



COST

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

COST Action TD1105

WGs and MC Meeting at Rome, 4-6 December 2012

Action Start date: 01/07/2012 - Action End date: 30/06/2016

Year: 2012-2013 (*Starting Action*)



Universitat
de Barcelona

J. Daniel Prades

WG1 – WG2 member

Training Schools Committee

Universitat de Barcelona / Spain



Department
of Electronics
Universitat de Barcelona

Scientific context and objectives in the Action

- **Brief reminder of MoU objectives:**
 - WG1:
 - Integration of nanomaterials into micromachined gas sensors
 - Development of gas nanosensors and microsensors
 - WG2:
 - Fabrication of gas sensors
 - Integration of nanostructures into AQC gas sensors
 - Design of new transducers for AQC gas sensors
- **Problem to address:**

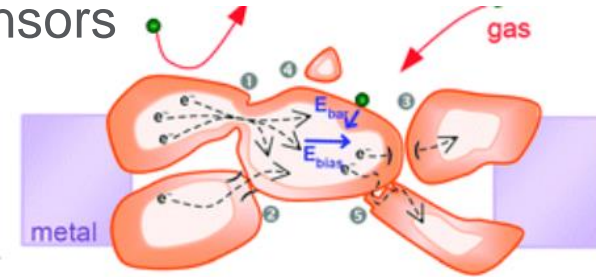
COST **POWER CONSUMPTION** **SELECTIVITY**

Current research activities of the Partner (1/3)

COST

- **Sensor type:** conductometric and ionization gas sensors based on metal oxides (€↓↓)

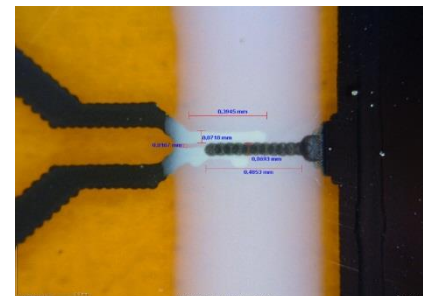
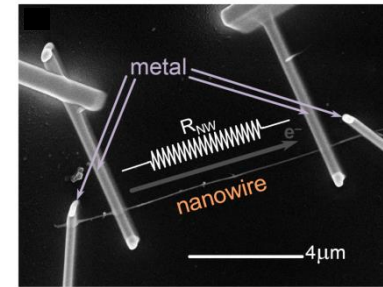
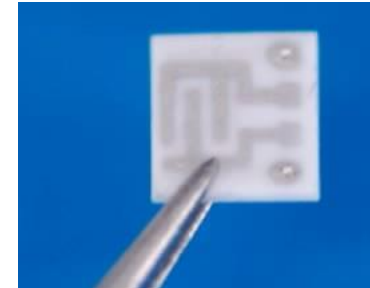
Sens. Actuators B 118, 198 (2006)



- **Fabrication:** cost effective integration of nanomaterials in sensor devices by means of:

- Focused Ion Beam Lithography (R&D)
- Dielectrophoresis (€↓↓)
- Ink-jet deposition
- Flexible and ceramic substrates

Phys. Rev. B 76, 085429 (2007)

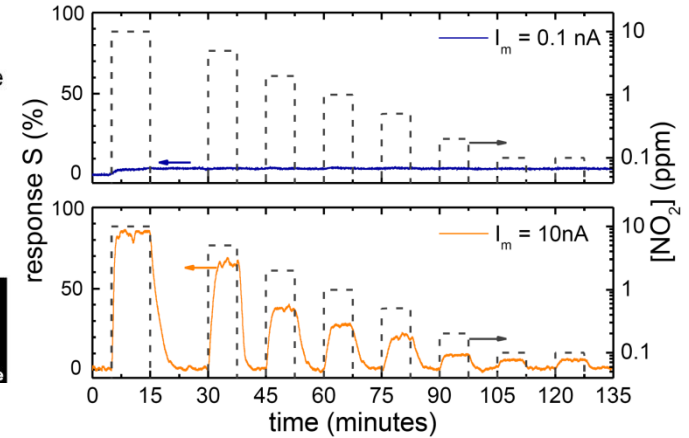
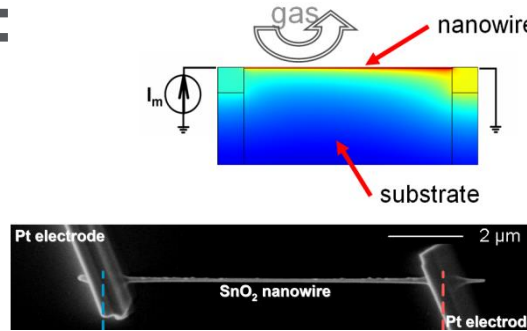


Current research activities of the Partner (2/3)

POWER CONSUMPTION

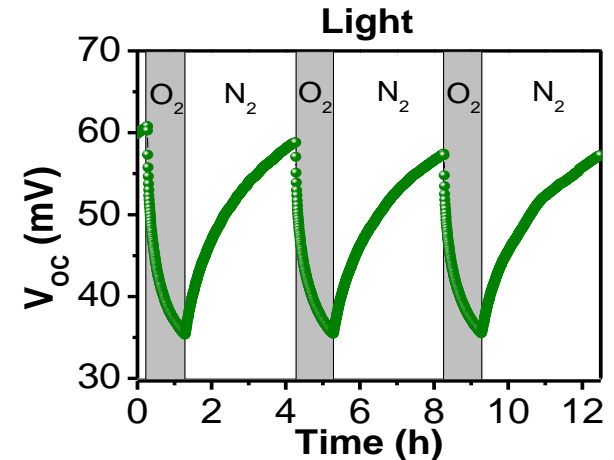
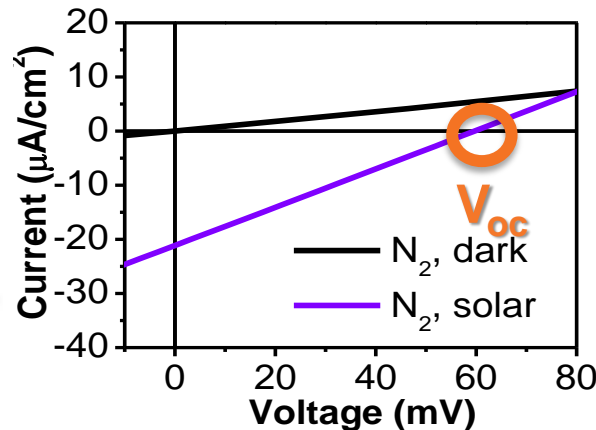
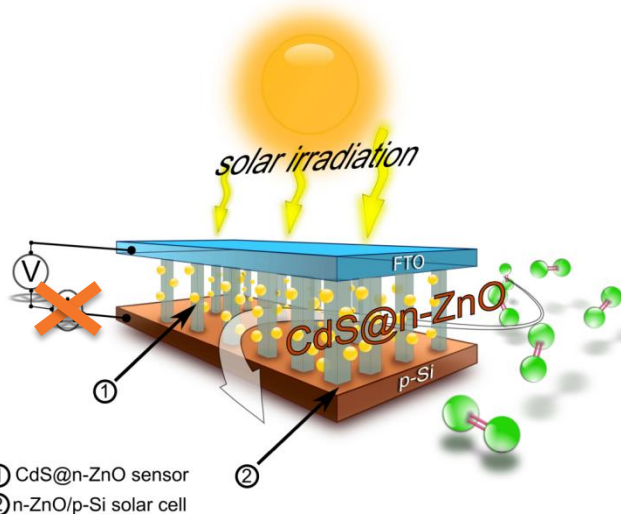
Appl. Phys. Lett. **93**, 123110 (2008)

- Heated gas sensors: self-heating in individual nanowires ($\sim 10\mu\text{W}$)



- Illuminated gas sensors: solar diode sensor (**ZERO POWER**)

Nanotechnology (2012)



Current research activities of the Partner (3/3)

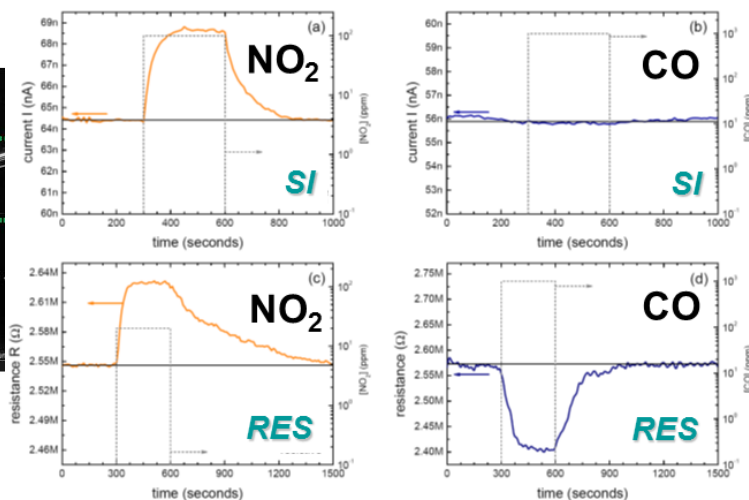
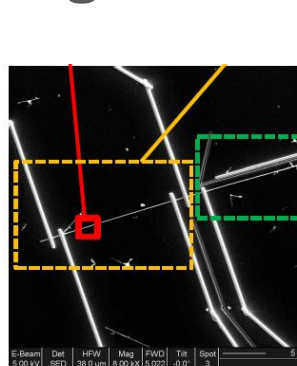
SELECTIVITY

• Surface ionization sensors: integration at the nanoscale

- Combined conductom./ionization
- Self-heating driven
- Low voltage operation

(1KV → 1V)

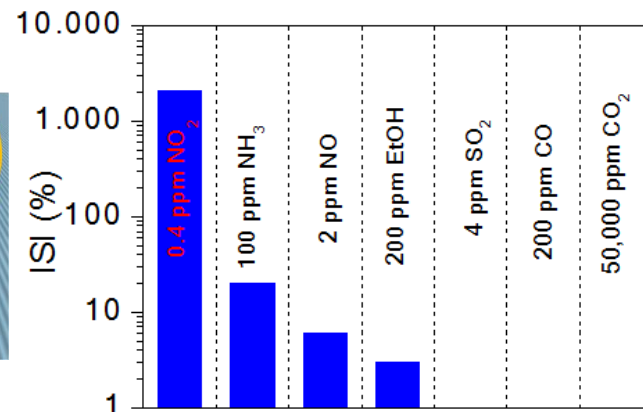
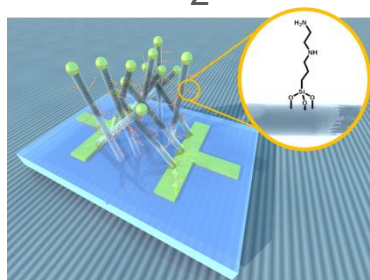
Nanoscale 3, 630-634 (2011)



• Bio-inspired surface modification:

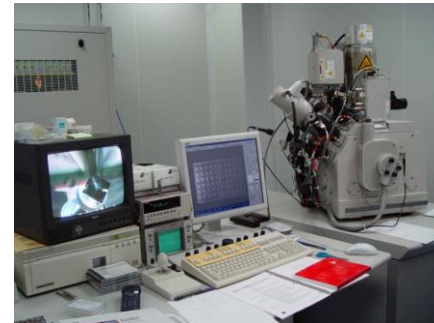
- **ULTRA-HIGH SELECTIVITY** towards NO_2
- HIGH sensitivity: up to 200.000% @ 200ppb

Angew. Chem. (2012)



Research Facilities available for the Partner (1/1)

- **Research Facilities:**
 - **Chemical synthesis and materials processing and deposition:** ink-jet, electrospray, screen-printing
 - **Device characterization and gas test laboratory.**
 - **Cleanroom:** class 1000, standard photolithography, e-Beam and FIB lithography, metallization, dicing, passivation, packaging, and nanomaterials growth.
 - **Central Characterization Services:** microscopy (optical, SEM, TEM, AFM), microanalytics (EDX, EBIC, cathodolumin., EELS, HAADF, STM), spectroscopy (XPS, Auger, XRD, Raman, FTIR, UV-vis), and analytical chemistry (mass spectroscopy, calorimetry, NMR).



Suggested **Priorities** for future research (1/1)

- Research directions as **PRIORITIES**:

- Self-heated nanowires:

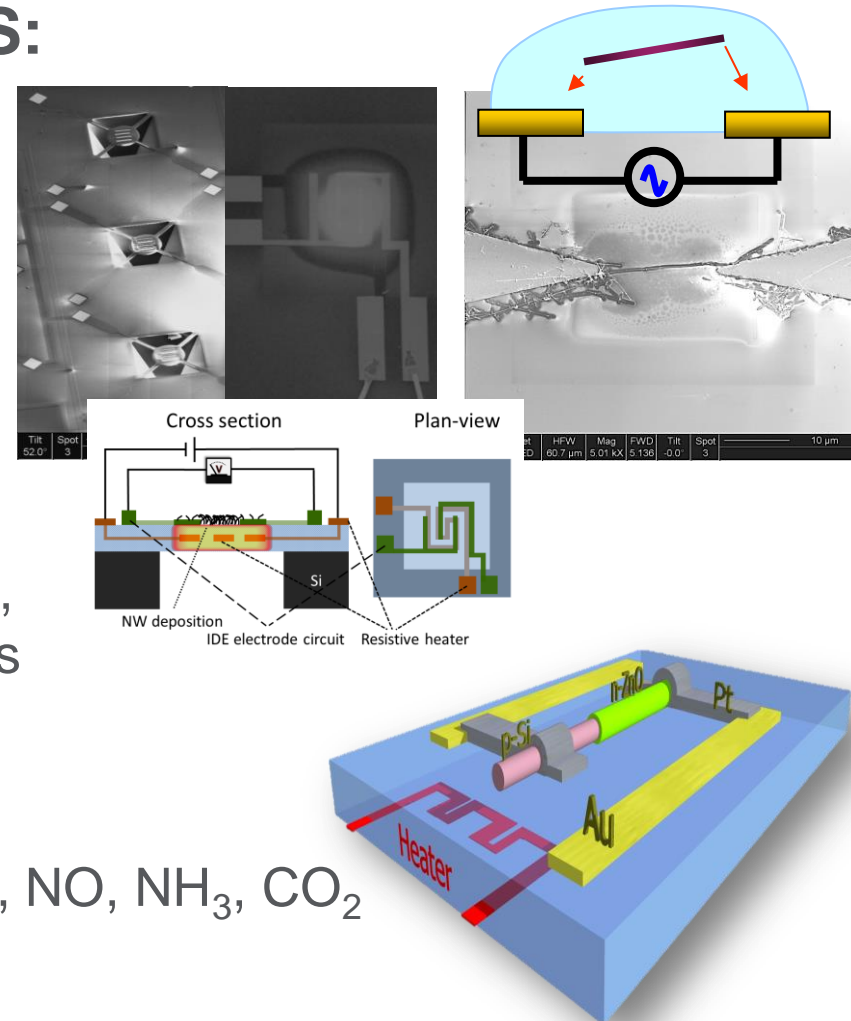
- scalable and cost effective integration of individual nanowires for ultra-low power consumption

- Solar diode sensors:

- development beyond proof of concept, integration in microelectronic platforms

- Bio-inspired functionalizations:

- extension to target gases such as CO, NO, NH₃, CO₂



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