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

COST Action TD1105

1ST TRAINING SCHOOL

Universitat de Barcelona, Spain, 13 - 15 June 2013

organized by UB, MIND-IN2UB - Dept. of Electronics and CSIC-IDAEA

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

Year 1: 2012 - 2013 (*Ongoing Action*)

Centro Nacional de Microelectrónica IMB

CSIC
Consejo Superior de Investigaciones Científicas

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Spain

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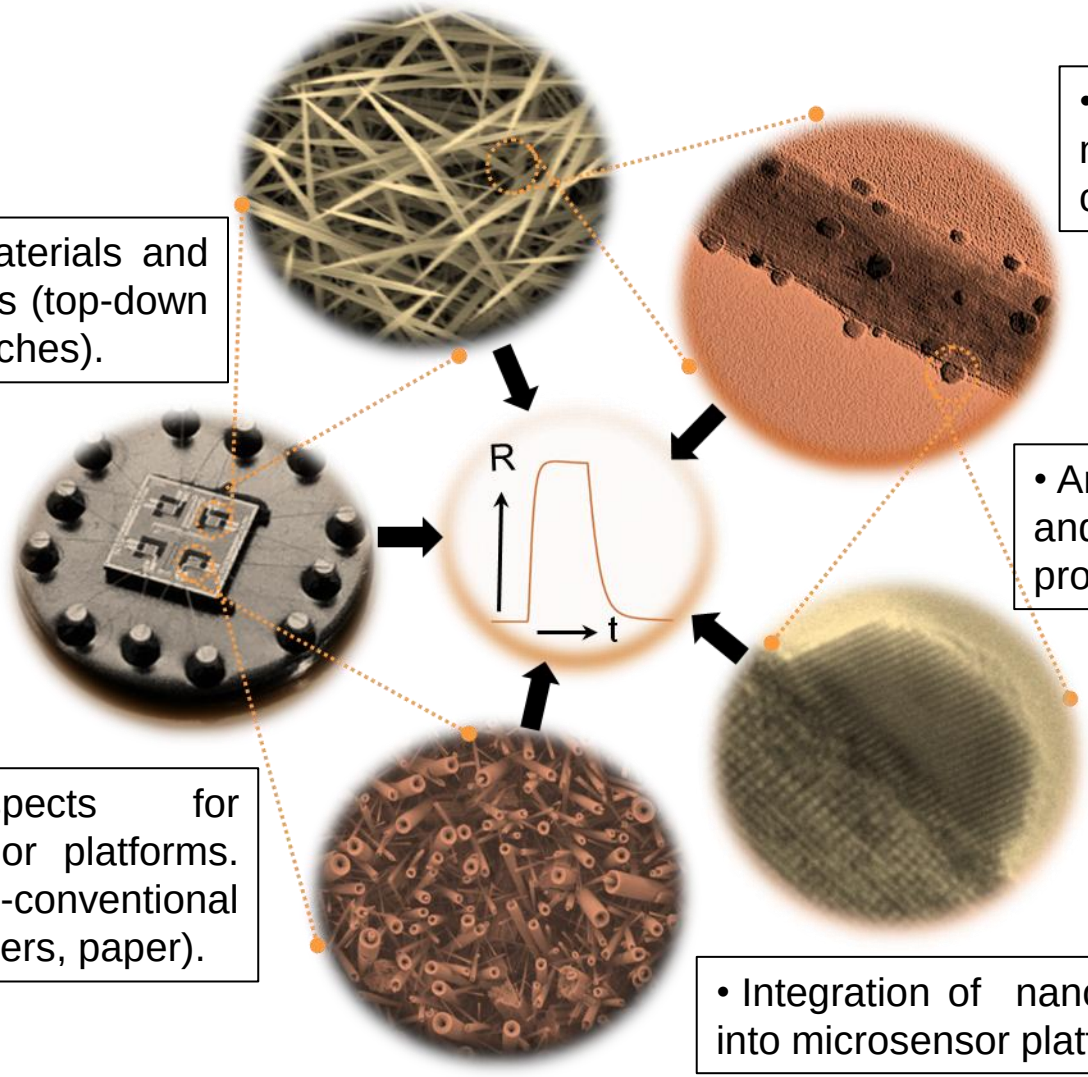
Expertise

- **Thin film deposition techniques and synthesis of functional nanomaterials and nanostructures.**
- **Analysis and characterization of thin films and nanostructures.**
- **Metal oxide gas sensor fabrication and testing.**
- **Fabrication and technology of devices**

Current research activities



• Synthesis of nanomaterials and sensing nanostructures (top-down and bottom-up approaches).

• Development of functional nanomaterials and nano-composites structures.

• Analysis of material properties and nanosize effects on sensing properties.

• Technologic aspects for optimizing the sensor platforms. Evaluation of non-conventional substrate (e.g. polymers, paper).

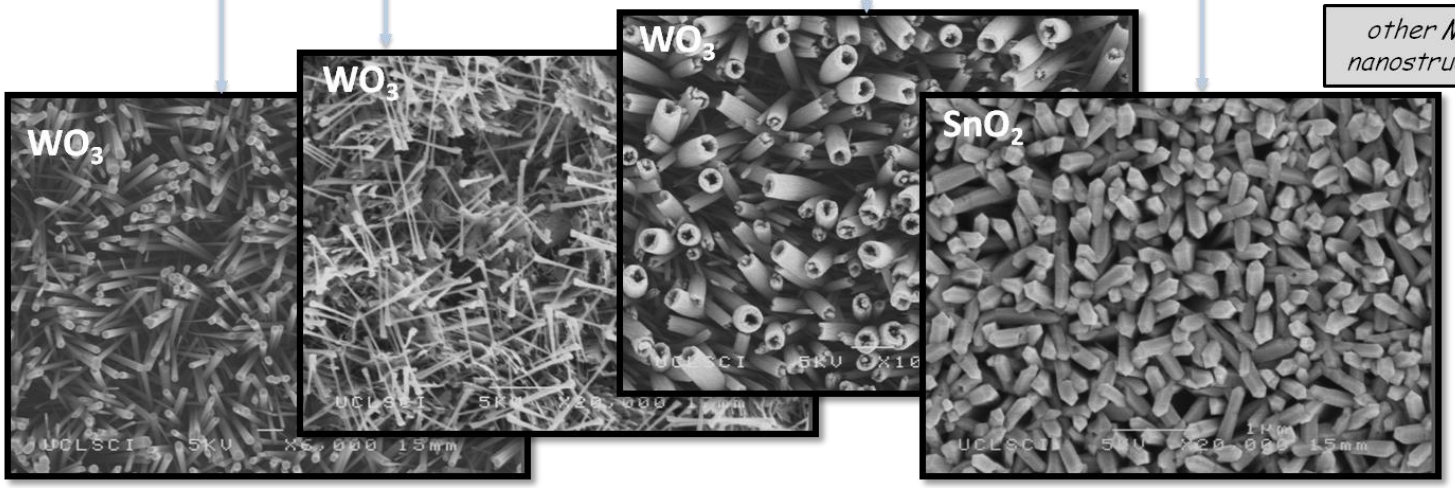
• Integration of nanomaterials into microsensor platforms.

In collaboration with Universitat Rovira i Virgili, University College London, Centro Nacional de Microelectrónica (IMB-CNM, CSIC)

RESULTS

Selective deposition of nanostructures via Aerosol Assisted CVD

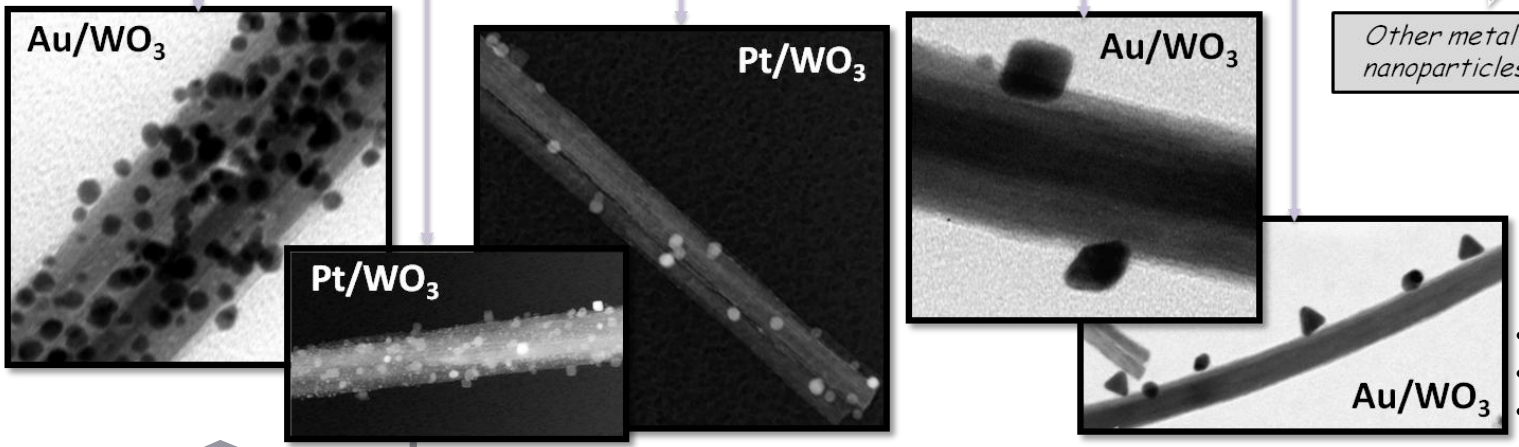
needles → hollow tubes → tubes → other MOX nanostructures



- Chem. Vap. Dep. 2011, 17, 247
- J. Nanosci. Nanotechnol. 2011, 11,1
- Inorg. Chim. Acta, 2012, 380, 328
- Sens. Actuator B 2012, 161, 406

Co-deposition of MOX nanostructures and metal nanoparticles

uniform metal nanoparticles → metal nanoparticles control shape → Other metal nanoparticles

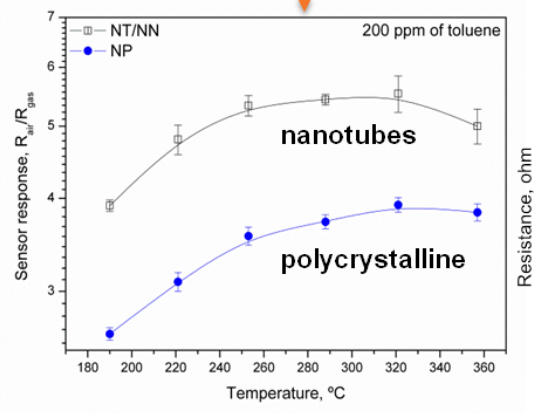


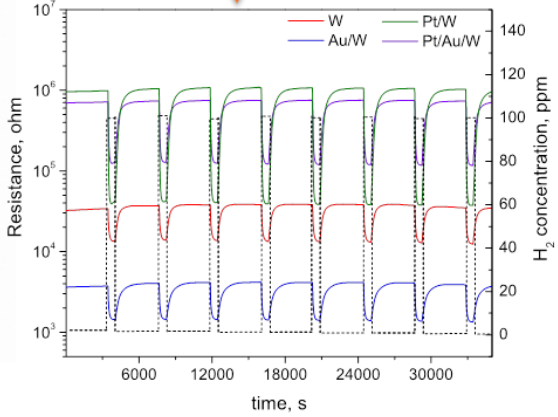
- Chem.Comm. 2011, 47, 565
- Adv.Funct.Mat. 2013, 23, 1313
- Mat. Chem . Phys, 2012, 134, 809

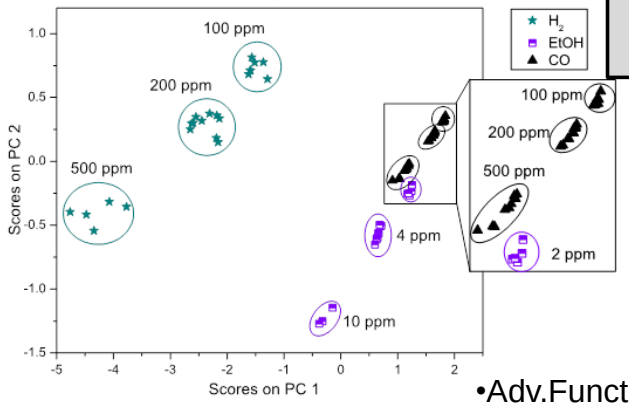
RESULTS

Gas sensing tests (tungsten oxide)

Sensitivity improvements → *Better reproducibility and stability* → *Potential for selective gas detection*





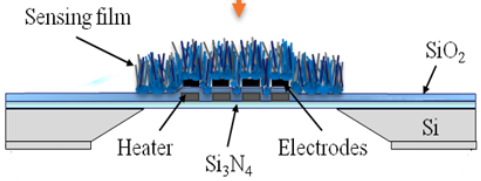


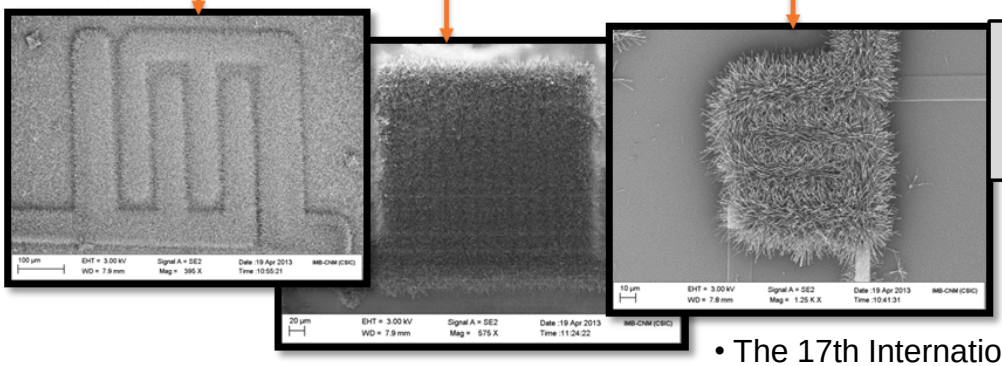
Analysis of the surface interactions

- Adv.Funct.Mat. 2013, 23, 1313
- Sens. Actuator B 2012, 161, 406

Integration of nanostructures and microsensor technology

Direct integration of nanostructures with microsensors via AACVD (hot-wall reactor or localized heating of the device) → *Optimization of the sensor platforms to nanostructured sensing materials*





Evaluation of various transducer configurations

- The 17th International Conference on Solid-State Sensors, Actuators and Microsystems

CONCLUSIONS

Achievements:

- Aerosol Assisted CVD has shown to provide a new and versatile route to develop and integrate functional nanostructured MOX for device applications, with the advantage of fewer step processes, relatively low processing temperature and no requirement for substrate pre-treatment.

- The sensing properties of these structures showed improved sensitivities, high reproducibility and potential for improving selectivity by using microsensor arrays.

Challenges and issues:

- Modulation of nanoparticles shapes, size and distribution in functionalized structures.

- Optimization of the sensor platforms to advanced sensing materials and nanostructures

- Exploring the interaction and mechanism of gas sensing in metal nanoparticles supported on metal oxides.