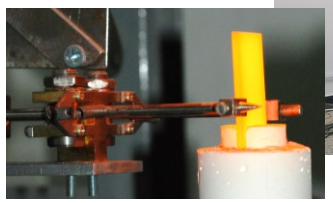
Materials & Tribology Unit

Hybrid nano-composites





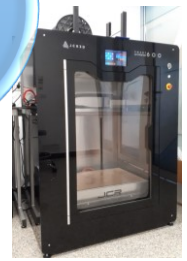
Thermal shock testing



Ablative & thermal protection materials

Mechanical testing & NDT

3D printing & AM



Aplicative Research Projects (selection)

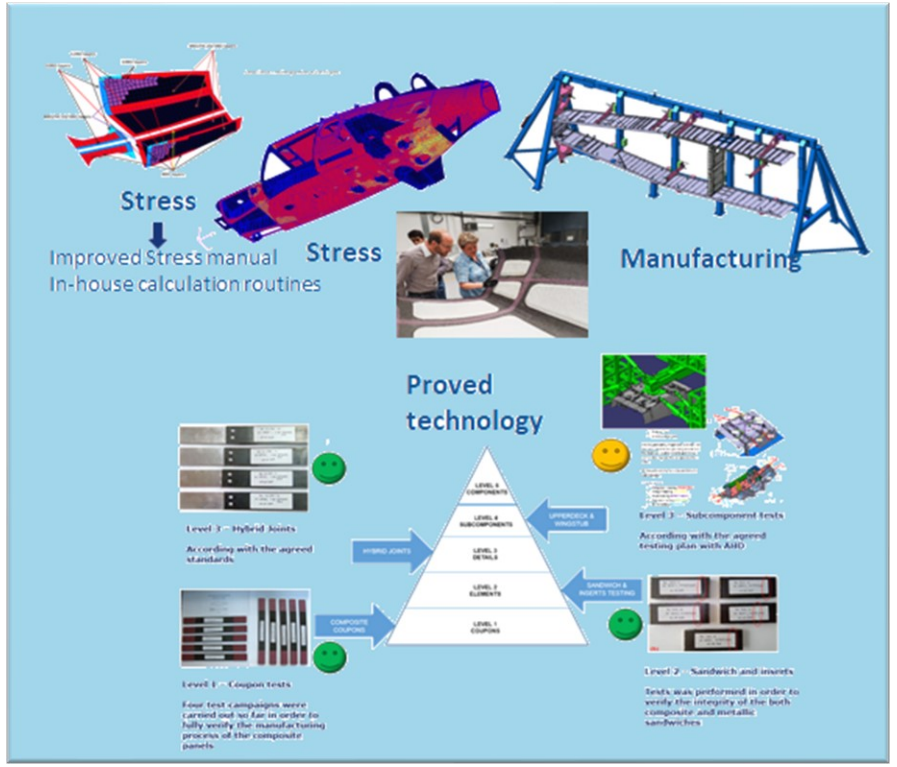
ESA-ADAMP- Ascent and Descent Autonomous Maneuverable Platform

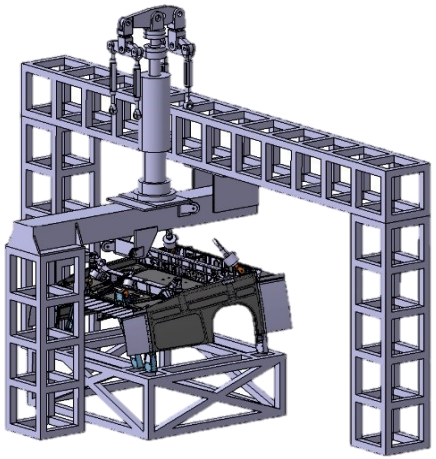
- Funded by the European Space Agency (ESA) through contract No. 4000130099/20/NL/CRS/hh
- Demonstrate vertical takeoff, short hovering and landing manoeuvres using a small-scale flight demonstrator.
- Fairing was built in INCAS Materials and Tribology Unit
- Tethers were used as a safety measure and to protect it from damage in case of an equipment failure during flight.
- Manoeuvres lasted ten seconds to a couple of minutes.

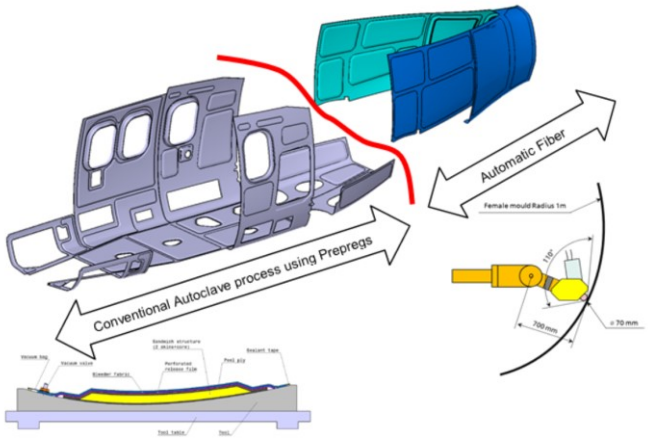
Clean Sky 2- RACER - The Rapid and Cost-Effective Rotorcraft

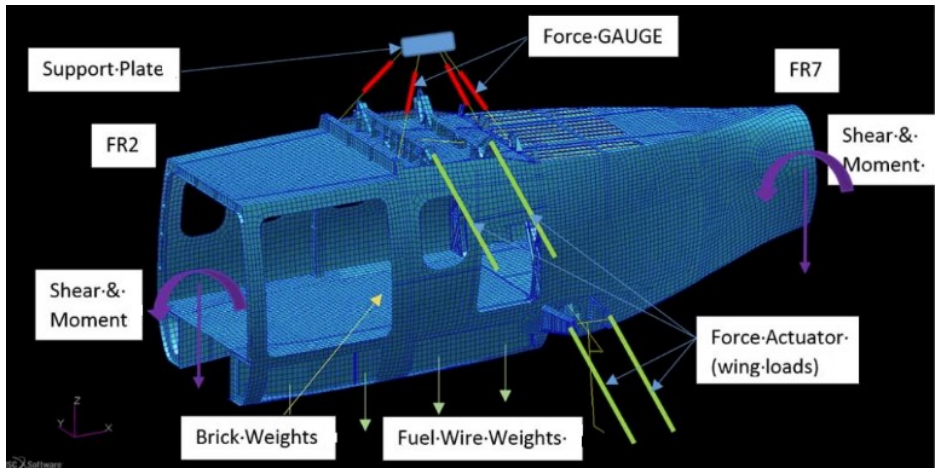
- Develop a high speed rotorcraft for future applications.
- INCAS - designing and analyzing the main fuselage and involved in Permit to Fly activities with stress and test reports.
- Complex design and analysis solutions for high performance metallic and composite structures.

- Design
- Structural calculation
- Testing metodology of composite structure
- Fast RotorCraft (FRC)
- IADP (Innovative Aircraft Demonstration Platforms)
- European Partnership, H2020.
- Ending TRL 6



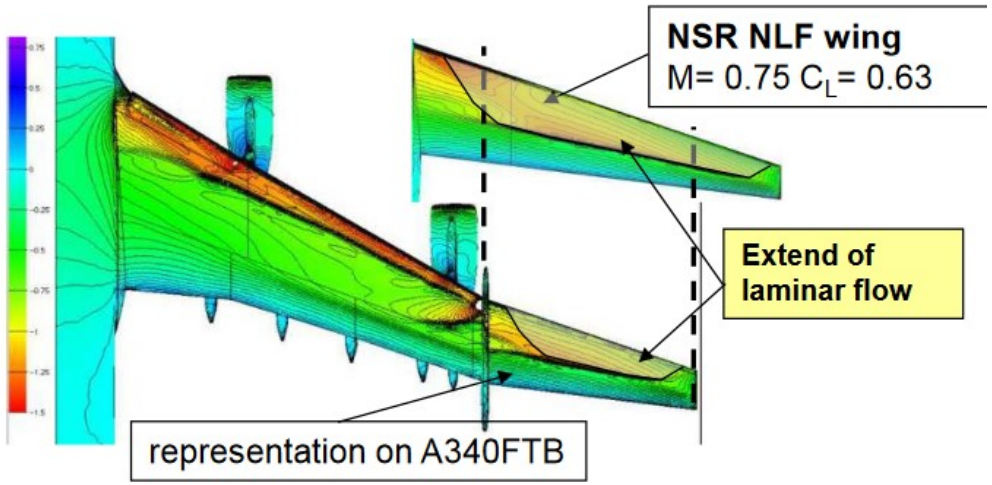


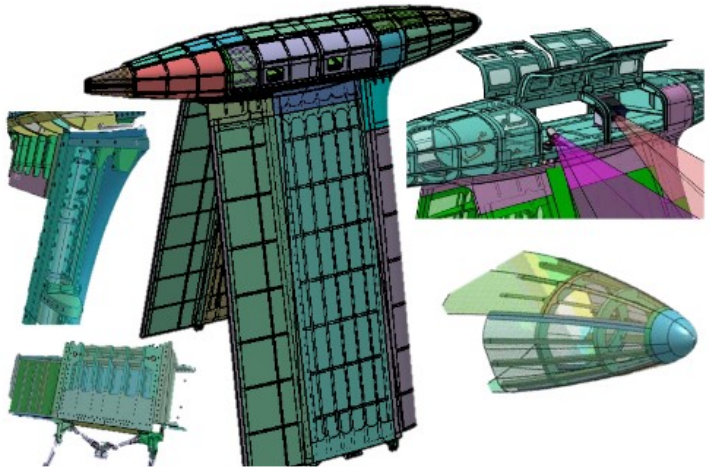


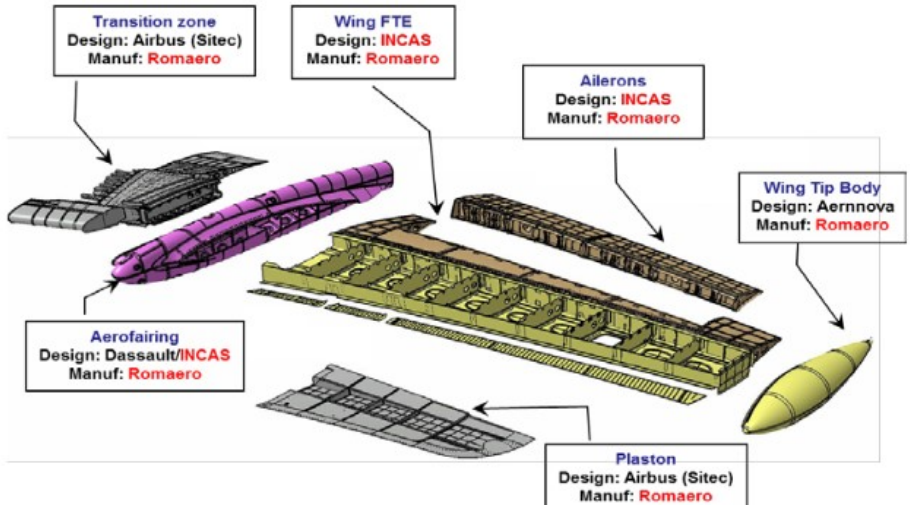


CleanSky 1- BLADE-Breakthrough Laminar Aircraft Demonstrator in Europe

- INCAS - partner on two packages, involving the development of the fixed trailing edge and ailerons for the new test wing and one involving a camera pod and pylons for data recordings
- Design was performed using CATIA5 CAD program.
- For Finite Element Modelling and analysis PATRAN and NASTRAN solver were used for static, stability, bird strike and fatigue analysis together with hand calculation methods







ESPOSA- Efficient Systems and Propulsion for Small Aircraft

Grant agreement ID: 284859

Period: October 2011- June 2016

Funded under: FP7-TRANSPORT - Specific Programme "Cooperation": Transport (including Aeronautics)

Topic: AAT.2011.4.4-4. - Integrated approach to efficient propulsion and related aircraft systems for small-size aircraft

Overview

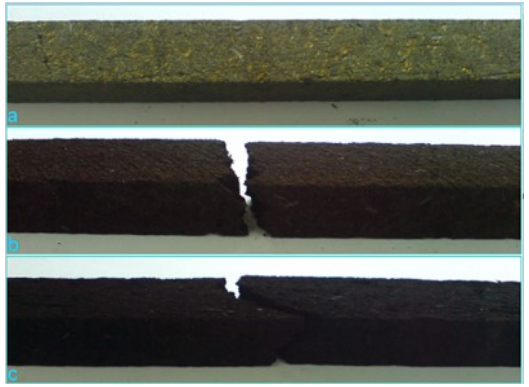
- The ESPOSA project planed to develop and prove innovative technologies for a family of small gas turbine engines and related systems that will contribute to the overall propulsion unit efficiency, safety and pilot workload reduction.
- New technologies and knowledge gained through the ESPOSA project will provide European general aviation industry with substantially improved ability to develop and use affordable and environmentally acceptable propulsion units and reliable aircraft systems minimizing operating costs, while increasing the level of safety.
- INCAS had an active participation in engine integration at aircraft level and high temperature testing for new materials for the novel engine architecture, as well as advanced simulations for the overall assessment of the propulsion system with respect to global aircraft performance and direct operating costs

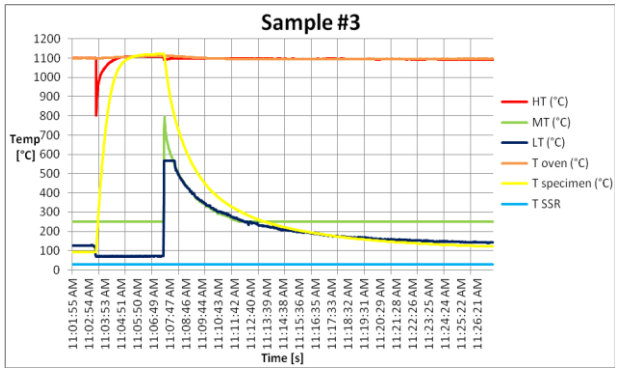
HYDRA- Hybrid ablative development for re-entry in planetary atmospheric thermal protection

- **Grant agreement** ID: 283797
- **Period**: Februart 2012- February 2015
- **Funded under**: FP7-SPACE - Specific Programme "Cooperation": Space
- **Topic**: SPA.2011.2.2-02 - Space critical technologies

- The main objective- develop a novel heat shield concept based on hybrid technologies with very high insulation, protection capability, lightweight, superior resistance and improved safety due to shock absorbance during the atmospheric re-entry

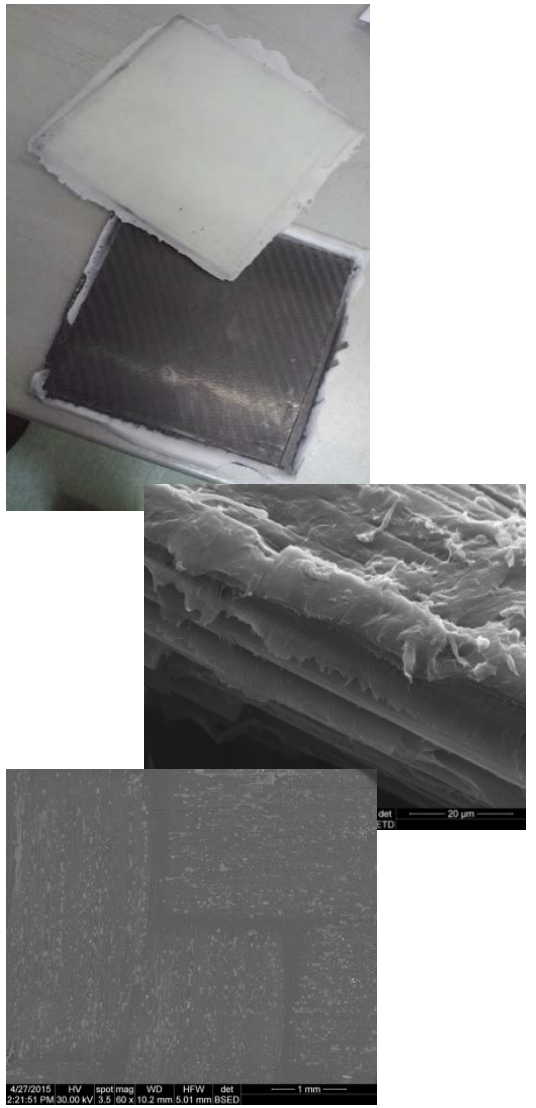
- INCAS performed thermal shock tests at 1100°C of TPS systems and mechanical tests at cryogenic and high temperature





Hybridmat- Hybrid composites with thermoplastic matrices doped with fibres and disperse nanofillings for materials with special purposes

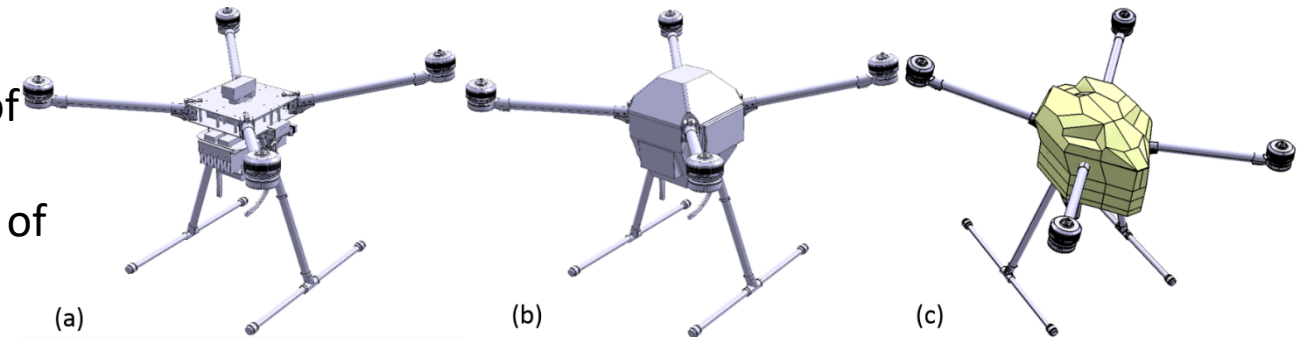
- **Grant No:** 168/2012
- **Funded by**: Romanian Research Ministry- Partenerate Programme
- **Period**: 2012-2016
- The concept of the project was based on the possibility to design and develop some nanocomposite materials based on polypropylene or polyamide and inorganic fillers (nanoparticles, nanotubes, whiskers) and fibers which lead to maximized properties especially from the point of view of the compatibility of the phases, thermal and photo-stability and mechanical properties.
- Results: Carbon fiber fabric nanofilled polyamide 6 laminated materials were obtained within the project with remarkable mechanical properties, that were proposed as suitable for automotive industry as well as aircraft interior
- “Process for obtaining laminates based on carbon fiber fabric impregnated with polyamide 6 with montmorillonite nanometric powder addition” Patent No 131686/2018
- Moving it upper on the TRL scale was faced with challenges that were not overcome at that point



Unmanned Aerial Vehicles Activities and Projects

- **PN-III-P2-2.1-SOL-2016-01-0008** – UAV platform (unmanned aerial vehicle) with dedicated capabilities and support infrastructure with applications in national security missions

  Designing, achieving and testing the prototype of an innovative UAS (Unmanned Aircraft System) TRL 8 level (complete system and certified by tests and demonstrations
- **PN-III-P2-2.1-SOL-2020-2-0329** – Solutions and systems for monitoring and aerial work activities sustaining the public health system during COVID-19 pandemic using UAS systems
- **PN-III-P2-2.1-PED-2021-0951** – PlastMatUAV- Lightweight reinforced thermoplastic materials for vacuum thermoformed encapsulation applications in unmanned aerial vehicles (UAVs)
- **PN-III-P2-2.1-PED-2021-3408** – Innovative development of molds through additive manufacturing for the aerospace field, integrated with thermal systems for the elaboration of composites without autoclave and without oven curing

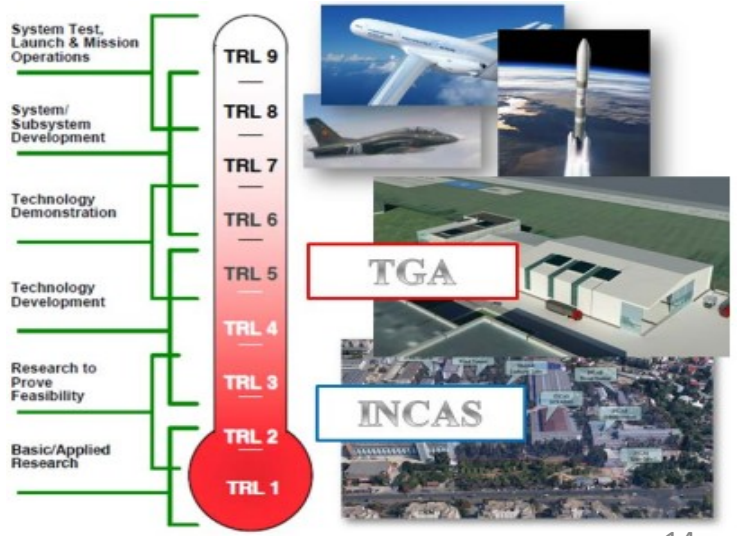


Moving it to a larger scale

Platform for technological development for “green” technologies in aviation and ecological manufacturing with superior added value

- **Competitiveness Operational Program 2014-2020**
- **Priority axis**: 1. Research, Technological Development and Innovation (RDI) to support economic competitiveness and business development,
- **Investment priority:** Research and Innovation (R&I), infrastructure excellence development capacities consolidation in R&I, as well as competences centers promotion, especially those of European interest
- **Total investment value**: 16.7 mEuro

- Project general objective: the development of advanced technologies center for the aerospace industry, based on Industry 4.0 principles, as a main component of the unique research infrastructure of INCAS, while ensuring the environment for capitalizing the innovative potential associated with “Green” type technological developments in the aerospace field.
- TGA is a technological research platform, able for the first time at UE level, to offer the interconnection of technological flows and the validation of technologies for composite-metal hybrid structures, providing resources for certification based on the BBA - Building Block Approach system up to the maximum level



The integrated concept of technological platform associated to new generation hybrid structures in aerospace industry, able to ensure process certification and direct technological transfer to the industry, to allow innovation capitalization and having a significant spin-off potential

Introduction of the most advanced technologies in AM and AFP in a complex technological flow able to demonstrate TRL7 technologies while ensuring “green” requirements conditions on the whole manufacture chain

TRL 7 level demonstration of the new concepts in 3D design for new generation materials and capitalization of the new “green” technologies in the industry sector

Developing the platform within an Industrial Park and integrating it in the research-development chain with the involvement of the most representative entities in research, academic and industry sector

Thank you for your attention!

INCAS
National Institute for Aerospace Research "Elie Carafoli"
www.incas.ro

MAGURELE SCIENCE PARK

INVEST NOW

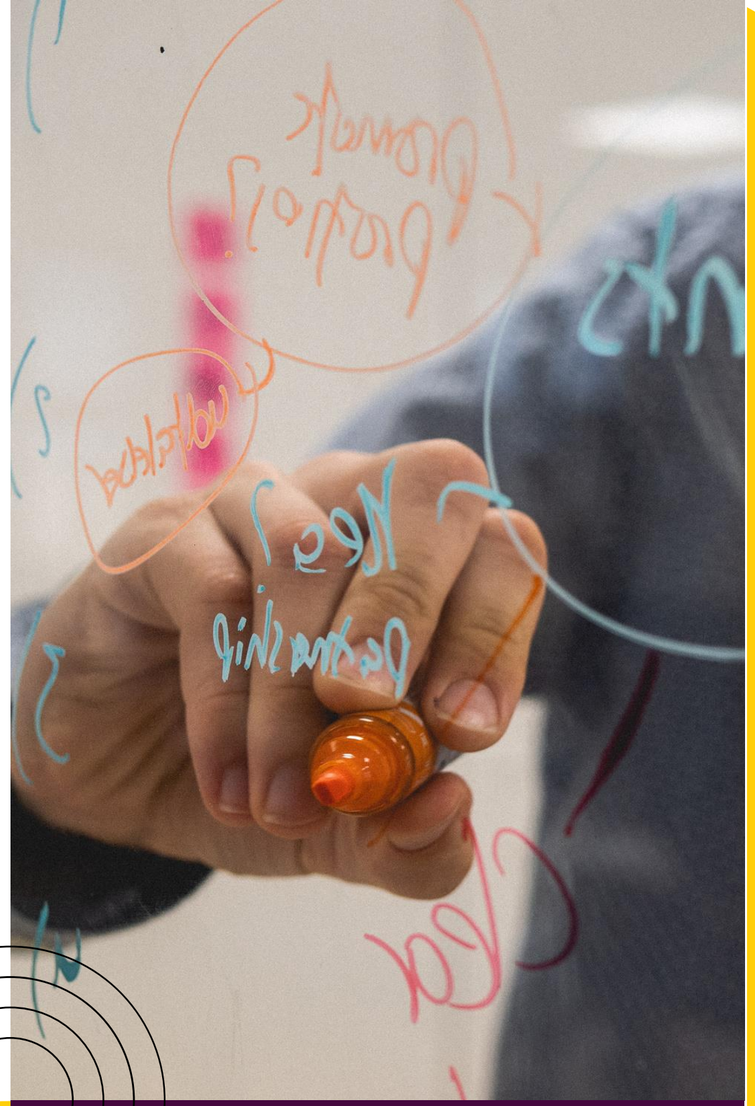
INNOVATE TODAY

BUILD THE FUTURE

Hello. :)

WE CREATE THE FUTURE BY EMPOWERING INNOVATION IN:

EDUCATION | RESEARCH | BUSINESS |



The “Magurele Science Park” Association (MSP), which is the initiative of the Ilfov County Council, aims to increase regional competitiveness through research and innovation, by a more efficient transfer of the research results into products, technologies and services, according with the market needs.

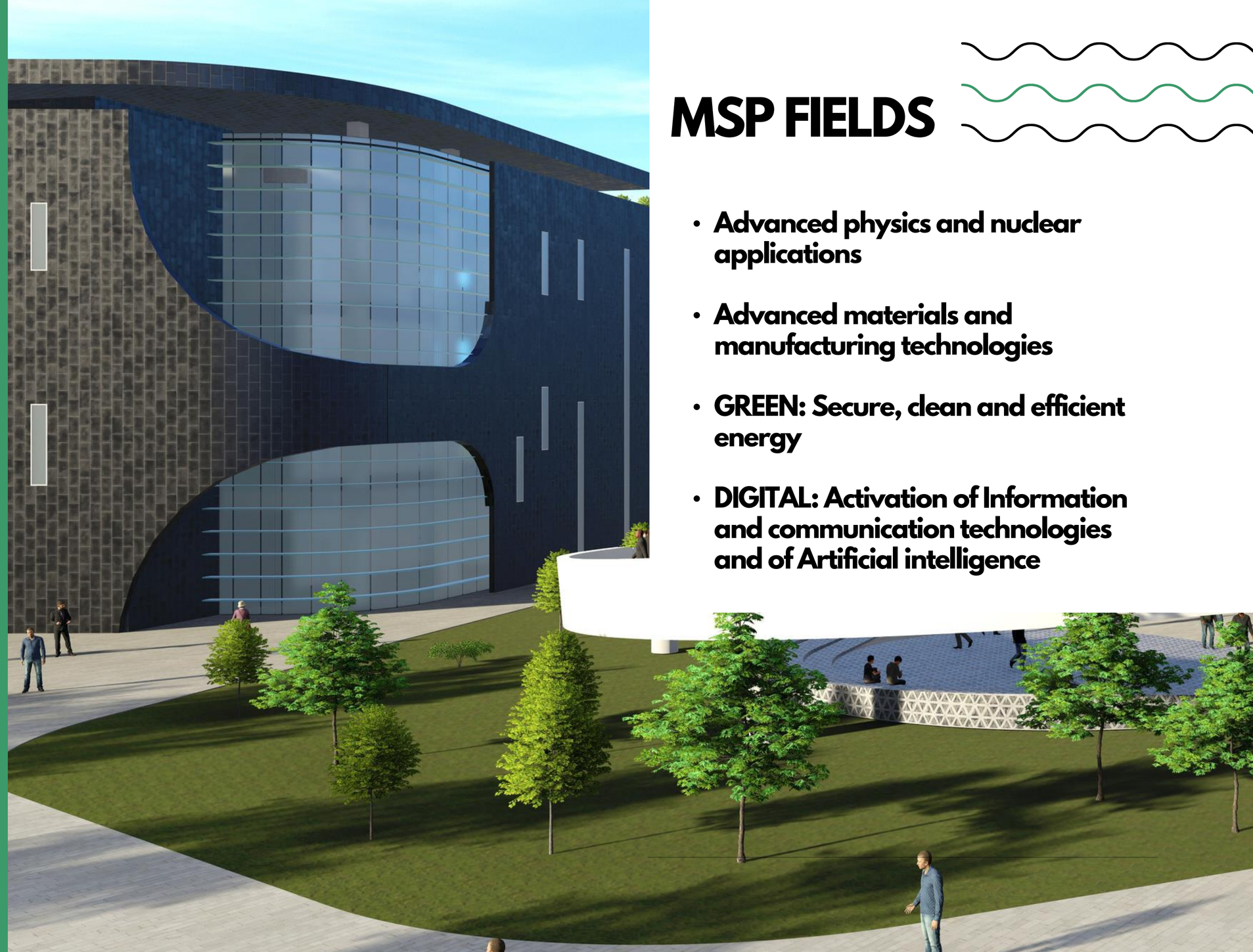
MSP
MAGURELE SCIENCE PARK

The Science and Technology Park in Magurele – a strategic regional investment

MSP will become the first HUB for ENTREPRENEURSHIP & INNOVATION in the region

Functionalities:

- **Innovation Center (approx. 6,000 sqm)**
- **TT Center (approx. 4,000 sqm)**
- **EXPO CENTER (approx. 4,000 sqm)**
- **Recreational Center (approx. 1,000 sqm)**



MSP FIELDS

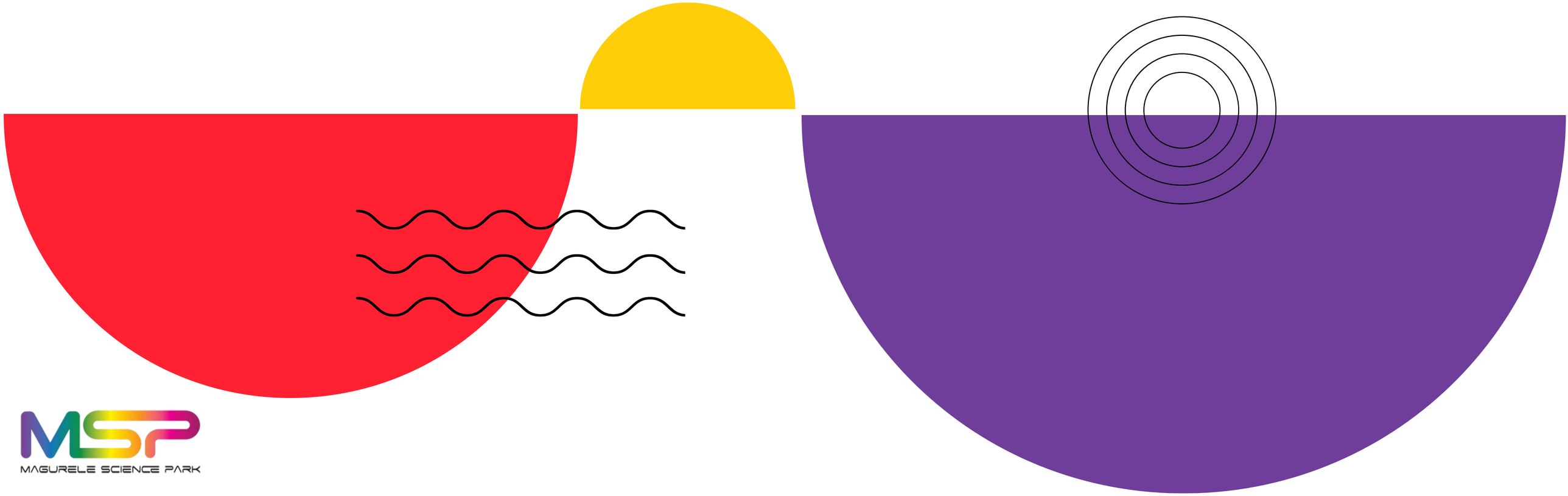
- **Advanced physics and nuclear applications**
- **Advanced materials and manufacturing technologies**
- **GREEN: Secure, clean and efficient energy**
- **DIGITAL: Activation of Information and communication technologies and of Artificial intelligence**

MSP OBJECTIVE

Working together to boost innovation and build trust!

Our aim (until the Park becomes operational):

to develop a strong and visible community and create cooperation links between our partners!



MAGURELE SCIENCE PARK

OUR TARGET PILLARS:

TIMELINE

developing #MSPcommunity

2016
Magurele Science Park Association founded

2018
2 Associate Members

2019
10 research

2020
+ 56
23 research
23 business
10 support entities

2021
+134
37 research
55 business
42 support entities

2022
+212
48 research
108 business
56 support entities

Now
+250
58 research
140 business
58 support entities

MSP
MAGURELE SCIENCE PARK

AND THE COMMUNITY IS STILL GROWING…

PROSME

HELPING SMES TO INNOVATE AND GROW INTERNATIONALLY

I

INTERNATIONAL PARTNERSHIPS

Partnership database

Brokerage events

Company missions

A

ADVISORY SUPPORT

Advice on EU laws and standards
Market intelligence
IPR expertise

I

INNOVATION SUPPORT

Access to finance and funding
Innovation Management Services
Technology transfer

MSP Association has become a partner within the Enterprise Europe Network (EEN)

een.ec.europa.eu

The “Magurele Science Park” Association – running project

SME4GREEN

The First Local Green Deal in Romania is developing in Ilfov

MSP has identified local community leaders, business representatives and initiatives that need to be brought on board to support the work in developing the Local green deals.

Supporting SMEs to lead the twin green & digital transition by offering Innovation management mentoring for 10 SMEs. The mentoring services will focus on how SMEs manage their innovation processes, and integrate green and digital technologies and processes.

#SME4GREEN

Funded by the European Union

Thank you!

ANDREI GROȘEANU- management consultant

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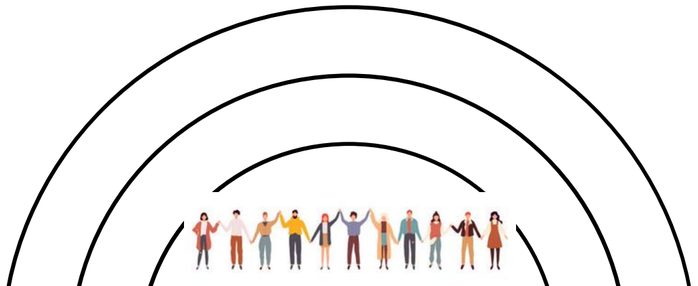

PRIOCHEM – XIX-th Edition, round table **Innovation way**
from wishful thinking to real-life applications
Bucharest, 11th Oct. 2023

NANOTERMO NANOTECHNOLOGY TO REDUCE / ELIMINATE ACTIVE SLUDGE PRODUCED BY HOUSEHOLD SEWAGE TREATMENT PLANTS

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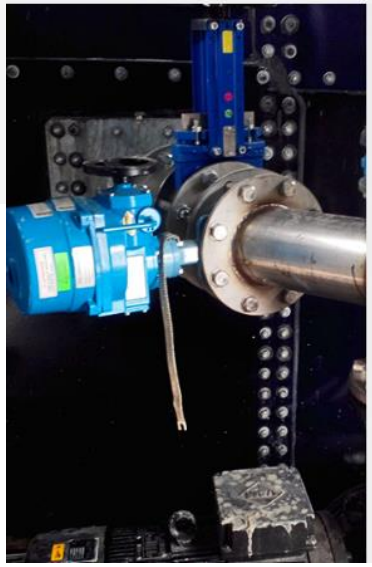
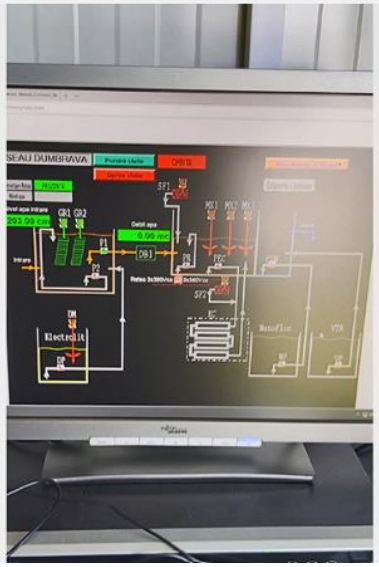
Baia Mare, ROMANIA
https://www.nano-gen.ro/en/

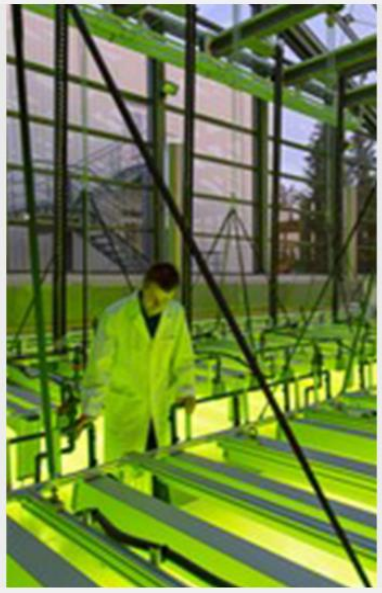
KEMA TRONIC

Modern Wastewater
Treatment Technologies








NANOTERMO installation

Background (1/2)

- Projects including nanotechnology

	Denumire	Capacitate SE
1	SE Târgu Secuiesc	30 000 PE
2	SE Danutoni	130 000 PE
3	Statia de epurare Bistrita	80 000 PE
4	Compania de apă Vital Baia Mare pt namolul din stațiile de epurare din Maramureș	350 000 PE
5	SE Dumbrava județul Timiș	900 PE

Background (2/2)

- Research & Development projects including nanotechnology

	Denumire proiect	Denumire instalatie
1	Program NEPTUNE Distrugerea cu dezintegrare a componentelor din apele industriale și a nămolului activ Capacitate: 1 m3 Durata: 6 luni SE Cluj Napoca	Instalație pilot SONOELCHEMCELL cu Instalație cu dezintegrare cu ultrasunete DUS Instalație de dezintegrare de BIOCRACK cu descărcarea de înaltă tensiune în impulsuri de înaltă frecvență
2	Creșterea eficienței fermentării anaerobice în stațiile de epurare orășenești prin implementarea nanotehnologiei de dezintegrare a nămolului Împreună cu ECOIND București Capacitate: 1 m3 Durata: 18 luni SE Focsani	Instalație pilot SONOELCHEMCELL echipată și cu difuzor cu bule de aer
3	Proiect NANOTERMO, cu cofinantare Innovation Norway Capacitate: 1 m3 Durata: 10 luni 10 luni la stația de epurare Satu Mare	Instalație pilot NANOTERMO cu hidroliza termică la 70° c, cu ejector venturi pentru producția de microbule de gaz MBG, cu transformarea MBG în mano bule de gaz fără cavitație

Results


Containers with sludge: raw and treated

	Namol brut	Namol tratat			
		72h	96h	120h	
	mg/l	mg/l	mg/l	mg/l	Eficienta
Suspensii	23280	9180	8020	4495	80,7% reducere (eliminare)
CCO Cr	18399	5528	2098	2446	86,9% reducere (eliminare)
Amoniu	361	531	587	620	1,7 ori crestere- productie NH4 verde

	Namol brut	Namol tratat			
		96h	120h	144	
	mg/l	mg/l	mg/l	mg/l	Eficienta
Suspensii	8600	4130	3675	850	90,1% reducere (eliminare)
CCO Cr	8082	2569	91.3	225	97,2% reducere (eliminare)
Amoniu organic	139	34	21	-	84,9% reducere
Amoniu verde				112	Productie-5,33 - productie NH4 verde

Conclusions

The new type of technology proposed for **small and medium-sized sewage treatment plants** solves the thorny problem of sewage sludge management and **adopts the concept of circular economy** in wastewater management, by:

- Reducing the resources used to treat wastewater and sludge (energy, raw materials)
- Recovery of resources from used water (energy)
- Reducing waste to zero

Thank you for your attention!

Nanotehnologie NANOTERMO de reducere / eliminare namol activ produs de statii de epurare menajere

Ing. Constantin Damian[1]

[1]SC KEMA TRONIC SRL, Baia Mare

Rezumat scurt. Tehnologia propusă elimină nămolul activ produs de stațiile de epurare a apelor uzate prin integrarea nanotehnologiei, cu dezintegrare ultrasonică, dezintegrare electrocinetică, producție de micro-nano-bule, într-un mod compatibil cu fluxurile de tratare a nămolurilor existente în stația de epurare și într-un mod durabil, care să permită recuperarea investiției prin îmbunătățirea echilibrului energetic și financiar la nivelul statiei de epurare

Cuvinte cheie: ape uzate urbane, nămol biologic, dezintegrare, nanotehnologie

1. Introducere

Nămolul din staţiile de epurare ramane o provocare , fiind pe pe o curbă ascendentă, în timp ce cerinţele de calitate impuse sunt tot mai stringente şi totuşi, presiunile economice cer soluţii ieftine. In special in cazul statiilor prevazute cu stabilizare aeroba, problema managementului namolului produs este una deosebit de dificila

Tehnologia propusă elimină nămolul activ produs de stațiile de tratare a apelor uzate prin integrarea nanotehnologiei, cu dezintegrare ultrasonică, dezintegrare electrocinetică, producție de micro-nano-bule într-un mod compatibil cu fluxurile de tratare a nămolurilor existente în stația de epurare și într-un mod durabil. care să permită recuperarea investiției prin îmbunătățirea echilibrelor energetice și financiare la nivelul WWTP, pentru a reduce pana la eliminare namolul produs. Hidroliza termica a namolului produce dezintegrarea flocoanelor de namol, liza celulelor si eliberarea constituientilor celulari cu solubilizarea CCO, a apei intracelulare. Prin cuplarea cu celalate metode de dezintegrare , apar fenomenele de plasma rece si EAOP, care conduc la distrugerea substantei organice si transformarea in CO_2 si apa.

2. Istoric

Solutia se bazeaza pe proiecte de statii de epurare (Tabel 1) si studii de cercetare preliminare (Tabel 2), realizate de KEMA TRONIC, care demonstreaza reducerea/ eliminarea namolului prin nanotehnologii.

Tabel 1 Proiecte cu nanotehnologii

	Denumire	Capacitate SE
1	SE Târgu Secuiesc	30 000 PE
2	SE Danutoni	130 000 PE
3	Statia de epurare Bistrita	80 000 PE
4	Compania de apă Vital Baia Mare pt namolul din stațiile de epurare din Maramureș	350 000 PE
5	SE Dumbrava județul Timiș	900 PE

Tabel 2 Cercetari nanotehnologii, realizate si in curs

	Denumire proiect	**Denumire instalatie**
1	Program NEPTUNE Distrugerea cu dezintegrare a componentelor din apele industriale și a nămolului activ Capacitate: 1 m3 Durata: 6 luni SE Cluj Napoca	Instalație pilot SONOELCHEMCELL cu Instalație cu dezintegrare cu ultrasunete DUS Instalație de dezintegrare de BIOCRACK cu descărcarea de înaltă tensiune în impulsuri de înaltă frecvență
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Figura 2 : Recipiente cu namol : brut si tratat

Tabel 3 Rezultate teste proiect Nanotermo

Rezultate Test 4

	Namol brut	**Namol tratat**			
		72h	**96h**	**120h**	
	mg/l	**mg/l**	**mg/l**	**mg/l**	**Eficienta**
Suspensii	23280	9180	8020	4495	80,7% reducere (eliminare)
CCO Cr	18399	5528	2098	2446	86,9% reducere (eliminare)
Amoniu	361	531	587	620	1,7 ori crestere- productie NH4 verde

Rezultate Test 6

	Namol brut	**Namol tratat**			
		96h	**120h**	**144**	
	mg/l	**mg/l**	**mg/l**	**mg/l**	**Eficienta**
Suspensii	8600	4130	3675	850	90,1% reducere (eliminare)
CCO Cr	8082	2569	91.3	225	97,2% reducere (eliminare)
Amoniu organic	139	34	21	-	84,9% reducere
Amoniu verde				112	Productie-5,33 - productie NH4 verde

3. **Descriere**

A. Căi de reducere a producției de nămol – conform desen NANTERMO (Figura 1 , Figura2)

1. Creșterea eficienței extracției de grăsimi cu separator de grăsimi cu microbule de aer
2. separarea substanței organice cu site cu e = 0,2
3. Eliminarea nitrificării/ denitrificării prin precipitare amoniu și fosfor cu noul reactiv din dolomită ECOIND / KEMA TRONIC
4. Nanotehnologia cu electro oxidare avansata pentru 50% din epurarea convențională, cu reducerea cu 70% a nămolului și 47% economie de energie electrică. E A O P se bazează pe implozia nanobulelor de cavitație produse de dezintegrarea ultrasonică și electrocinetică și nanobulele lor de gaz fără cavitație

B. Nanotehnologii de reducere productie namol activ

C. Hidroliza termica la 70°C a namolului ingrosat la 3%SU (Figura 3)

1. Descompunerea nămolului în gaz (gazeificarea) prin electrooxidarea avansată combinată cu epurarea biologică cu injecție de aer cu bule fine. Descompunerea nămolului se face prin:
    a. Termoliza rezultată din implozia nanovulelor de cavitație și nanobulelor fără cavitație hidroliza termică homoliza azotică ca urmare a interacțiunii NBG-N cu curentul electric generat de dezintegrarea electrocinetică
    b. Hidroliza azotica ca urmare a interactiunii NBG-N2 cu curentul electric generat de dezintegrarea electrocinetică
    c. Oxidare apă supercritică
2. Captarea gaz rezultat din epurare (N2+CO2) și aer insuflat, transformare în microbule de gaz (MBG-N2, MBG-CO, MBG-O2) și apoi în nanobule de gaz (NBG-N2, NBG-CO, NBG-O2) ca urmare a efectului secundar al imploziei NBG.
3. Recirculare continuă lichid în dezintegrarea ultrasonică și electrocinetică
4. Producția de amoniu verde - rezultat din transformarea NBG-N2 în amoniu verde, de către cianobacterii
5. Transformarea biogazului compus din CH4, H2S, CO2 și a NH4 organic rezultat din fermentarea anaerobă în sursă de H2 verde astfel:
   Cu echipamentul NANOHIDROGEN-CF , în fermentatorul clasic cu nanotehnologia NANO TERMO, are loc descompunerea :

- CH4 în C și H2,
- H2S în S și H2,
- CO2 în CO și ,

Acestea, impreună cu H2 rezultat din fisiunea homolitică a apei, formează amestecul gaz de apă.

6. Transformarea NH4 verde, NBG-CO2, NBG-O2 în biomasă, prin producția de alge. Algele se vor fermenta în instalatia NANOHIDROGEN.
7. Transformarea nămolului fermentat, fără pesticide, hormoni, farmaceutice, microplastice în îngrășământ ecologic, care conține oligoelemente și fosfor, și care este îmbogățit în NBG-N2 (care vor fi transformate în NH4 verde de către ciano bacterii prin stocare uscare)

8. Transformare nămol în H2 și gaz de apă, gaze combustibile, care prin cogenerare cu turbine cu gaz asigura independența energetică a tuturor stațiilor de epurare, prin producția de energie electrică pentru stația de epurare și energie termică pentru uscarea nămolului

4. Concluzii

Noul tip de tehnologie propusa pentru statii de epurare mici si mijlocii rezolva problema spinoasa a managemntului namolului de epurare si adopta conceputul de economie circulara in managementul apei uzate, prin:

- Reducerea resurselor utilizate pentru tratarea apei uzate si namolului (energie, materii prime)
- Recuperarea resurselor din apa uzata (energie)
- Reducerea la zero a deseurilor

Referinţe

[1] Catalog Ultrawaves

[2] Catalog Vogelsang

[3] Catalog Fluiteco

[4] Nørskov, Jens, Chen, Jingguang, Miranda, Raul, Fitzsimmons, Tim, and Stack, Robert. 2016. *"Sustainable Ammonia Synthesis – Exploring the scientific challenges associated with discovering alternative, sustainable processes for ammonia production"*. United States. https://doi.org/10.2172/1283146.https://www.osti.gov/servlets/purl/1283146.

[5] Smeeta Fokeer, Jan Sievernich and Petra Schwager -"*Achieving a Green Hydrogen transition built on equity and consensus Strategies and challenges for a just green hydrogen transition*". https://iap.unido.org/articles/achieving-green-hydrogen-transition-built-equity-and-consensus

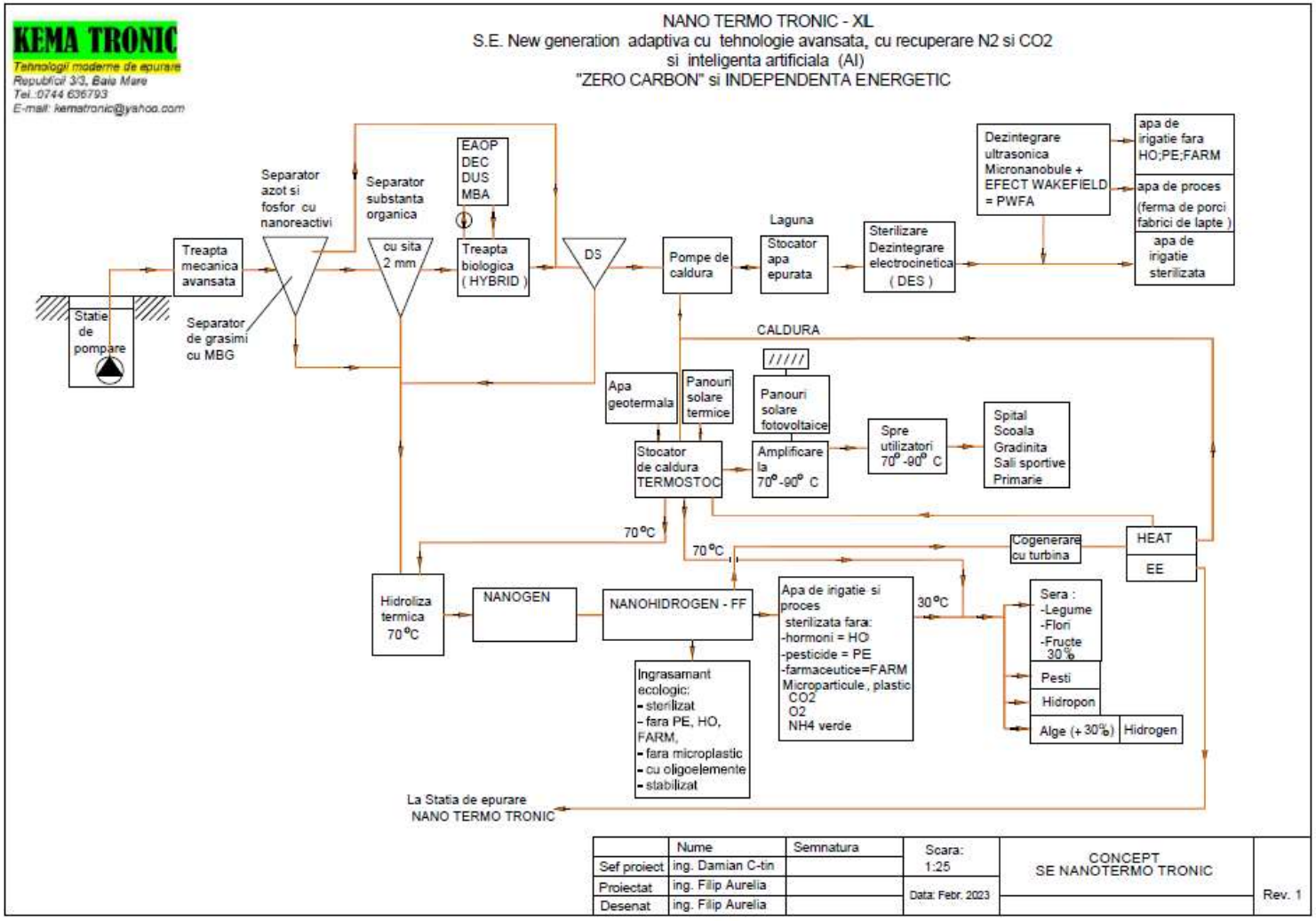

Figura 5: NANO TERMO TRONIC

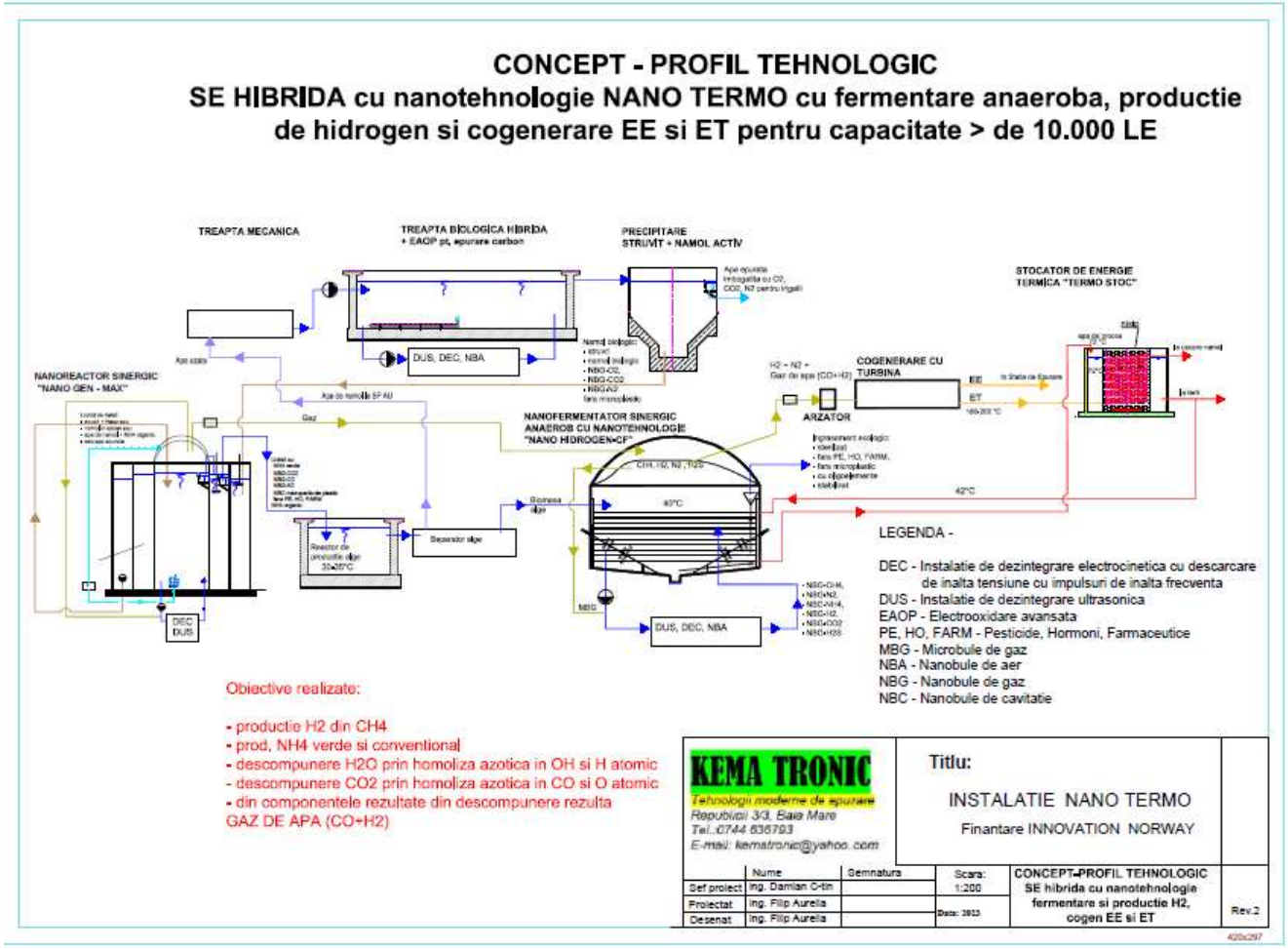

Figura 4: Profil statie de epurare hibrida cu nanotehnologie Nanotermo3

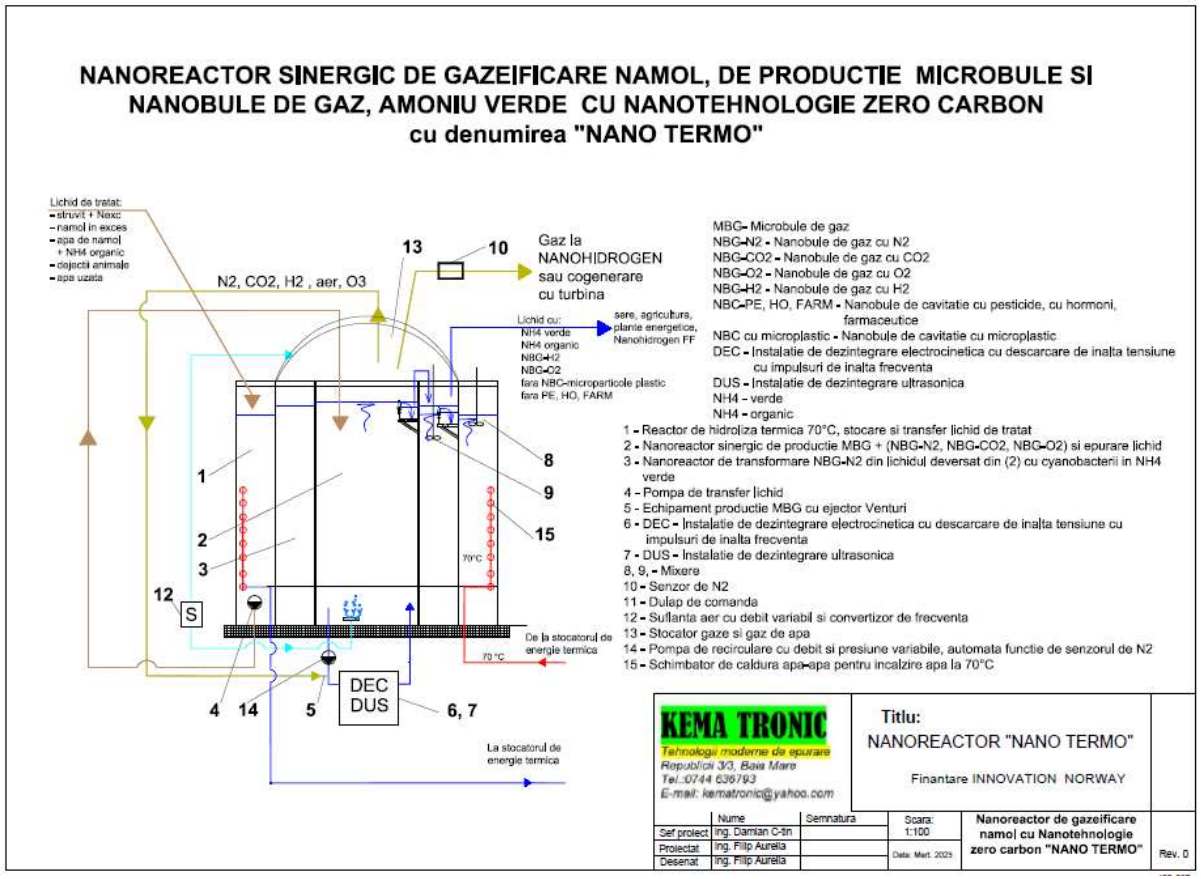

Figura 3: Nanoreactor Nanotermo