

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

COST Action TD1105

WGs and MC Meeting at SOFIA, 16-18 December 2015

Action Start date: 01/07/2012 - Action End date: 30/04/2016

Year 4: 1 July 2015 – 30 April 2016 (*Ongoing Action*)

Research and Innovation Needs of WG1: Sensor Materials and Nanotechnology



UNIVERSITY of OULU
OULUN YLIOPISTO

Prof. Jyrki Lappalainen

WG1: Sensor Materials and
Nanotechnology (Vice-Chair)

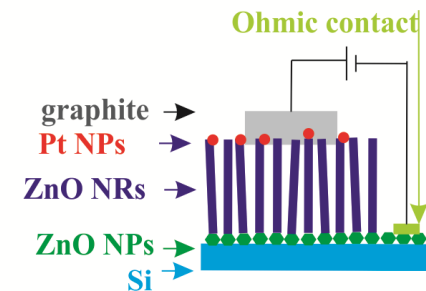
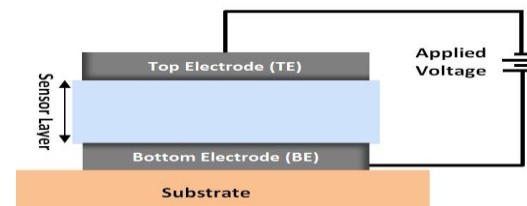
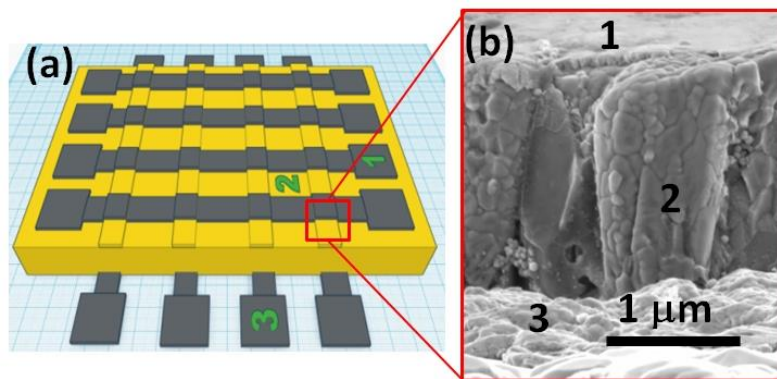
University of Oulu, Finland

 **cost**
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY



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

- **Research directions as WGs R&I NEEDS for Action TD1105:**
 1. Vertical resistive sensor structures utilizing the gas concentration gradient, high electric field modulation, and component aspect ratio to increase sensitivity and decrease operation temperature towards RT (100-200 °C).
 2. Structural tailoring of semiconductor oxides like TiO_2 by doping.

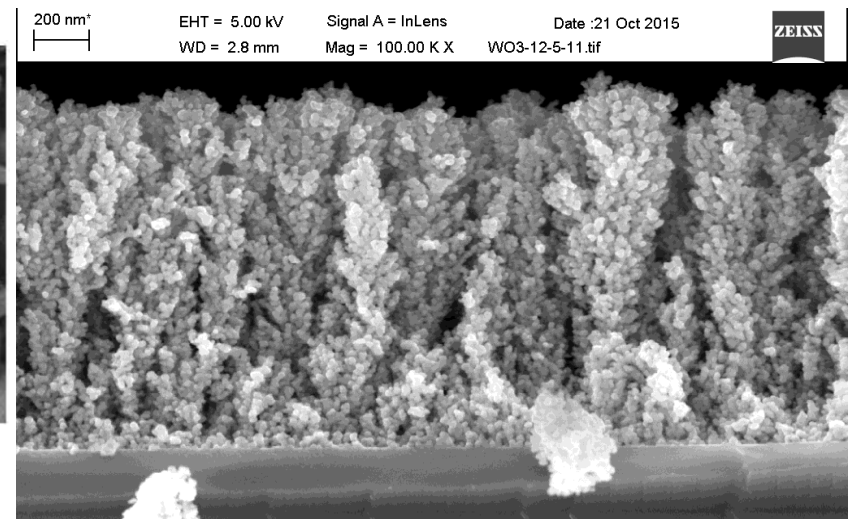
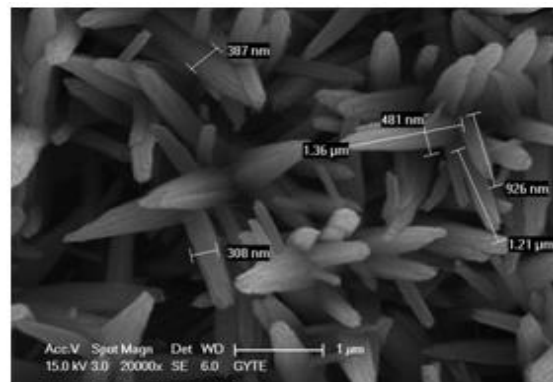
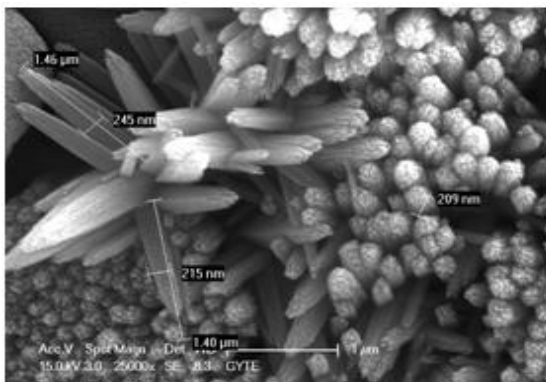


Suggested **R&I Needs** for future research to Action WGs/SIGs General Assembly

- **Research directions as WGs R&I NEEDS for Action TD1105:**

3. Developing further the nanostructured metal oxides. Using pulsed laser deposition (PLD) in fabrication of nanostructured MOX sensing layers of nanoparticles, nanotress, and fractals in 10-nm range!

4. Fabrication of MOX nanofibres, nanotubes, and nanostars, for example of ZnO and TiO₂, and decoration with Pd/Pt nanoparticles.



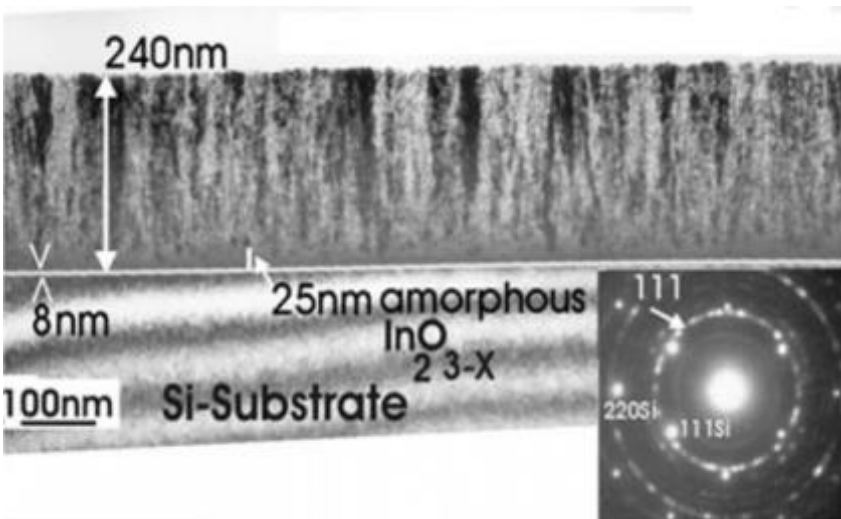
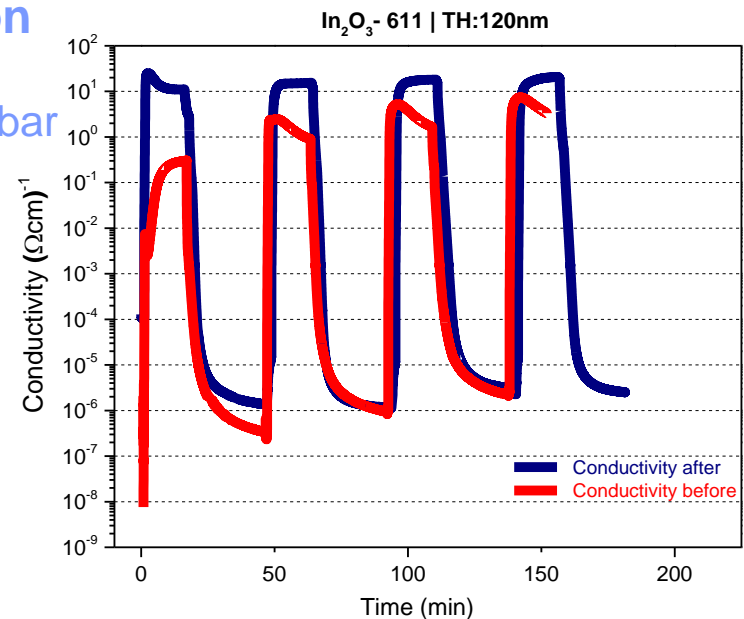
Suggested **R&I Needs** for future research to Action WGs/SIGs General Assembly

- **Research directions as WGs R&I NEEDS for Action TD1105:**

5. Photon flux activation of the conductivity, chemical surface adsorption and reactions, and also local heating of the sensor material in order to decrease the operation temperature of the sensor element.

Photoreduction
with 254nm /
2 mW/cm² 800mbar
vacuum

Oxidation
with 500sccm
ozone flow @
800mbar





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

- Studying the effects of sensor geometry in more details to understand the operation of the vertical resistive sensor.
- Understanding the physical ackround involved with photon excited sensing processes in deteils.
- Combining the two above for low-temperature operation and low-energy consumption sensors.
- Detailed structural modification and characterization of MOX nanostructures in order to *optimize sensitivity and stability*.
- *Utilization of mixed-phase- and heterostructures, composites, and utilization, for example, p-n junctions in gas sensing process.*