

# European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

**Final Meeting at PRAGUE (CZ), 5-7 October 2016**

***New Sensing Technologies for Air Quality Monitoring***

Action Start date: 01/07/2012 - Action End date: 15/11/2016 - EXTENSION: 15/11/2016

## Research and Innovation Needs of SIG3



**Marcel BOUVET**

Sub-WG 1.3 leader, MC member

Univ. Bourgogne Franche-Comté

Dijon / France

Substitute of Eduard LLOBET

Universitat Rovira i Virgili / Spain

 **cost**  
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



# Challenges in Air Quality Control

- **Background / Problem statement:** [What is the scientific context and what **challenges** are the Action WGs/SIGs addressing?]
- Develop stable transducers by mass production methods
  - Develop active materials by easy scalable methods
  - Integrate active materials in transducers reliably and inexpensively
- What is the effect of temperature and humidity on the transducers?
- Finding a rationale for choosing active material and transducer according to the target pollutant(s)
  - Which physical parameters change/ and which are measured?

# Research Goals in Air Quality Control

- **Background / Problem statement:** [What is the scientific context and what **research goals** are the Action SIG3 addressing?]

## Guidelines for best coupling Air Pollutant -Transducer

Pollutant	Transducer	Physical parameter
NO <sub>x</sub>	<b>Conductometric</b> (resistor, ChemFET, heterojunctions)	Conductivity
O <sub>3</sub>		(charge carriers density or mobility)
CO		Work function
CO <sub>2</sub>		Impedance
NH <sub>3</sub> , amines	<b>Resonant</b> (QCM, SAW, cantilevers)	Mass
H <sub>2</sub> S, thiols		Stiffness
VOCs (BTEX, formald.)	<b>Electrochemical</b> (amperometric, potentiometric)	Current or potential of a redox process Potential difference
PM	<b>Optical</b> (UV, Vis., NIR, IR, optical fibers)	Absorption
Mould		Emission
(SO <sub>2</sub> )		Dielectric constant

How a pollutant affects the physical parameter measured by the transducer?

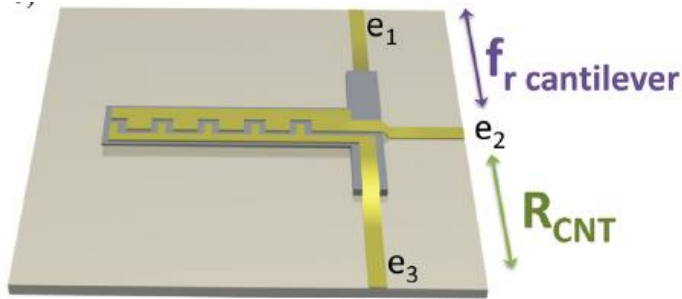
Multi modal sensor arrays:

- # materials
- # transducers
- # operation modes

# Research Goals in Air Quality Control

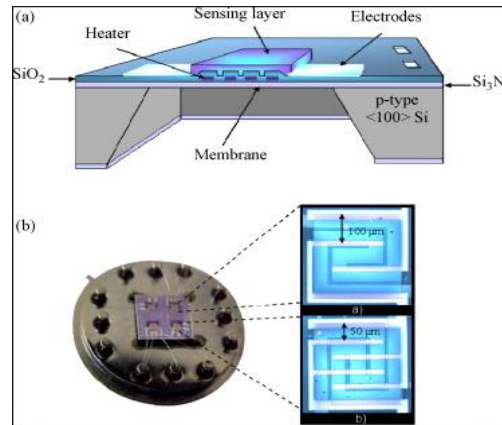
- **Background / Problem statement:** [What is the scientific context and what **research goals** are the Action SIG3 addressing?]

## # transducers

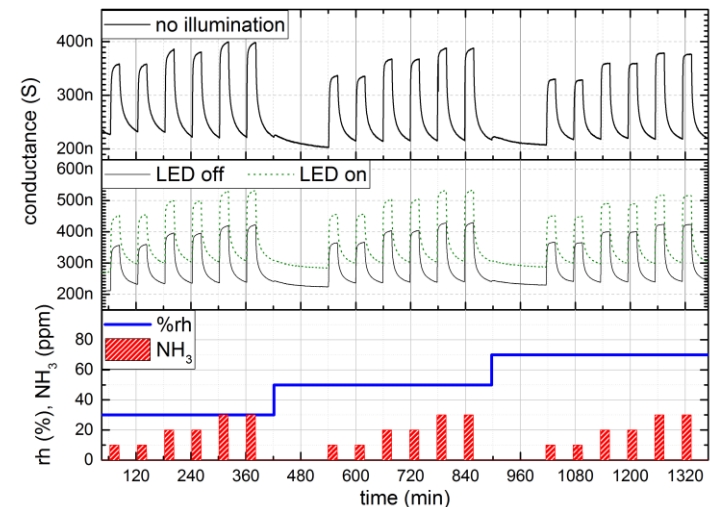


**Resistive and resonant transducers** (E. Llobet, Spain)

**Optical and conductometric transductions** with  $\text{Ln}^{3+}$  doped  $\text{SnO}_2$  or  $\text{TiO}_2$  (Tartu, Estonia)



## # operation modes



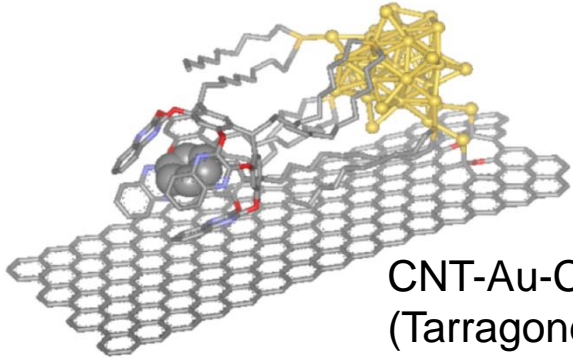
**Illumination effect on  $\text{NH}_3$  sensing** (Saarbrücken/Dijon, Germany/ France)

Hotplates for **thermal modulation**

# Research Goals in Air Quality Control

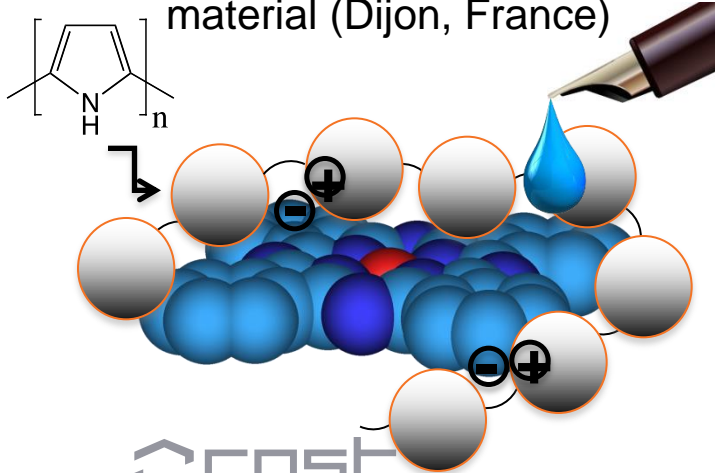
- **Background / Problem statement:** [What is the scientific context and what **research goals** are the Action SIG3 addressing?]

## # materials



CNT-Au-Cavitand  
(Tarragone, Spain)

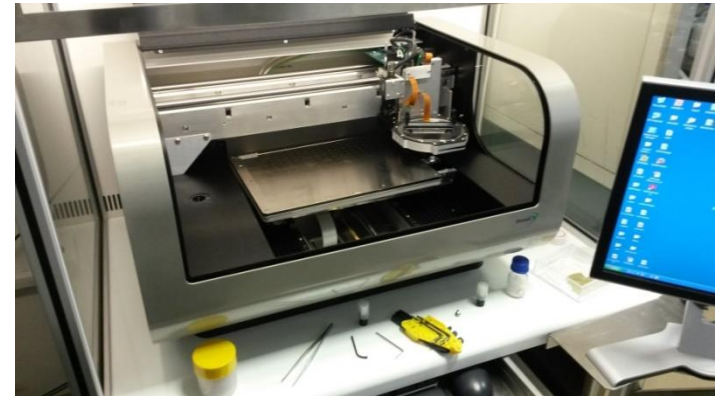
Electrodeposited PPy-MPc hybrid  
material (Dijon, France)



## Solution processing



Air-brushing set-up  
(Tarragone, Spain)



Inkjet printing of sensing  
materials (Forth, Greece)

# Priority Innovation Requirements in Air Quality Control

- **Background / Problem statement:** [What is the scientific context and what **priority innovation requirements** are the Action SIG3 addressing?]
  - To develop reproducible sensing materials by easy scalable methods (syntheses, deposition techniques, low temperature processing)
  - Sensing materials based inks for fully printed sensors
  - To include the study of humidity effects on sensors response

# CONCLUSIONS

## Suggested **R&I Needs** for future research to Action WGs/SIGs General Assembly

- Research directions as WGs R&I NEEDS for Action TD1105:
- Coupling air pollutants to transducers generally overlooked
- Detecting pollutants at required levels (e.g. ppb for toxic gases, detection of nanosized PM)
- Sensing materials based inks for fully printed sensors
- Appropriate testing of sensors under realistic conditions (concentrations, humidity) to speed up development time