NET4Air: A Twinning Project Story

27th of February 2026

Dr. Carmen Moldovan

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

UCL Tyndal National Institute (IE)

CNT-ICMATE (IT)

The NET4Air project has received funding from the European Union's HORIZON-WIDERA-2021-ACCESS-03-01 Twinning program under grant agreement No. 101079455.

What is NET4Air?

NET4Air: Networking Center for Excellence in Nanoelectronic Devices for Air Monitoring

Call: HORIZON-WIDERA-2021-ACCESS-03

Starting: 1st of January 2023

Duration: *40 months*

Goals

- Advance excellence capacity and resources at IMT;
- Increase IMT expertise in innovative nanotechnologies, materials, devices, smart systems, data analytics and best practices for environment monitoring;
- Create a collaborative program with state representatives, local agencies, research centers, universities, industry and citizen associations;
- **Regional excellence in devices and best practices for air quality monitoring;**
- Engage citizens in air quality science;
- Apply European Green Deal principles

Specific Objectives

- To improve excellence capacity and resources in IMT enabling the closure of the research and innovation gap within Europe.
- **To implement the scientific project "Wearable and /or portable platform for air monitoring"** (including sensors, electronics, energy management, data acquisition, processing and communication, wearable and/or portable devices) demonstrating the capability to work together in a European partnership and to answer European grand challenges such as Climate change while also aiding Romania in ***understanding and reducing*** air pollution
- To create **the Networking Centre for excellence** in **Nanoelectronics formed by joining together around the Consortium partners and the R&D actors** (from research institutes, universities departments, environmental NGOs, national accredited labs, SMEs and big industrial players) in Sensing Technologies and Data management for Environmental monitoring applications, with the goal of **bridging the gap between Western Europe organizations and lower-performing institutions in Romania, facilitating Romania's better integration into the European Research Area.**
- To create strategic partnerships (Research organizations, Industry, Public and Governmental Organizations, and Agencies) and generate public awareness, by providing state of the art information about the environment monitoring and remedial measures and creating a favourable environment for concerted actions

Specific Objectives

- To significantly **raise the research excellence profile of IMT** by increasing the number of publications in high ranked ISI journals; enhancing IMT's visibility and impact in Europe by conference attendance and participation in EU programmes; consequently, these will significantly contribute to raising Romania's composite indicator on Research Excellence (Romania is at the bottom of the European ranking);
- To enhance the **research management and administration skills** at IMT, both on technical proposal preparation and project administration aspects;
- **To increase mobility (inwards and outwards) of qualified scientists, and young researchers** including doctoral candidates, international students and women scientists in the field of the project.
- **To promote and enhance gender equality in the widening organization** and to define over a dedicated WP (WP4) the action plan for Equality, Inclusion and Diversity to be implemented in the Consortium and also to be recommended in the organizations connected to the project through the actions of the Centre for excellence.
- To increase connections with industry and enhance cooperation with businesses in the area of intellectual property and commercialization of environmental monitoring technologies with a special focus on air monitoring; to reinforce a dialogue with end-user associations, policy makers, investors and society;

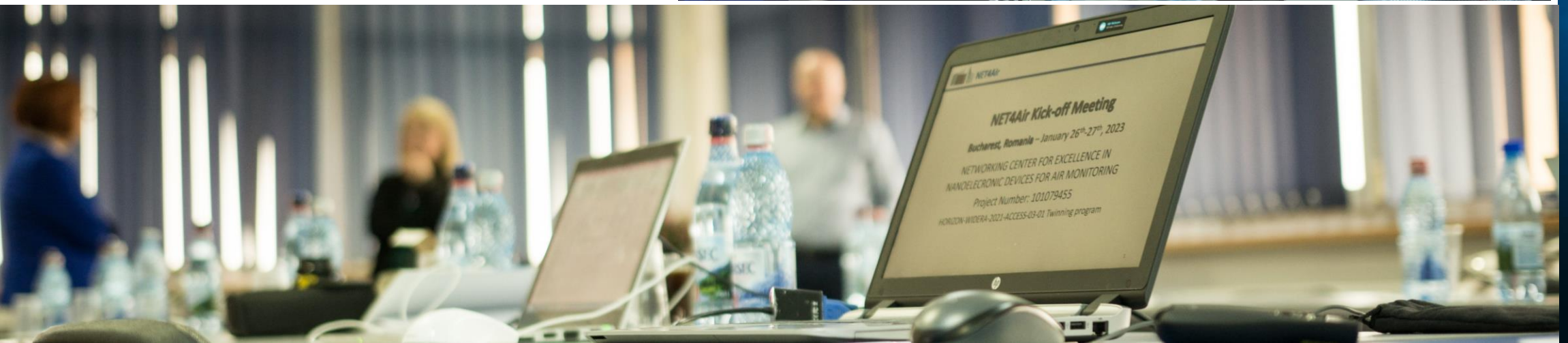
WP1: Ethics & WP2: Management

Ethics

- NET4Air employs geolocation monitoring platforms
- Requires protection and anonymization of data obtained via platforms
- Requires external supervision
- Ethics supervisor

Kick-off: 26th - 27th January 2023

- Project trajectory, implementation plan versus objectives
- Schedule for seminars, school and workshop
- Decisions on organizational and technical aspects



WP3: Stimulating Excellence and Innovation

- Training stages at partner sites
- Bilateral staff exchanges and secondments
- Seminars and short courses
- Schools and workshops on environmental sensors, IoT, and data acquisition
- Networking of technological facilities
- Survey on market and research innovation needs in air monitoring

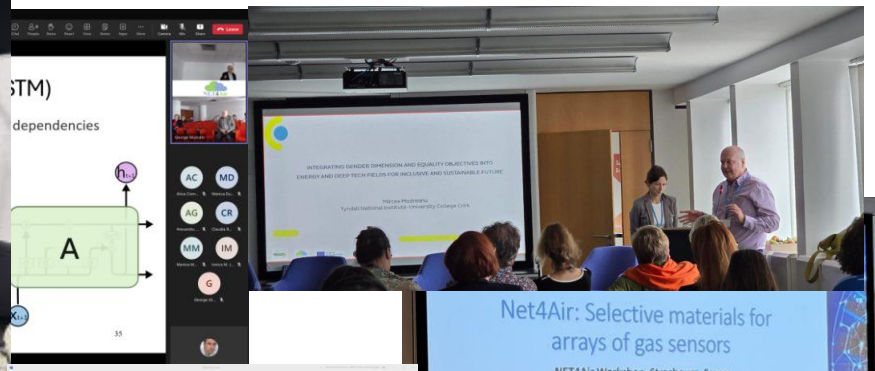
Activity	Duration	Location	Number of Staff
Visit	1 day	Tyndall	2
Visit	5 day	Tyndall	4
Secondment	4 day	CNR-ICMATE	6
Secondment	10 day	IMT	1

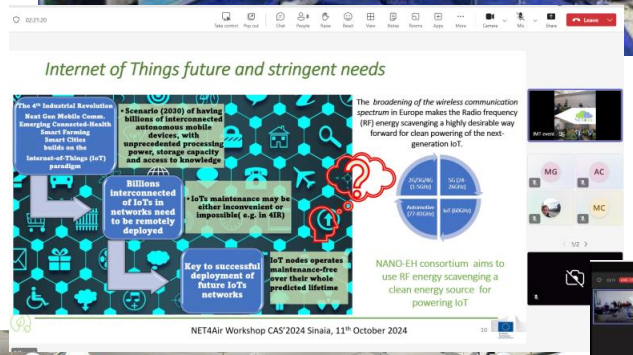
5 Workshops / Schools

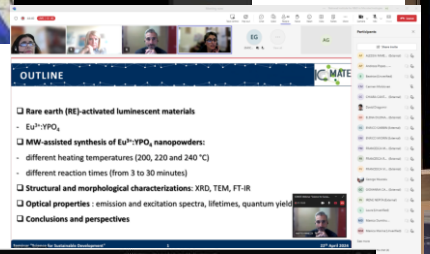
23 Seminars

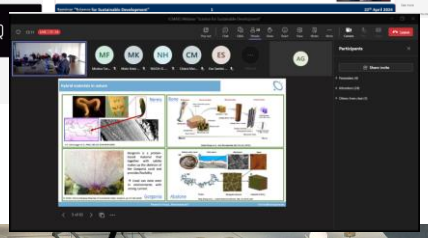
Event Type	Topic	Presenter	Date	Attendees
Seminar	Raman Spectroscopy at Nanoscale	M. Modreanu	21/03/2023	116
Seminar	MARECO: The polythematic sea station in Bonassola, Italy	A. Benedetti	29/03/2023	72
Seminar	Advanced Oxidation Processes (AOPs) for water remediation	A. Galenda	29/03/2023	72
Seminar	Plasmonic nanoalloys challenges and opportunities for photocatalysis	V. Amendola	20/04/2023	73
Seminar	Atomistic modelling of nanoalloys: structure, chemistry, and response	D. Forrer	20/04/2023	73
Seminar	New insights into the modulation of layered double hydroxides for photocatalytic air purification	L. Sanchez	24/05/2023	57
Seminar	From particle stabilized foams to TiO2 based multiscale porous materials	F. Ravera	24/05/2023	57
Seminar	Materials mechanical properties for sustainable energy production and transportation	G. Angella	27/09/2023	60
Seminar	Sustainable materials with tailored mechanical properties	S. Zapperi	27/09/2023	60
School	NET4Air's School on Environmental Sensors	Agenda	14/10/2023	32
Seminar	Gender Equality: best practices at CNR (IT) and IMT (RO)	S. Presto & C. Moldovan	09/11/2023	50
Seminar	Unravelling electronic and interfacial properties of low-dimensional materials via synchrotron techniques	M. Timpel	06/12/2023	45
Seminar	The structural and microstructural characterization of highly ordered layers by X-ray Reciprocal Space Mapping	F. Agresti	06/12/2023	45
Seminar	Lessons from Nature: how to get the best out of materials	M. Knez	24/01/2024	65
Seminar	Progresses in the design of functional systems by chemical vapor phase techniques for biomedical applications	N. El Habra	24/01/2024	65
Seminar	Pollutant measurements via optical diagnostics	S. de Iuliis	06/03/2024	60
Seminar	The impact of indoor environmental conditions on the deterioration of materials in Modern and Contemporary Art	L. Nodari	06/03/2024	60
Seminar	Microwave-assisted processing of materials	C. Leonelli	22/04/2024	51
Seminar	Microwave-assisted approach for the preparation of luminescent nanopowders with tuned morphology and optical properties	C. Mortalo	22/04/2024	51
School	NET4Air's Introduction to AI	Agenda	24/04/2024	46
Seminar	High-Entropy Alloys on graphite: wetting and reactivity evaluation by CALPHAD method	S. Gambaro	12/06/2024	50
Seminar	Integration of antibacterial properties in biomedical alloys by additive manufacturing	J. Fiocchi	12/06/2024	50
Workshop	NET4Air Workshop CAS 2024	Agenda	11/10/2024	61
Seminar	Integrating Gender Dimension and Equality Objectives into Energy and Deep Tech Fields for Inclusive and Sustainable Future	C. Moldovan & M. Losurdo & M. Modreanu	22/10/2024	
Seminar	NET4Air: Towards the development of a platform with interchangeable air pollution sensors	A. Grigoroiu	07/05/2025	64
Seminar	Personal Thermal Management Using Thermoelectric Technology And Textile-based Heat Exchangers	G. Latronico	07/05/2025	64
Workshop	NET4Air Workshop – Innovative Sensing Technologies for Environmental Monitoring	Agenda	30/05/2025	25
Workshop	NET4Air' Workshop "Smart sensor technologies for next-level air quality monitoring"	Agenda	10/10/2025	40

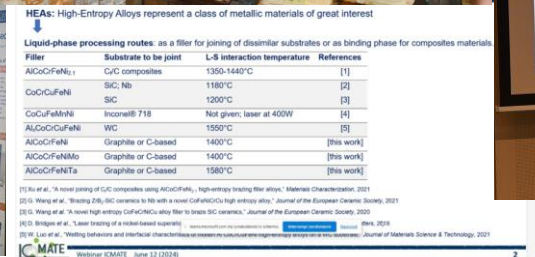
WP3: Seminar Highlights



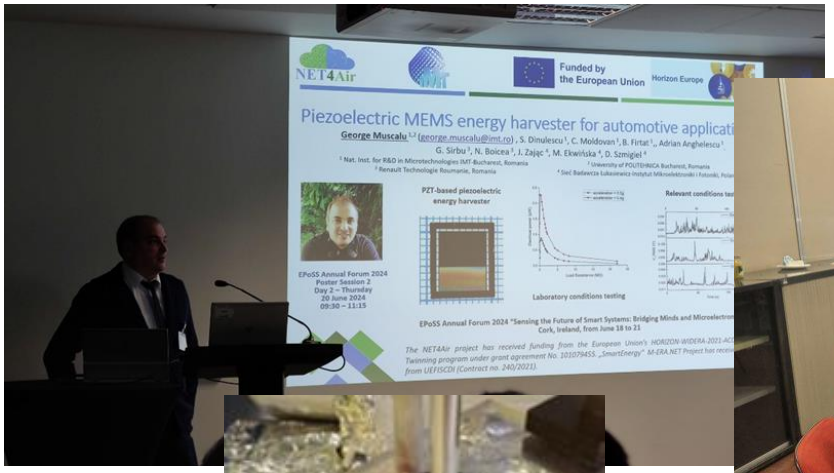


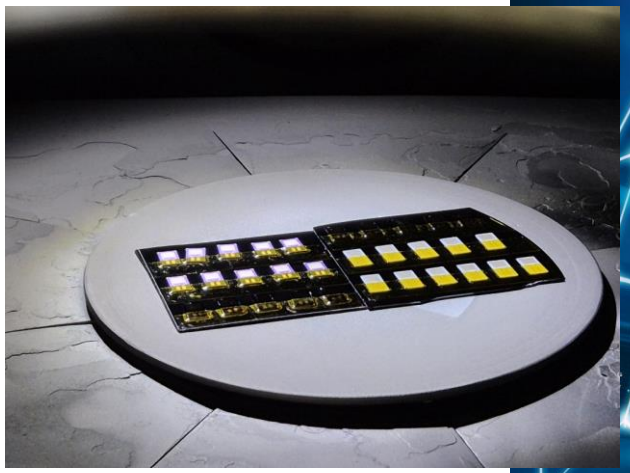


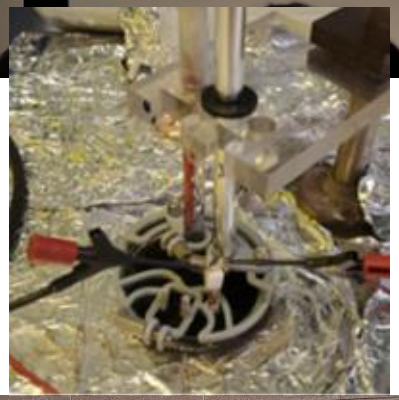




WP3: Exchange Highlights







WP4: Exploratory Research Project “Wearable and /or portable platform for air monitoring”

Sensor array platform and electronic interface that accepts **interchangeable sensors.**

Four use cases are targeted using different combinations of sensors and data transmission options.

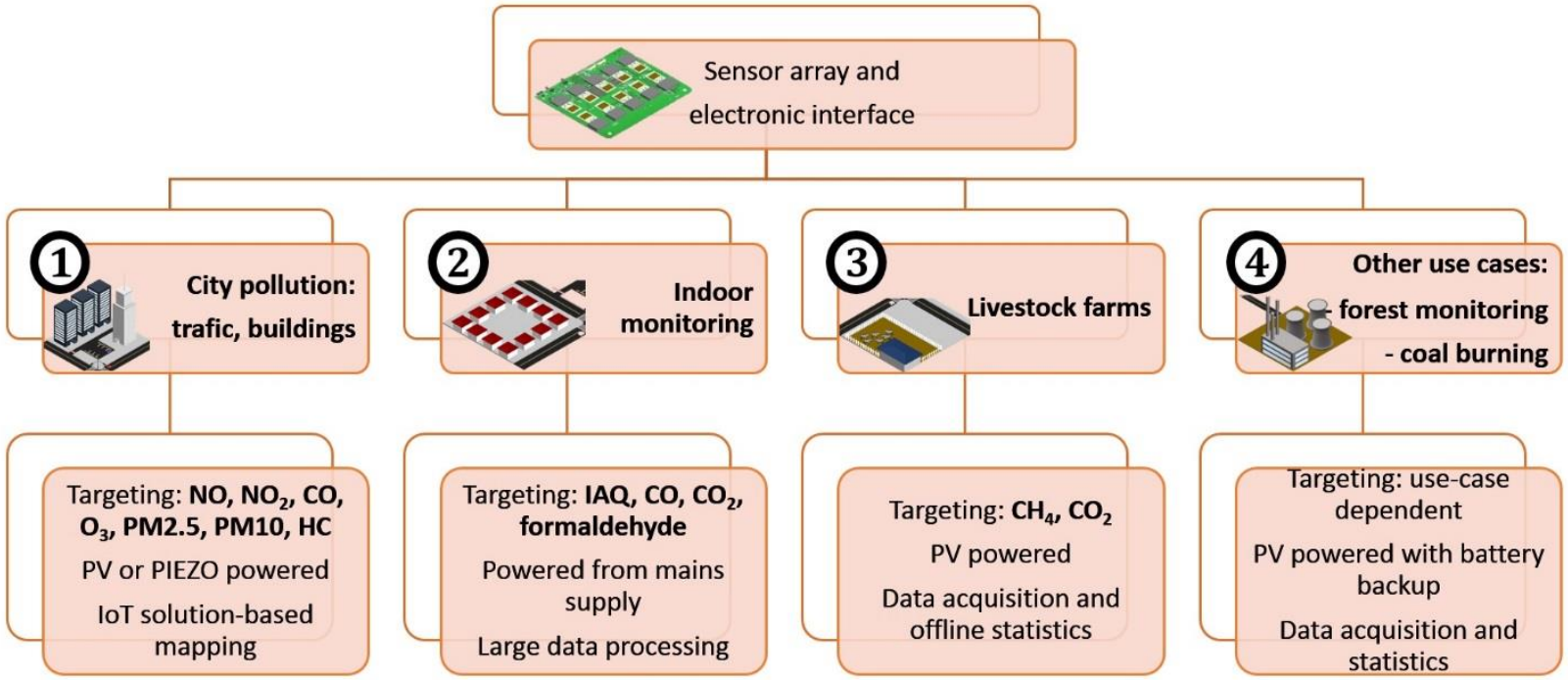
Sensors will be **fully characterized** before deployment.

Selectivity of the sensors will be enhanced by a tailor-made gas unmixing algorithm.

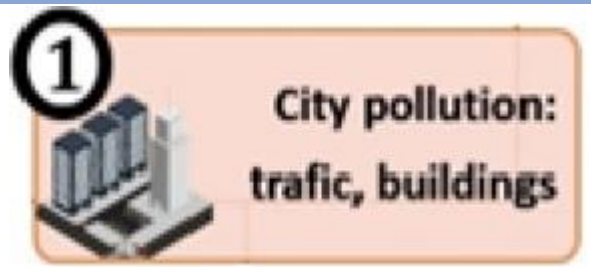
Air quality mapping of specific locations will be performed.

Platform specifications:

- self-powered
- portable / wearable
- findable and reusable data
- accessibility
- air quality control
- 100 users involved in study



USECASE 1 City pollution

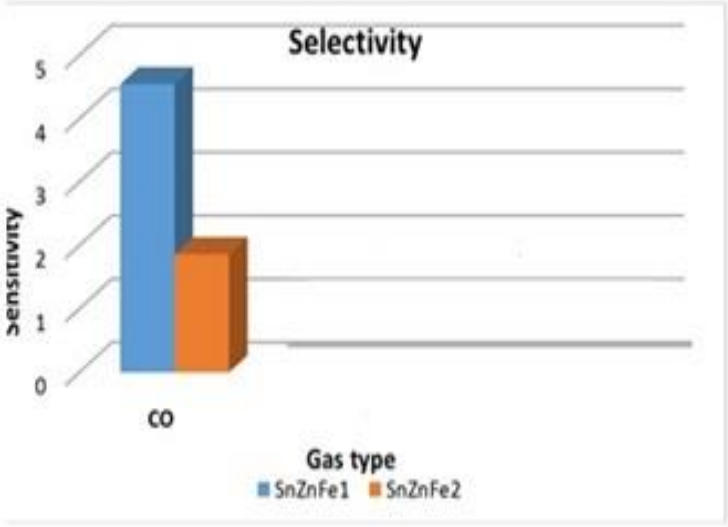


Targeted Gases

NO, NO_2, CO, O_3, PM 2.5, PM 10, HC

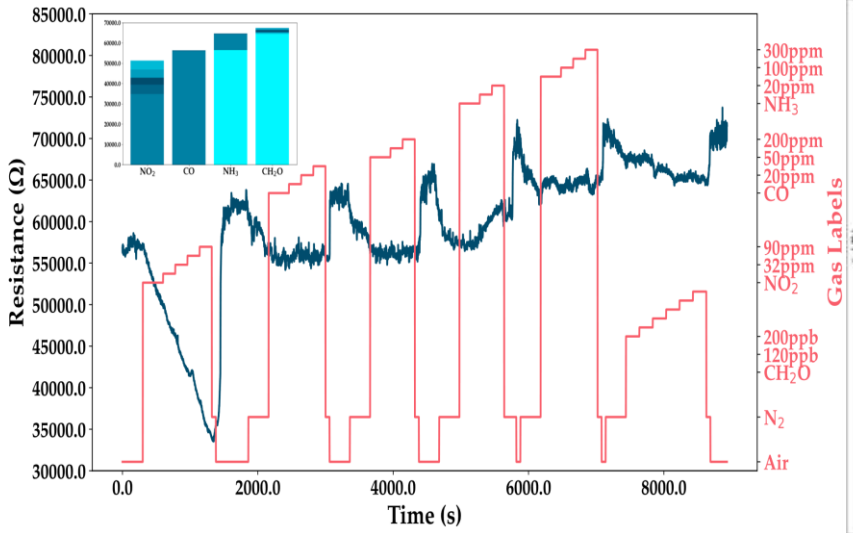
CO gas sensors

- high sensitivity of the prepared sol gel metallic oxides layers when using ternary oxides combination (**SnZnFe**)



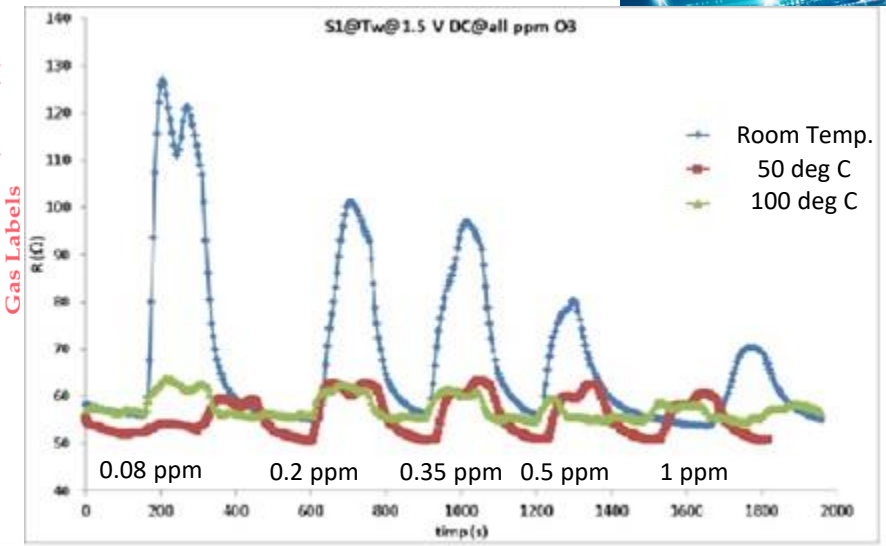
NO_2 gas sensors

- **PANI/rGO/ZnO** sensitive layer – good linearity in the measurement range **(8-90 ppm)**



O_3 gas sensors

- **In_2O_3** sensitive layer – good reproducibility for 0.08 ppm concentration



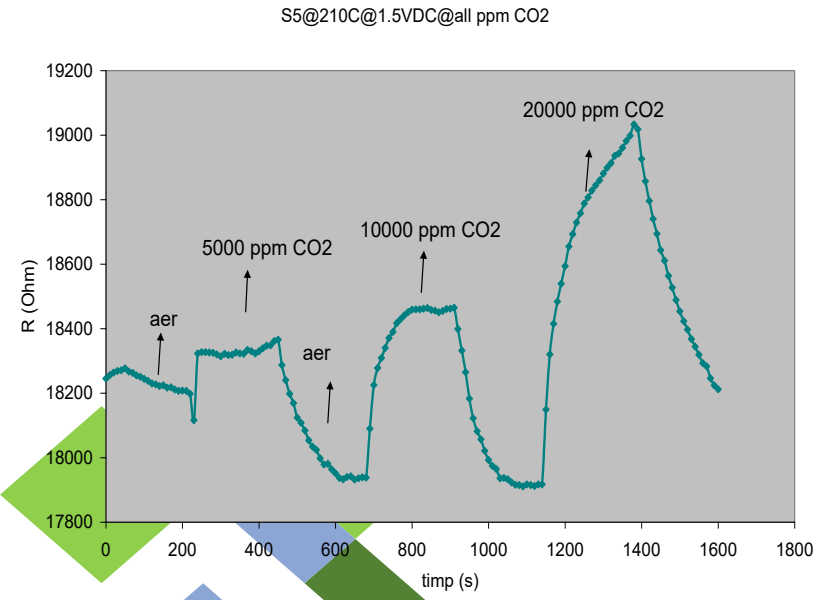
USECASE 2 - Indoor monitoring

Targeted Gases

CO, CO_2, formaldehyde, IAQ

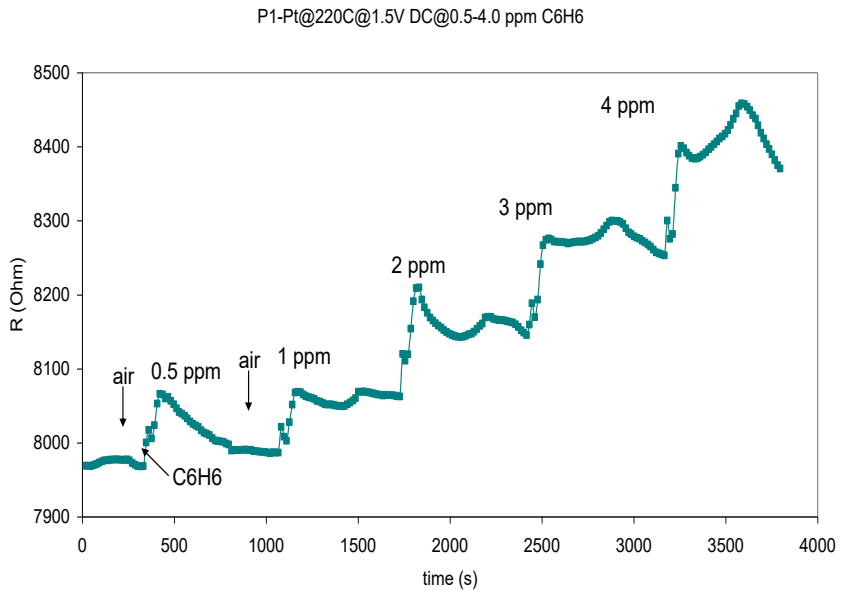
CO_2 gas sensors

- **CuO** and **CoO** sensitive layers
- Substrate temperature **210 dec. C**



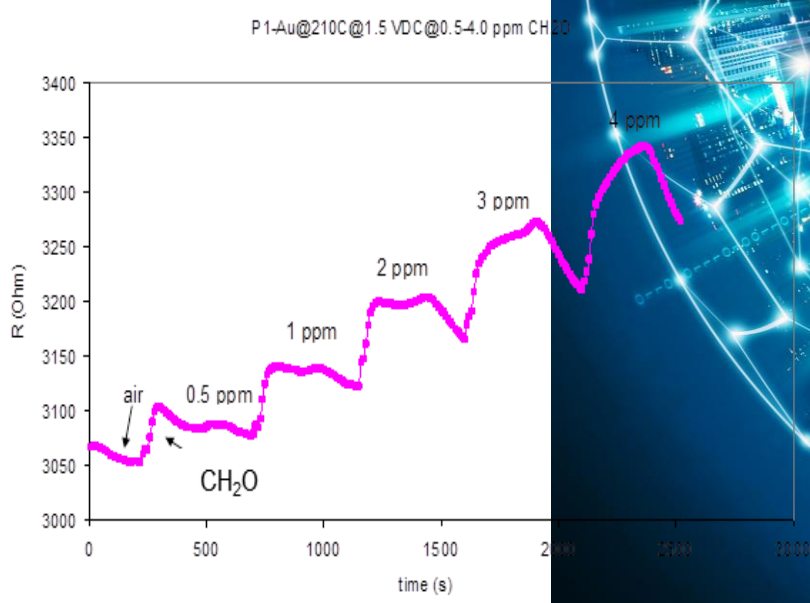
C_6H_6 gas sensors

- **CuO** sensitive layer with **Pt – IDE**
- Measurement temperature **220 dec. C**



Formaldehyde sensors

- **CuO** sensitive layer
- Measurement temperature **210 dec. C**

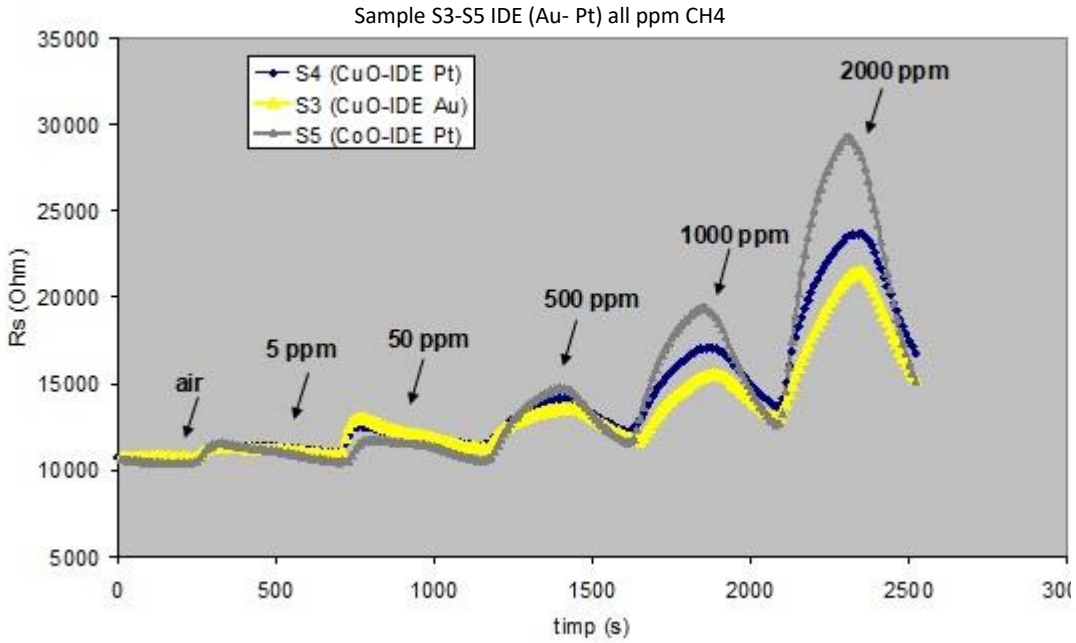


USECASE 3 – Green house gases

Targeted Gases → CH_4, NH_3, CO_2

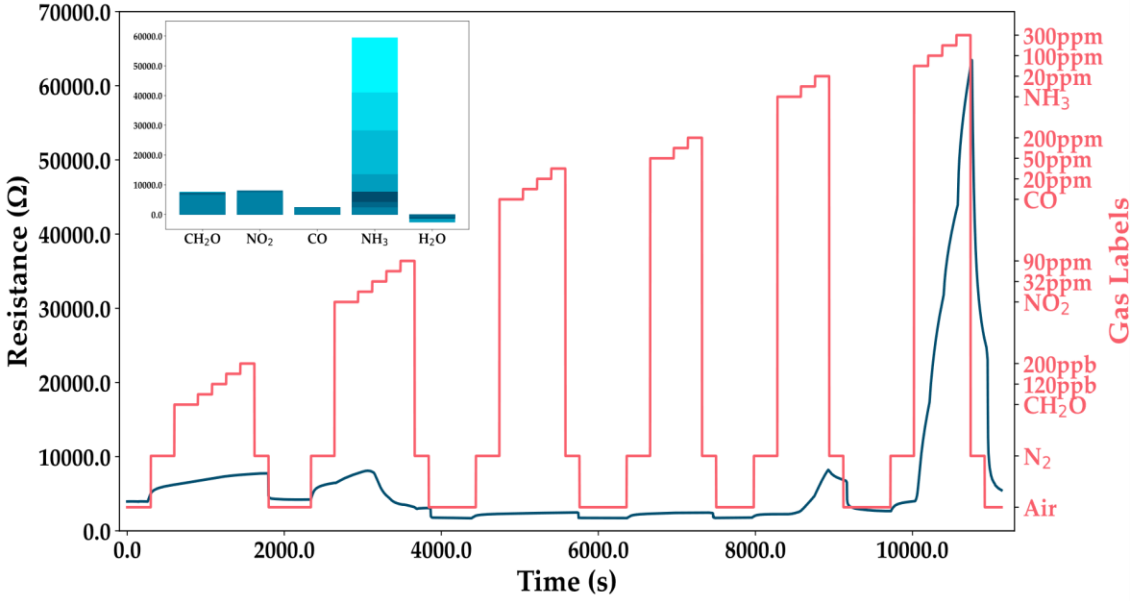
CH_4 gas sensors

- **CuO** sensitive layer with **Pt – IDE**
- Measurement temperature **210 dec. C**



NH_3 gas sensors

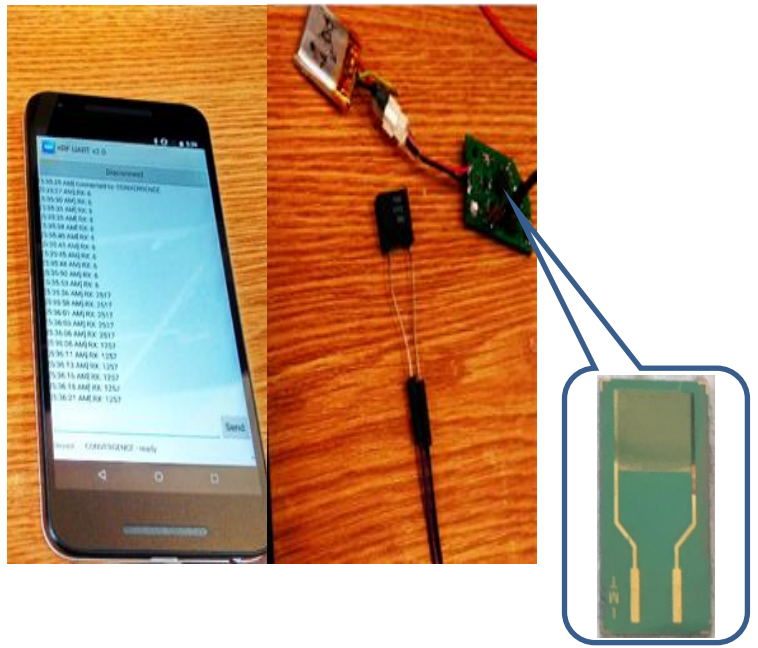
- **PANI/rGO** sensitive layer – good linearity in the measurement range **(5-300 ppm)**



PANI based CO sensor

Ink Jet printed PANI based CO sensor

Dedicated ink as a sensitive layer for CO detection to be deposited on the sensor electrodes.
The ink formula with conductive particles consisting of polyaniline, polystyrene sulfonate and carbon nanotubes (PANI:PSS/SWCNT) has been synthesized.
inkjet printing solution are: viscosity of 10–12 cP, surface tension of 28–33 dyn /cm, boiling point >100 °C, 4 < pH < 9.



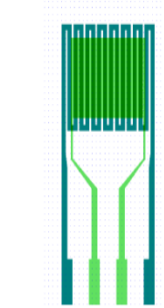
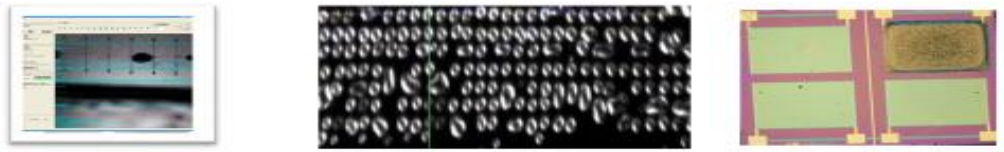


Table 9. Ink Jet solutions properties.

Name of Ink-Jet Formulation	Conductivity (mS·cm^{-1})	pH	Viscosity (CP)
PANI: PSS (EG/Tween 80%)	2	4.0	8
PANI:PSS/SWCNT (PSS:Lacticacid:EG; Tween 80%)	4.98	6.0	12

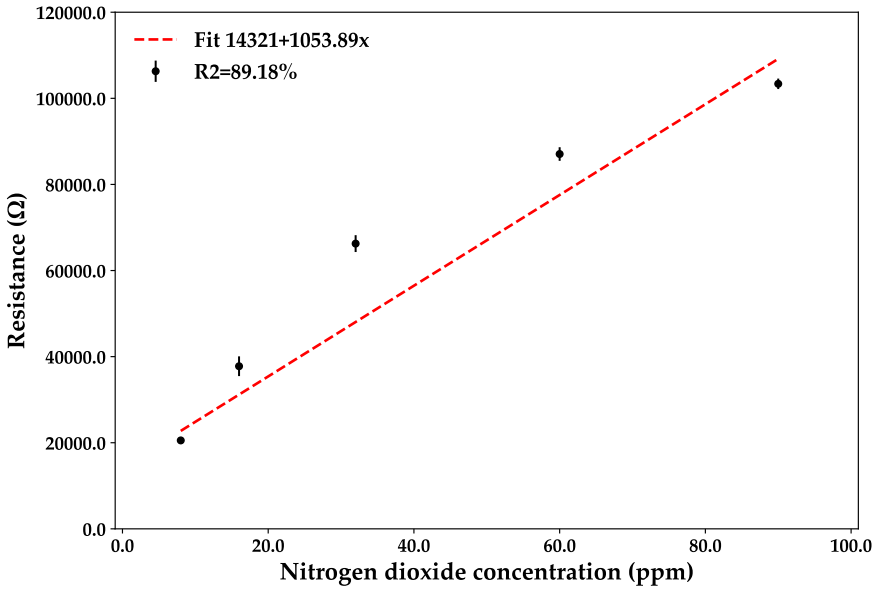
The printing results are shown in Figure 15. Figure 15a represents the camera image of the IDEs surface during printing with the Dimatix DMP 2800 system Figure 15b shows the visible spots on the optical microscope of the sensor surface after IDEs printed with ink-jet formulation. The solution shows a good viscosity for printing process and therefore after drying shows a uniform deposition on IDEs (X.B).

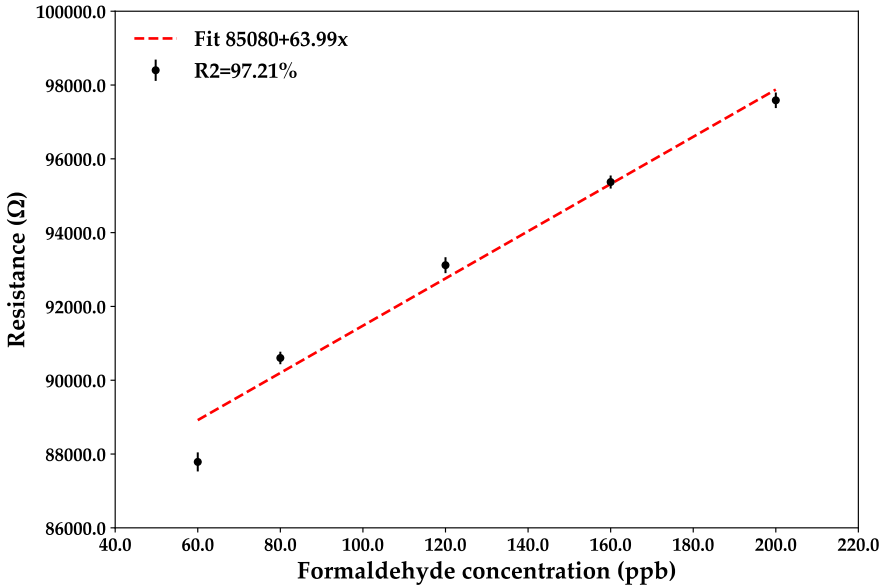


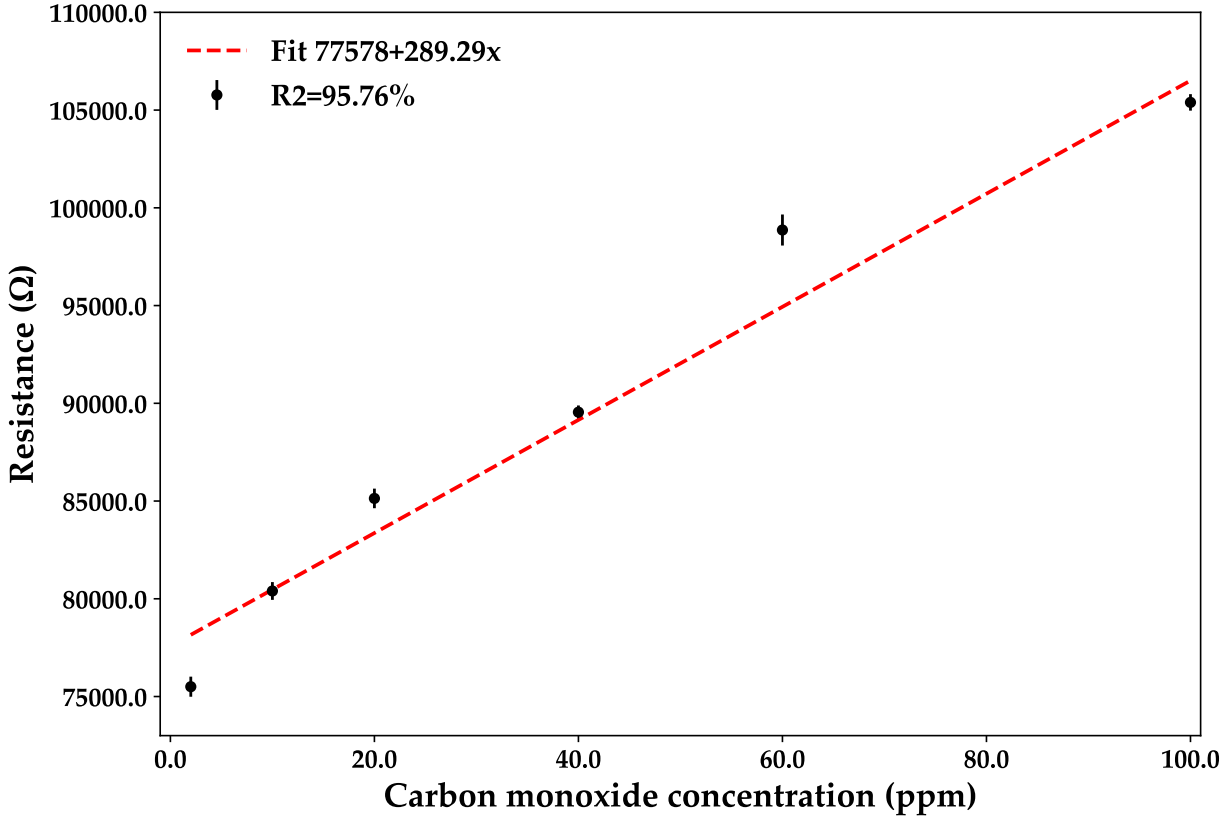
(a) (b)

Figure 15. (a) Images during the printing process of the PANI:PSS/SWCNT ink with Dimatix DMP 2800; (b) Optical microscope image if PANI:PSS/SWCNT on one pair of IDE.

Carbon Monoxide







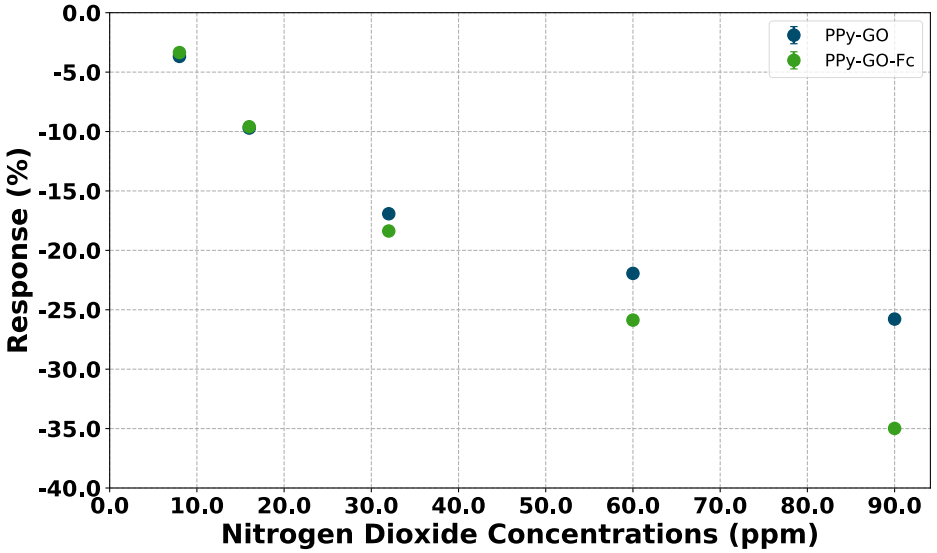
PANI - SWCNT - Fc

S [10ppm] = 19.22% **Sensitivity** = 0.37 % / ppm

S [100ppm] = 56.28% **LoD** = 3.02 ppm

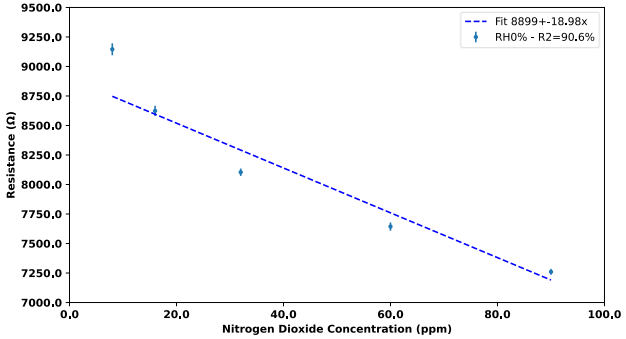
Nitrogen Dioxide

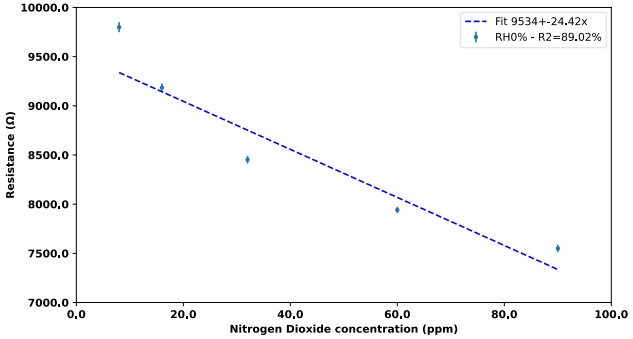
Response



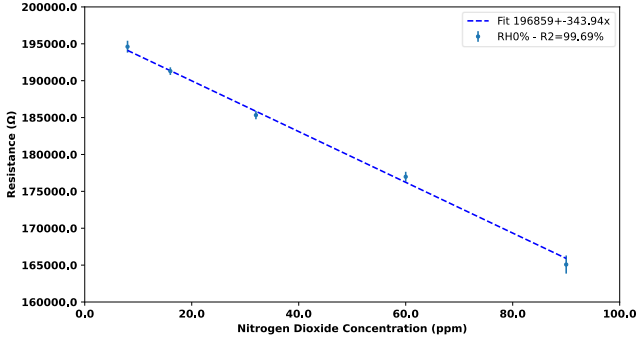
Linearity

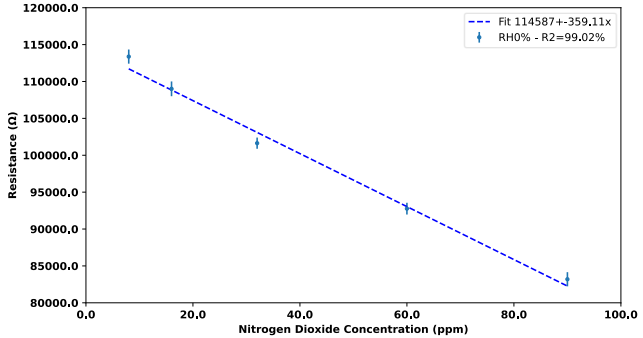
PPy - rGO





PPy - rGO - Fc

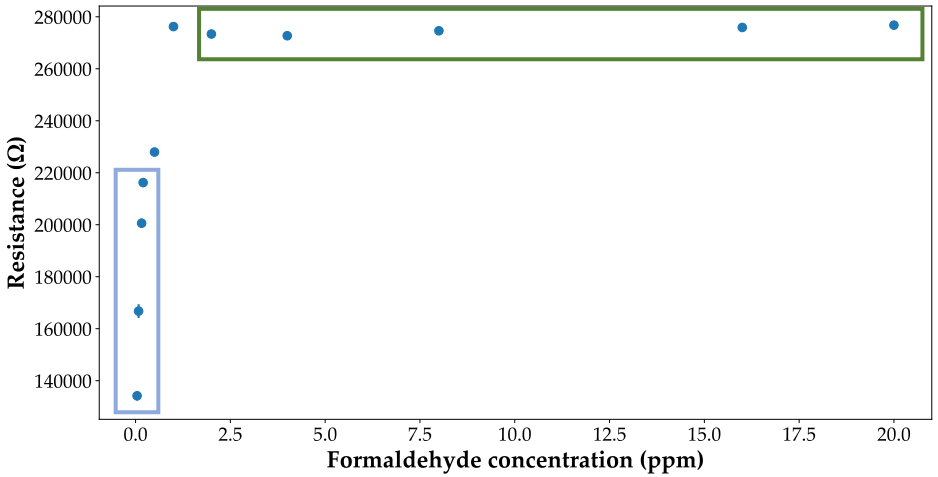


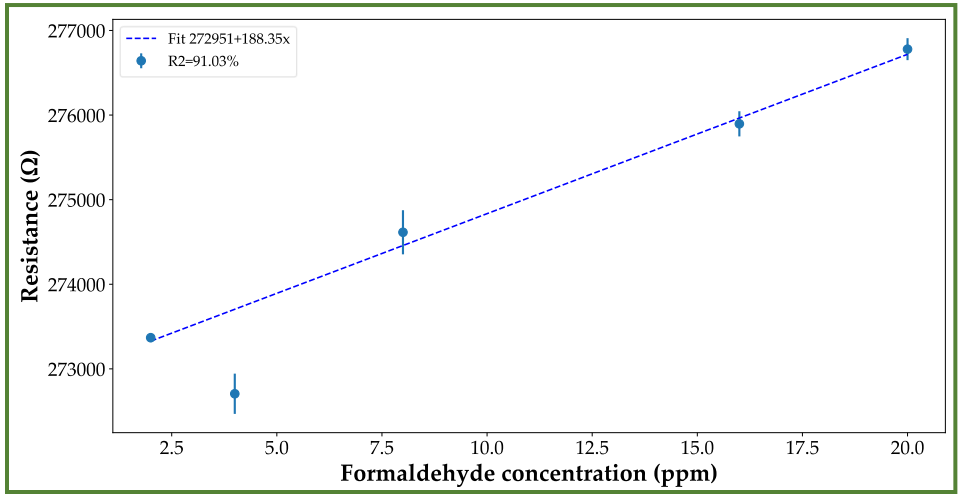


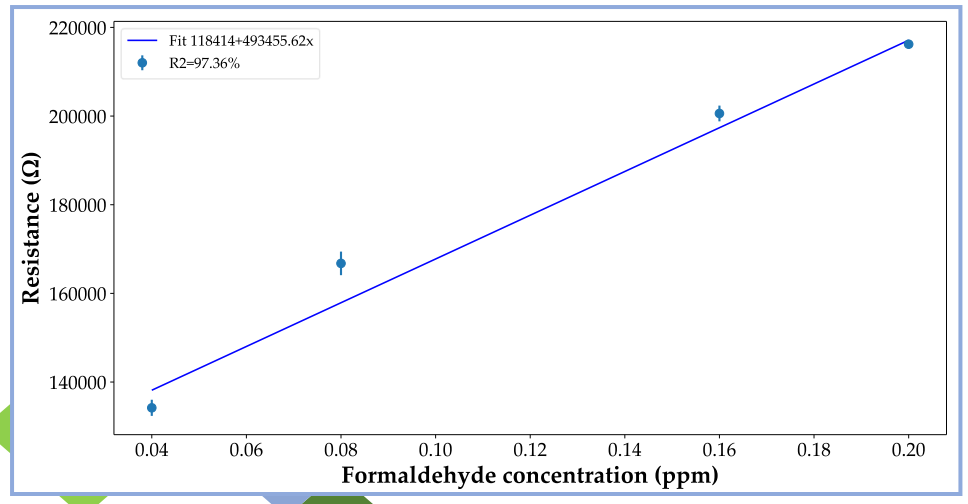
Grigoroiu, A., Mihailescu, C.M., Savin, M., Braşoveanu, C., Moldovan, C.A., Dinulescu, S., Muscalu, G.S., Brincoveanu, O., Firtat, B., Ion, M. and Dragomir, D., 2023, October. Enhancing NO 2 gas sensing performance at room temperature using electrodeposited composite PPy-rGO-Fc. In 2023 International Semiconductor Conference (CAS) (pp. 43-46). IEEE.

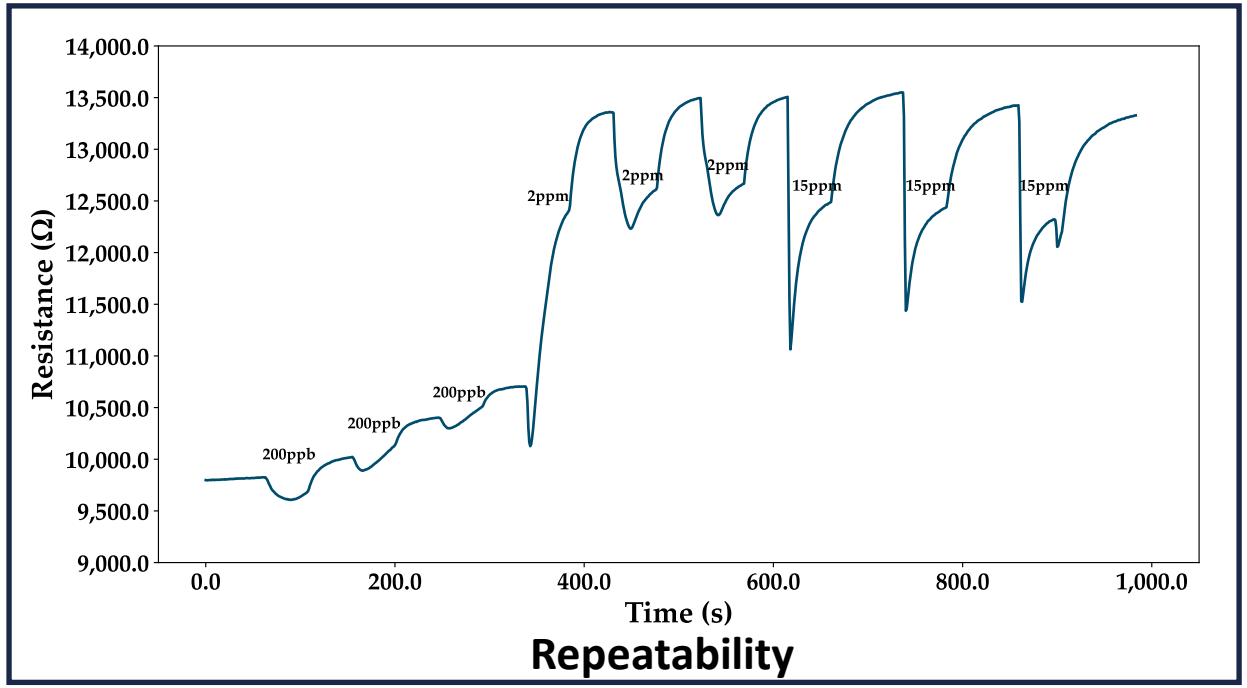
Formaldehyde

Linearity



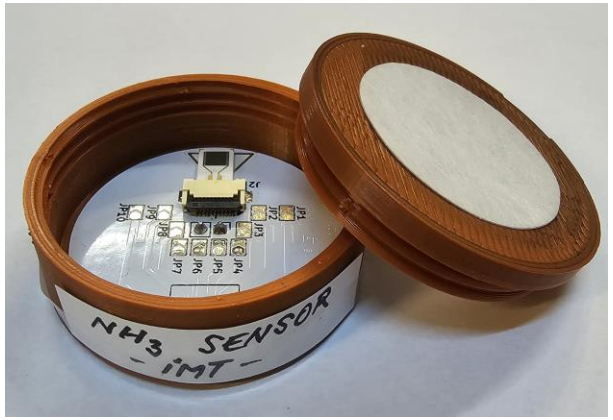




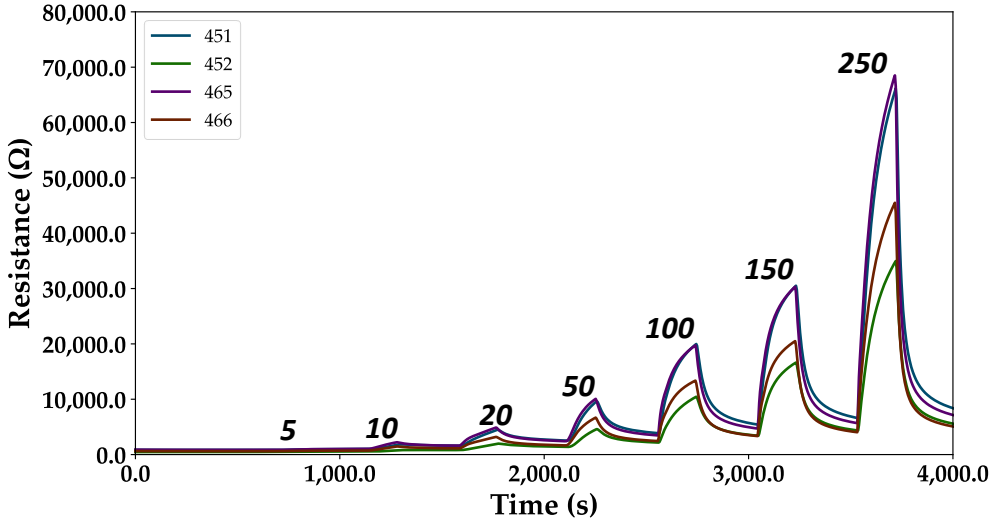


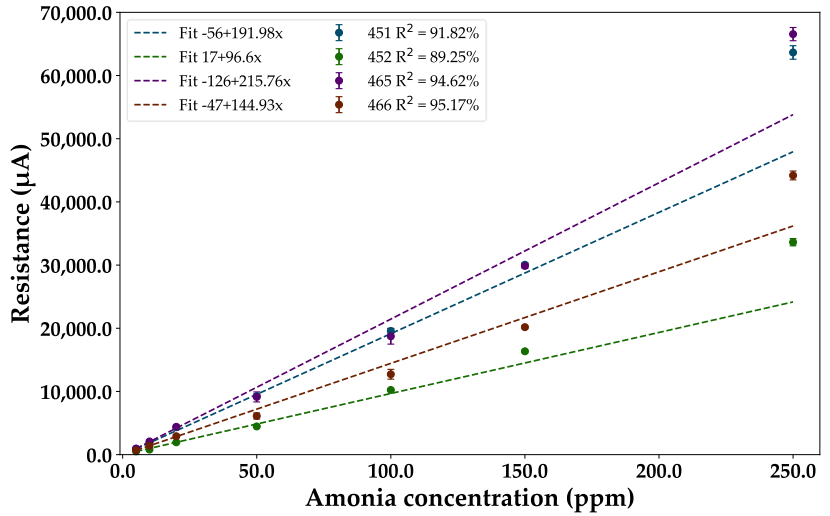
Repeatability

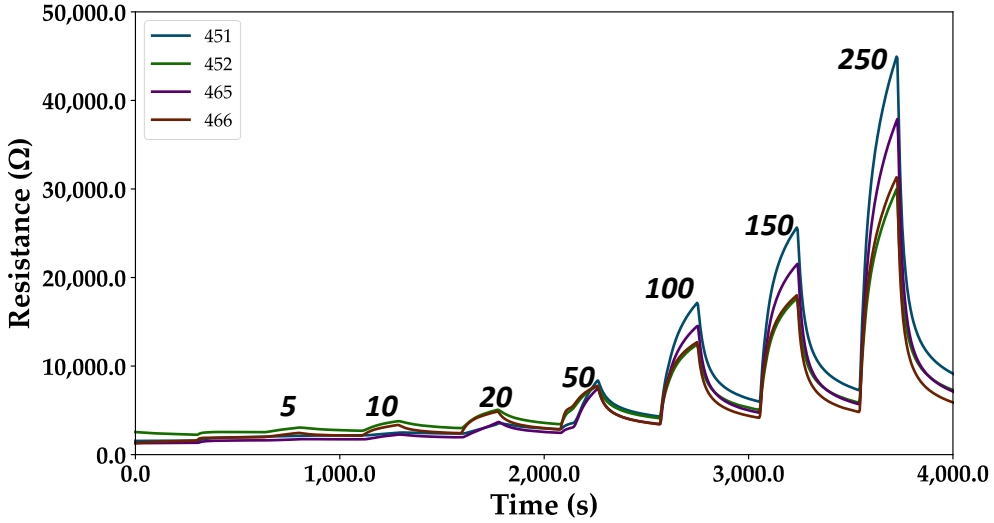
Ammonia

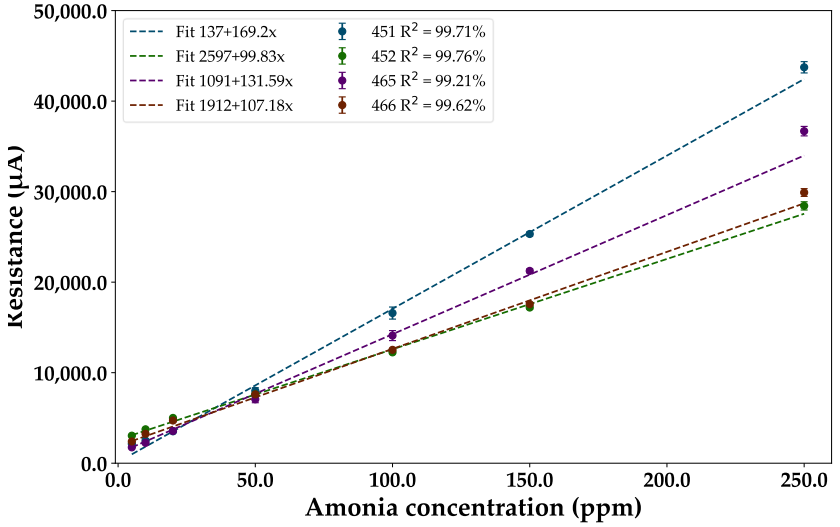

NH3 SENSOR
- iMT -


NH3 SENSOR
- iMT -


451
452
465
466
Resistance (Ω)
Time (s)
5
10
20
50
100
150
250


Fit -56+191.98x
Fit 17+96.6x
Fit -126+215.76x
Fit -47+144.93x
451 R² = 91.82%
452 R² = 89.25%
465 R² = 94.62%
466 R² = 95.17%
Resistance (µA)
Amonia concentration (ppm)

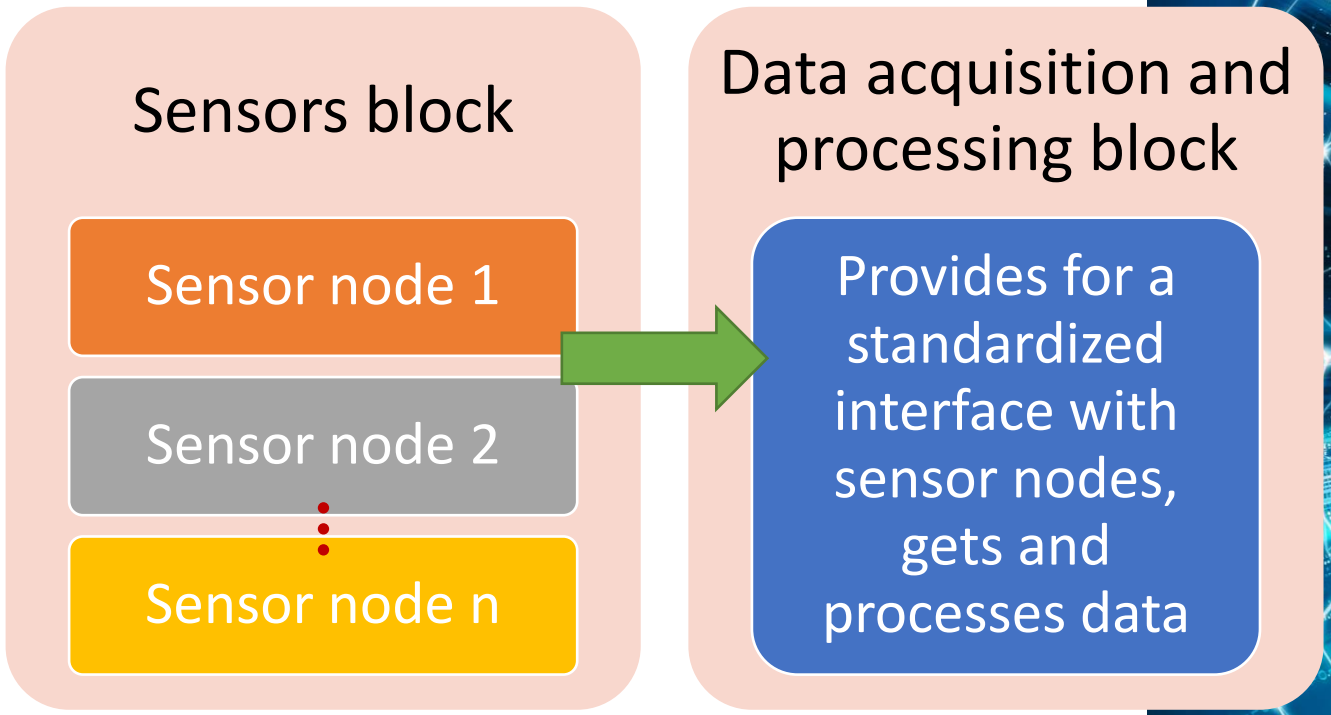

451
452
465
466
Resistance (Ω)
Time (s)
5
10
20
50
100
150
250


Fit 137+169.2x
Fit 2597+99.83x
Fit 1091+131.59x
Fit 1912+107.18x
451 R² = 99.71%
452 R² = 99.76%
465 R² = 99.21%
466 R² = 99.62%
Resistance (µA)
Amonia concentration (ppm)

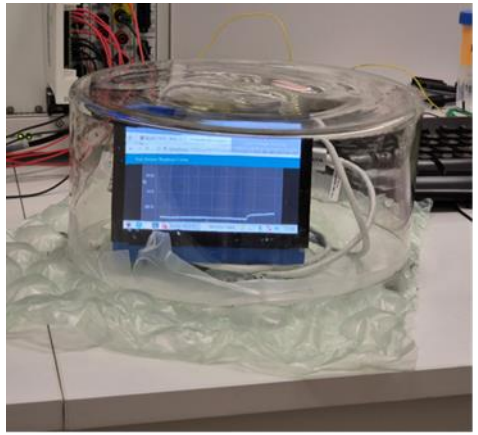
System overview

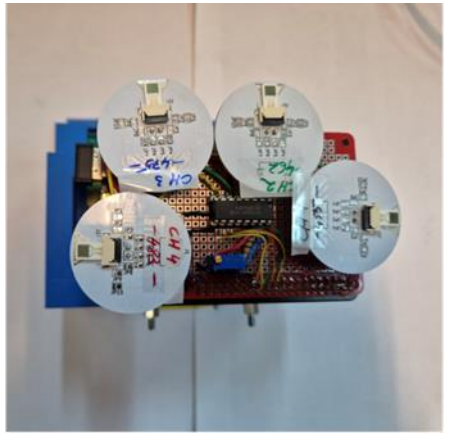
General requirements:

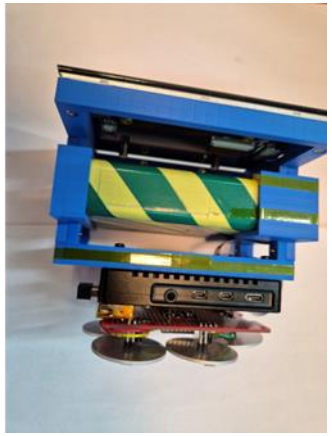
- Functionality split between two blocks: sensing and data acquisition
- Sensor block consists of one or more sensor nodes, each catering to a particular sensor type
- Data block gathers the data output by all the sensor nodes and provides subsequent data processing functionality
- Interface between the two blocks should be standardized, in order to provide interoperability between different sensors of the same type
- On the sensor block side, depending on the actual sensor type used, some form of signal conditioning and/or analog front-end circuitry is needed; output is to meet the specifications for the defined interface to the data ACQ block.

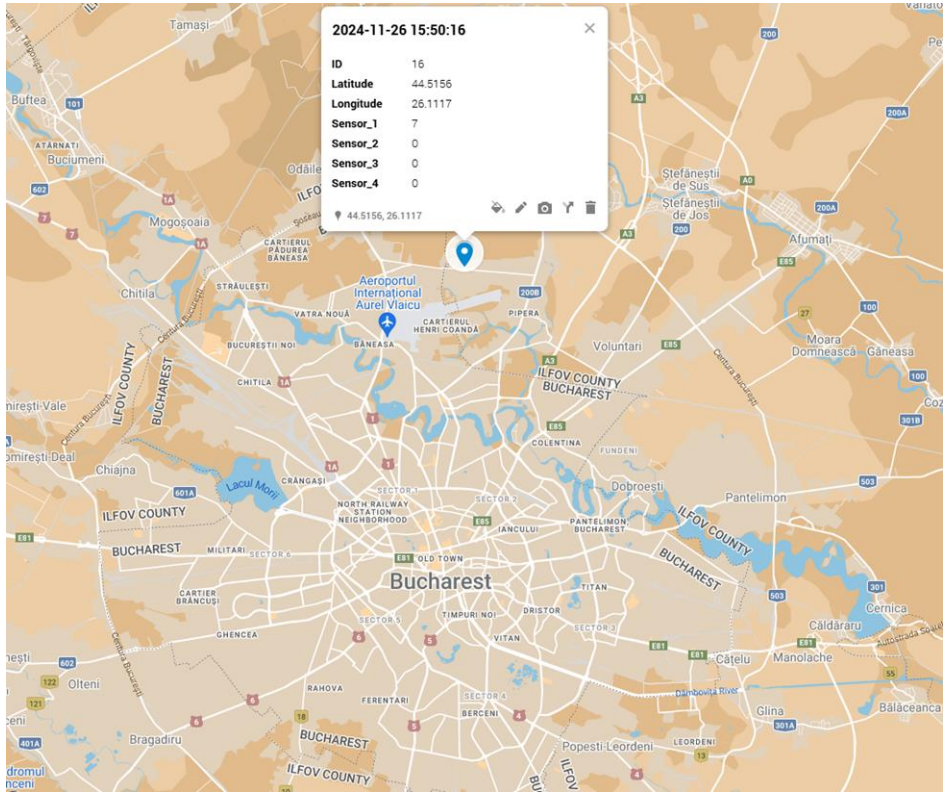


UC1 Concept









a

```
SELECT * FROM `UC1_Measurements`
```

ID	Latitude	Longitude	Sensor_1	Sensor_2	Sensor_3	Sensor_4	Time
5	44.515600	26.111700	0.2	0	0	0	2024-11-26 15:03:46
7	44.515600	26.111700	7	0	0	0	2024-11-26 15:50:07
8	44.515600	26.111700	6	0	0	0	2024-11-26 15:50:08
9	44.515600	26.111700	5	0	0	0	2024-11-26 15:50:09

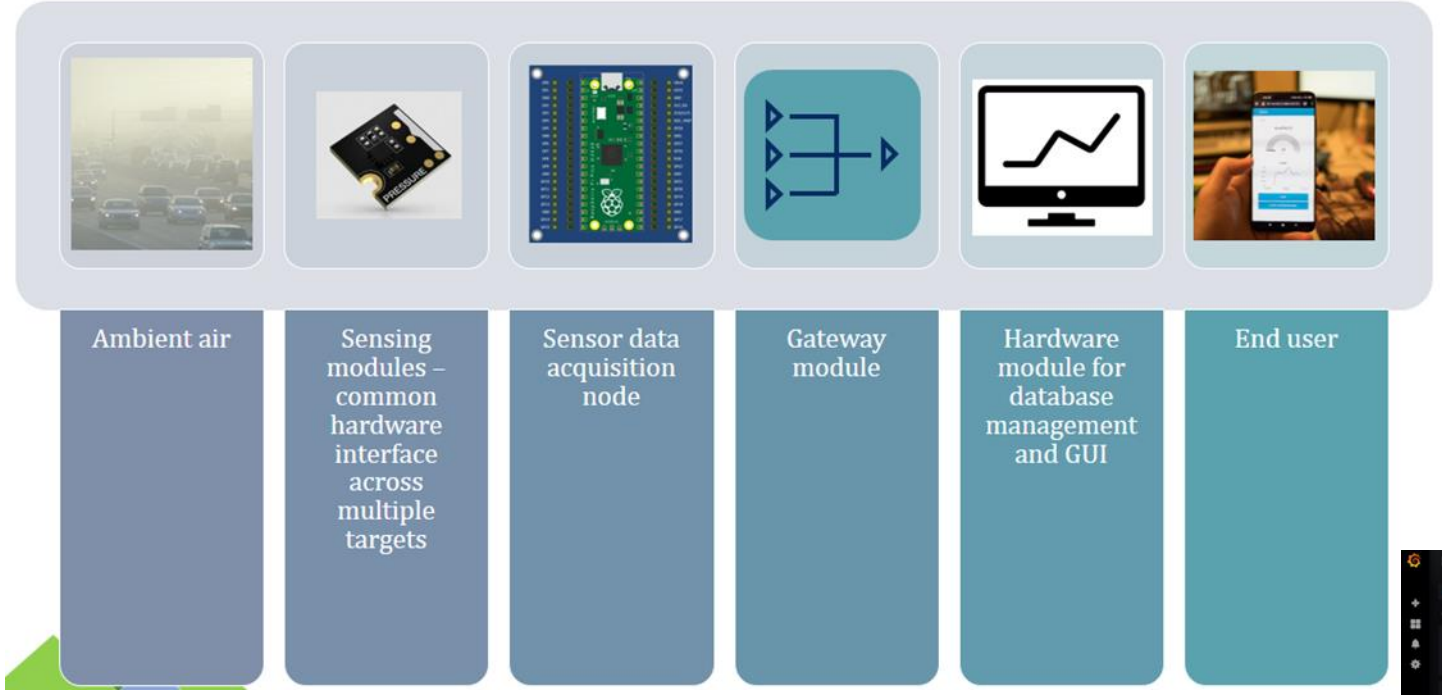
b

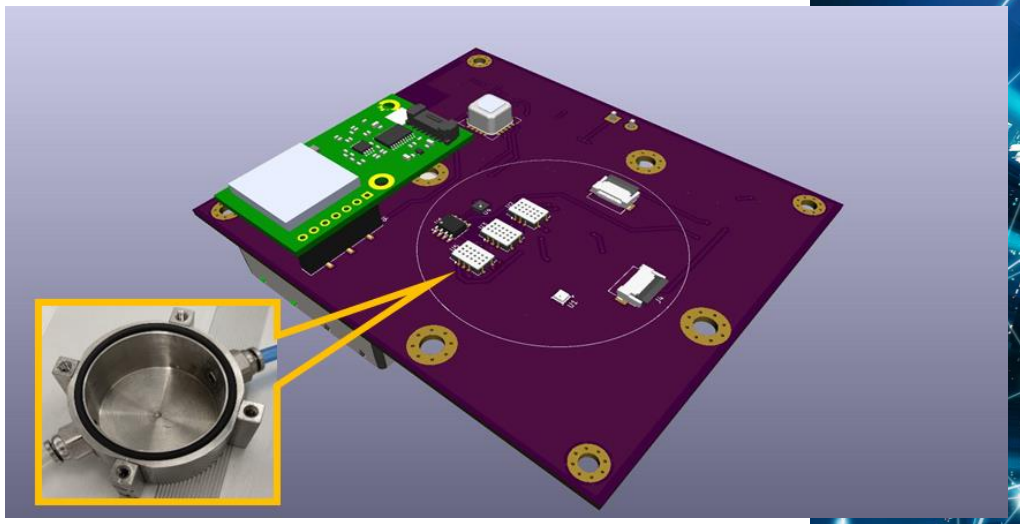
```
SELECT * FROM `UC1_measurements` ORDER BY `ID` ASC
```

ID	1	Latitude	Longitude	Sensor_1	Sensor_2	Sensor_3	Sensor_4	Time
1		44.515600	26.111700	18	38	131	141	2025-02-05 13:05:22
2		44.515600	26.111700	18	38	131	141	2025-02-05 13:05:26
3		44.515600	26.111700	18	38	131	142	2025-02-05 13:05:30
4		44.515600	26.111700	18	38	130	141	2025-02-05 13:05:34

Target Gas	NH_3	NO_2	CO	CH_2O
Sensing Layer	PANI-MWCNT-NH2	PPy-GO-Fc	PANI-SWCNT-Fc	PANI-rGO-Ag

UC2 Concept



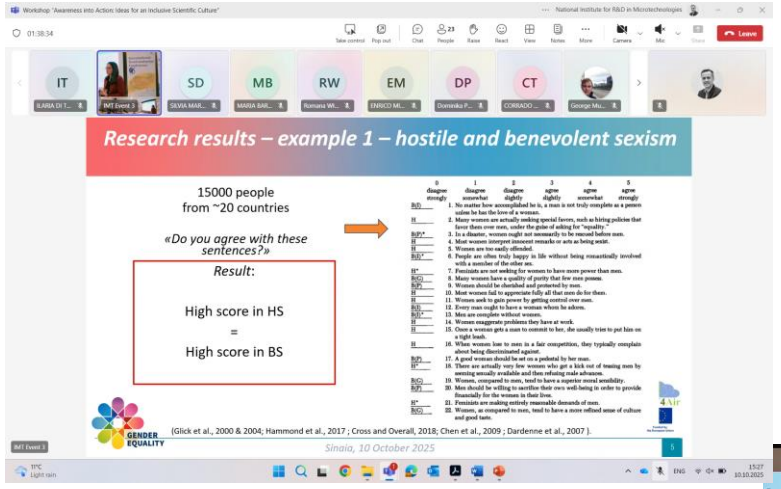


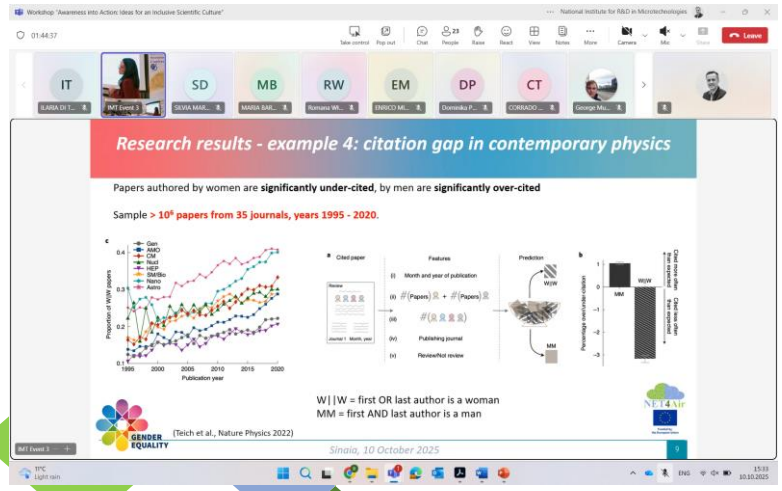
- Custom circuit board designed to accommodate various internally developed sensors for different use case scenarios

UC2 Concept

- Baseboard using wireless communication enabled microcontroller for upstream data parsing and transmission
- Easily swap in or out sensors for a configuration of sensor data relevant to the use case deployment

WP5: Promotion of gender equality, diversity and inclusion, specialization of staff and young researchers

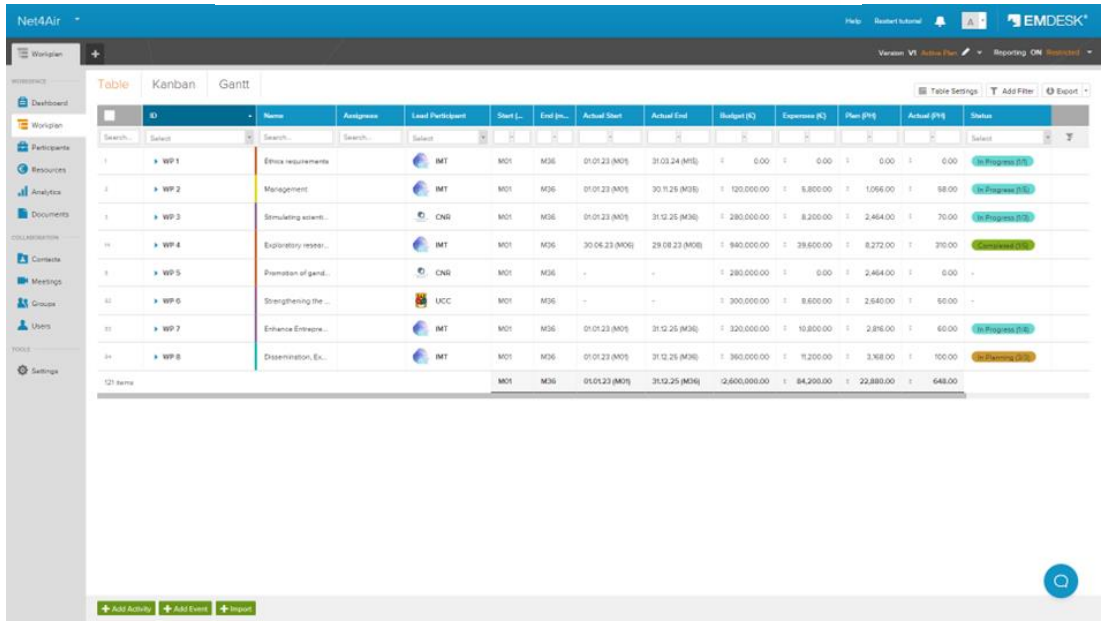


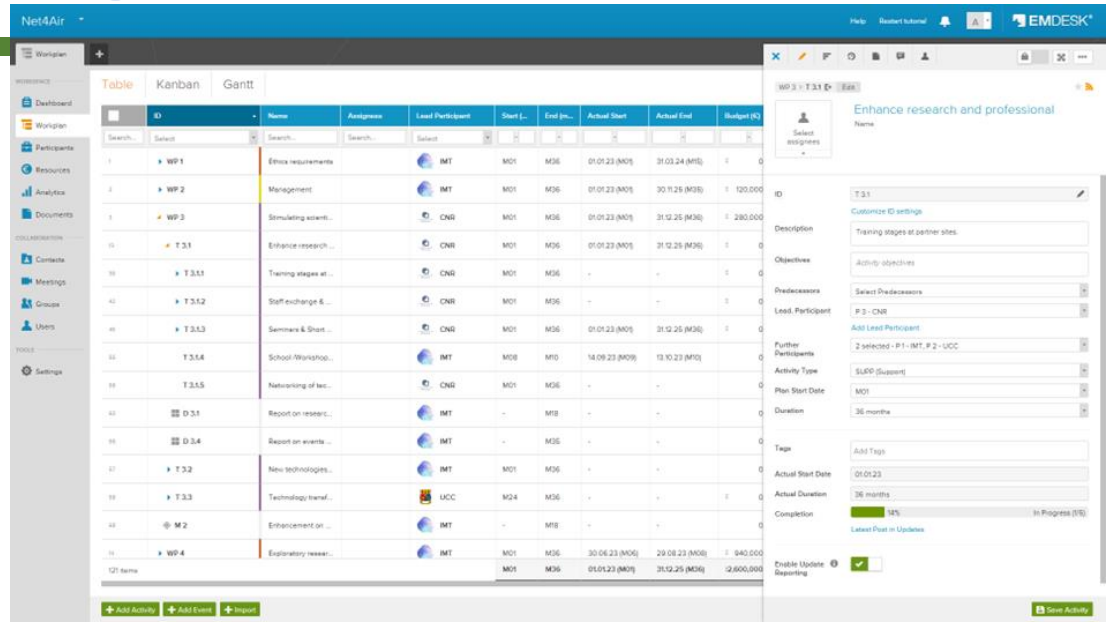


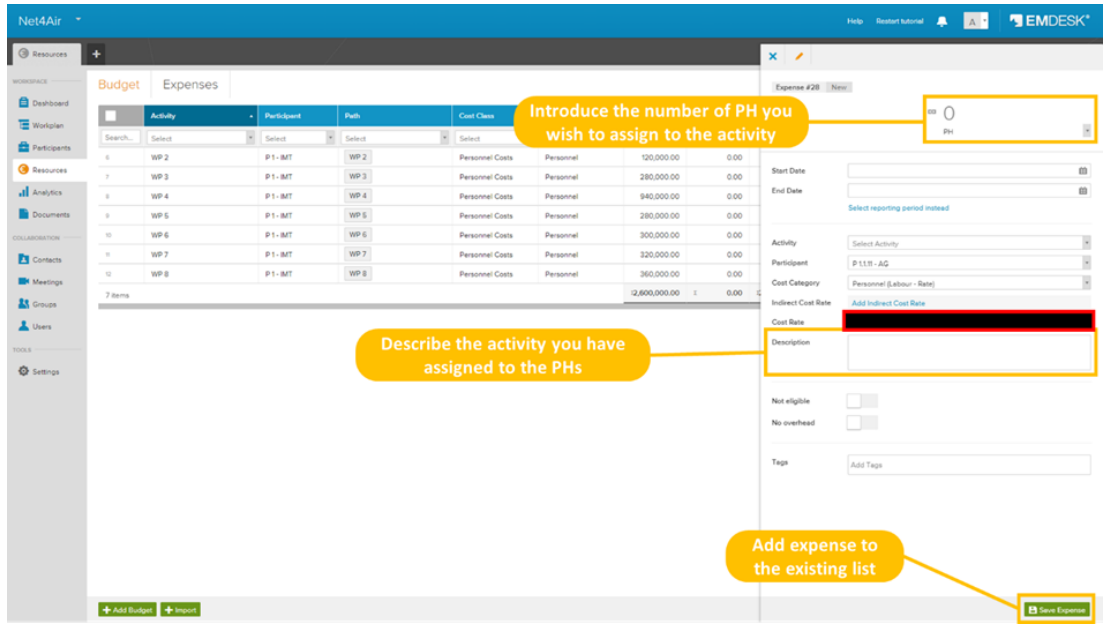
2 Workshops on Gender Dimension

WP6: Strengthening administrative skills

EMDESK®
Research Project Management Software



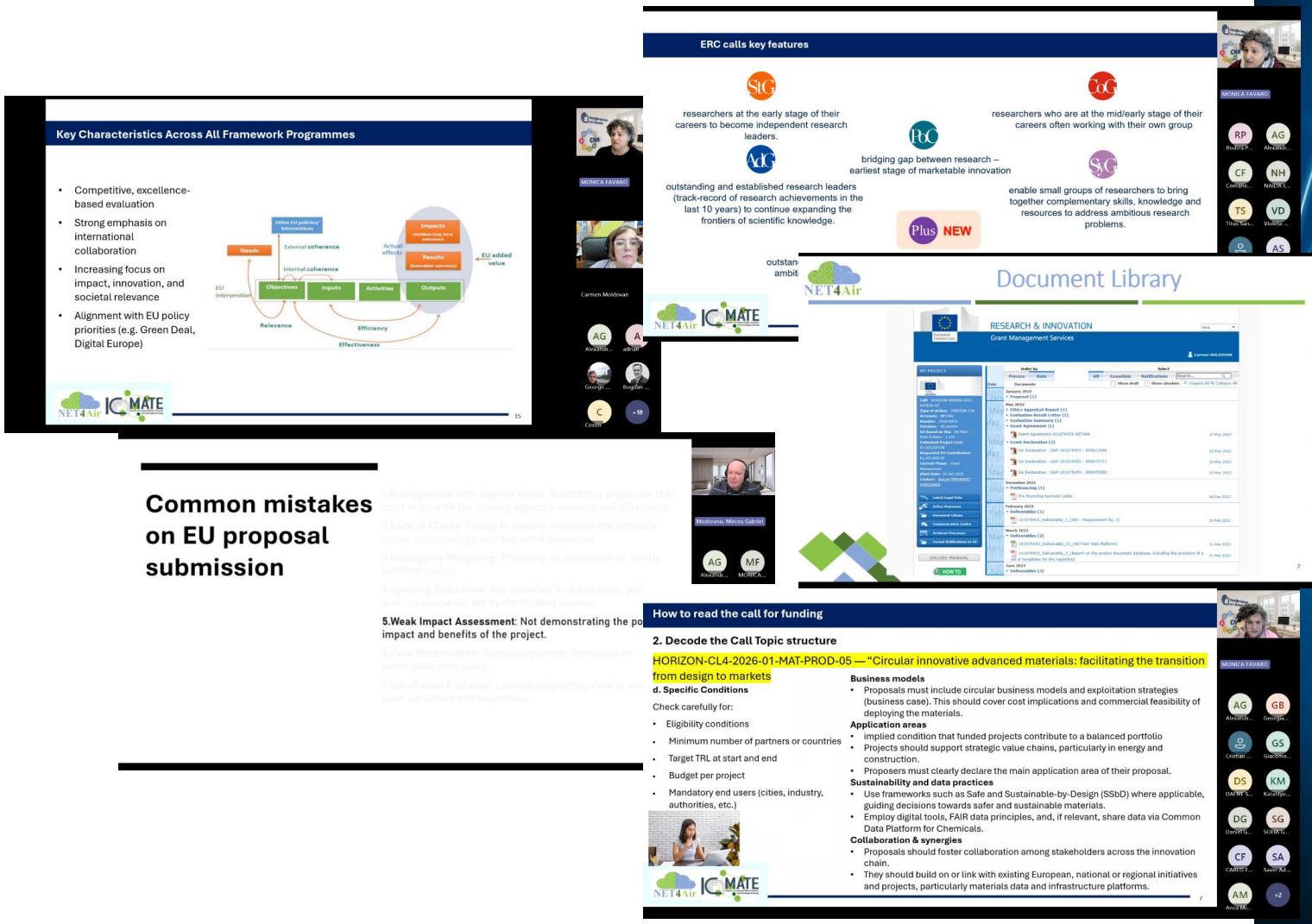




W6: Proposal preparation

Online Training Programme on Horizon Europe

- Horizon Europe Overview
- Pillar I and III: ERC and EIC funding schemes
- Pillar II: EIC funding schemes for collaborative projects
- The Lump Sum funding scheme of EU projects
- Grant Management
- Cluster 4 HEU calls 2026
- Chips-JU Calls 2026



W6: Successful Projects

During Project:

RO-SMARTSYS

Innovate Locally, Compete Globally

UNLOOC

MIMOSA

4D Microscopy of bio materials

10 Project Proposals

4 Projects granted + 2 supported

3 granted Projects coordinated

Coordination Experience Helped with:

NerveRepack

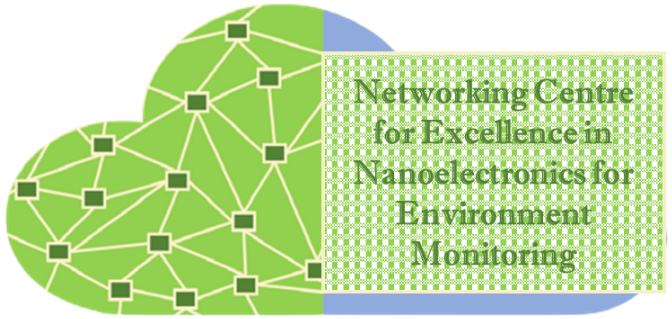
ICOS

International Cooperation On Semiconductors

WP7: Networking center of excellence

Goals:

- Exchange of information with major stakeholders from Romania;
- Generating new environment monitoring strategies;
- Creating strategic partnerships between Romanian organizations, industry, citizens, and government organizations and agencies;
- Creating public awareness on the environment;
- Providing information about the best practices for environment control and protection;
- Development of standards for air quality monitoring in Romania;
- 'Knowledge Transfer Zone for Socio-Economic Development';
- One day meetings with SMEs.



Support: 2031 +

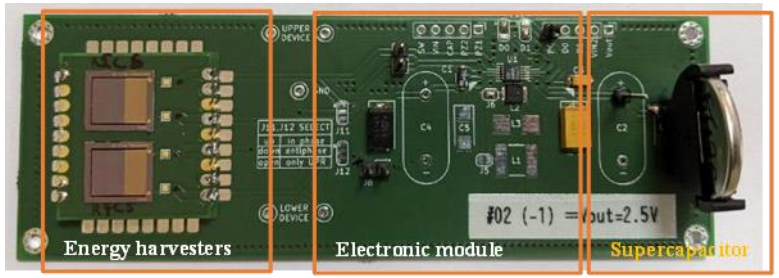
Target: 25 partners

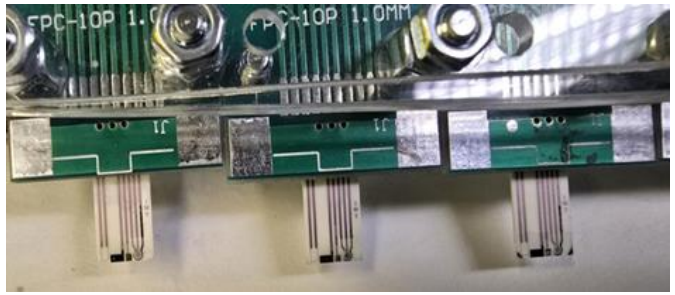
Benefits:

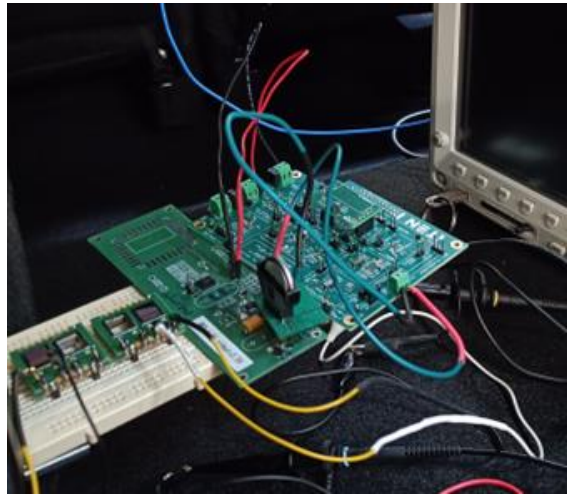
- Round tables, for the elaboration of a coherent conceptual;
- Policy advice trainings for staff and young researchers;
- Courses, schools, and workshops related to environmental monitoring;
- Open Days at IMT and partner sites;
- Support for the organization of large scientific events.

Centre of excellence members

- **Five** secondments at partners (Renault, DDS, Romelgen, Areus)







20 NET4Air Centre of Excellence Members – Romania

+ 10 EU partners

WP8: Dissemination

https://net4air.eu/home/

15 Presentations of the project in scientific conferences, summits, workshops, etc.

Type	Event Name	Action Title	Date
Conference	DIASPORA Conference Timisoara	NET4Air Project Presentation	11/04/2023
Summit	26th World Micromachine Summit	Country Review for Romania	22/05/2023
Brokerage	CESMIN – Brokerage and dissemination event	Presentation: 'NET4Air: Networking Center for Excellence in Nanoelectronic Devices for Air Monitoring'	31/05/2023
Workshop	CESMIN Project Closure Workshop	Presentation of calls in the domain of micro-nanotechnologies launched in 2023 within the Horizon Europe Programme	27/07/2023
Conference	17th Romphyschem	Presentation: Smart Systems for environment monitoring and biomedical applications	26/09/2023
Conference	2023 International Semiconductor Conference	Launching the NET4Air Networking Centre for Excellence in Nanoelectronics for Environment Monitoring	12/10/2023
Conference	2023 International Semiconductor Conference	Presentation: Enhancing NO2 gas sensing performance at room temperature using electrodeposited composite PPy-rGO-Fc	13/10/2023
Conference	2023 International Semiconductor Conference	Invited Talk: Emerging nanoscale materials for future generation of energy autonomous internet of thing devices	13/10/2023
Fair	GoTech World 2023	Sharing of leaflets	09/11/2023
Conference	2024 EMRS Spring Meeting 2024	Invited Talk: Investigation of 2D MoS2 grown at wafer scale and roadmap for future 2D MoS2 application for microelectronic and photonic applications	27/05/2024
Summit	27th World Micromachine Summit	Country Review for Romania	
Fair	GoTech World 2024	Sharing of leaflets	13/11/2024
Conference	2025 EMRS Spring Meeting 2025	Project Booth	26 - 30/05/2025
Summit	28th World Micromachine Summit	Country Review for Romania	
Conference	2025 EMFall Meeting 2025	Poster: Electrochemical synthesis and characterization of a Polyaniline : Azulene-tetrazole nanocomposite film for formaldehyde sensing	15/09/2025

7 Technical press releases, thematic portals, or industrial platforms

8 Publications

CONCLUSIONS

- **Successful implementation of the scientific project "Wearable and /or portable platform for air monitoring"** with clear way of continuation in other EU and National Projects and with strong links with industry
- **The Networking Centre for excellence** in **Nanoelectronics formed by joining together around the Consortium partners and the R&D actors** has been launched and is continuously working on the EU Network development and EU actions promotion.
- **New EU projects submitted with a good success rate**.
- Workshops, conferences, seminars organised and attended in numbers exceeding the plans;
- Staff exchanges, visits, secondments – all numbers achieved
- Increased number of publications
- Increased visibility and credibility
- **Increased experience in EU project coordination and a continuous learning process about project management and implementation.**

Partners

Tyndall National Institute
Institiúid Náisiúnta

ICMATE
Institute of Condensed Matter Chemistry and Technologies for Energy

IMT People

Carmen Moldovan

Director of Research Center CENASIC

Project coordinator, electronics background, expertise in design and technology (MEMS, micro-nanodevices), characterization.

Bogdan Firtat

Scientific Researcher

Senior scientist with PhD in smart systems for biomedical applications.

Octavian Ionescu

Scientific Researcher

Associate Prof. with an area of expertise in applied electronics and the production of renewable energy. He works in fields of smart, IoT connected sensors, electronics reliability.

Marian Ion

Scientific Researcher

Senior physicist and PhD with expertise in solid-state physics, thin films, and Wearable body sensors.

Carmen Mihailescu

Scientific Researcher

PhD in Chemistry and senior chemist with over 15 years of experience in the research and development of sensitive thin films for electronic devices.

Alexandru Grigoroiu

Scientific Researcher

Doctoral studies in AI applied to medical sciences and a Masters in biomedical, control and software engineering.

Mihaela Savin

Scientific Researcher

Senior chemist and PhD with expertise in the development of electrochemical sensors and nanocomposite polymeric materials.

George Muscalu

PhD Student

Electronic engineer with expertise in the development of microsensors and microsystems; Masters in microsystems.

Silviu Dinulescu

PhD Student

Having a Master degree in Electronics and Communications, he has expertise in portable electronic readout modules and system integration with low-power of MEMS energy harvesters

Costin Brasoveanu

Technological Development Engineer

Master degree in Microsystems with expertise in the development of microsensor technologies development.

Thank you!

Website: *www.net4air.eu*

Contact: *net4air.contact@imt.ro*