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

COST Action TD1105

2nd International Workshop *EuNetAir* on

New Sensing Technologies for Indoor and Outdoor Air Quality Control

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Pd-Doped ZnO Nanorods for VOCs Sensing

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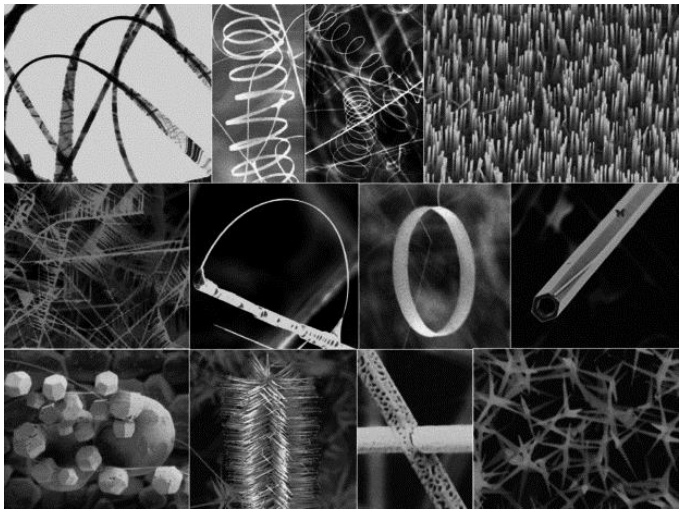
MOTIVATION

Zinc Oxide (ZnO)

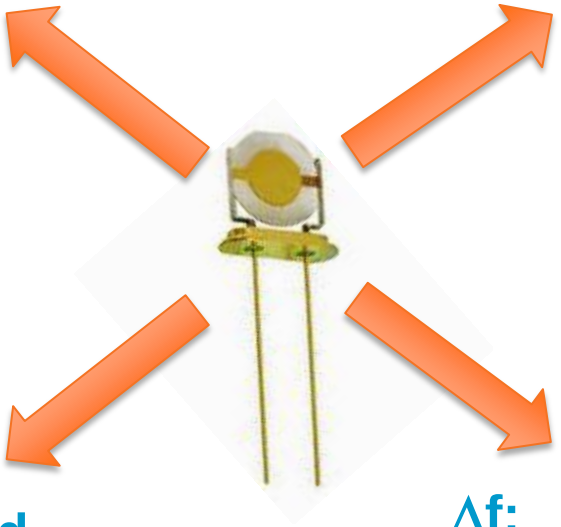
- Native n-type semiconductors
- Piezoelectric properties
- Spintronics applications (:Mn, Co, Fe,…)
- *Solution, **Vapor and ***Lithography for nanostructured ZnO
- 0D, 1D, **2D** and 3D forms
  - **Nanorods,**
  - **Nanowires**
  - **Nanotubes**



Sensing Materials and Transducers

Gold Electrode

10 MHz



Modified Pd
Doped ZnO NR

Δf: Sensor
Responses

VOCs Sensing

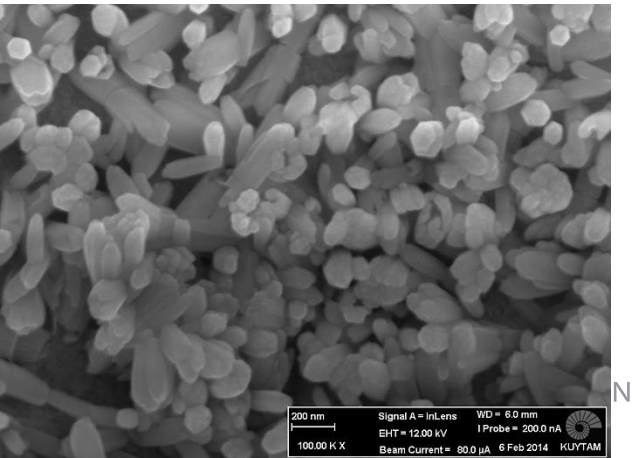
Room Temprature

Test Samples and Analytes

- Palladium (Pd) doped ZnO nanorods on gold electroded QCM transducers (10 MHz)
- Nanorods were fabricated on both sides of QCM
- Solution based process for doped undoped ZnO nanorods

Doping Concentrations of ZnO nanorods

0%
0.02%
0.5%
1.5%
2.5%



Analytes

- Alcohols
  - Ethanol
  - Methanol
  - Isopropyl Alcohol
- Aromatics
  - Xylene
  - Toluene
- Ester
  - Ethyl Acetate
- Ketone
  - Acetone
- Chlorinated
  - Chloroform

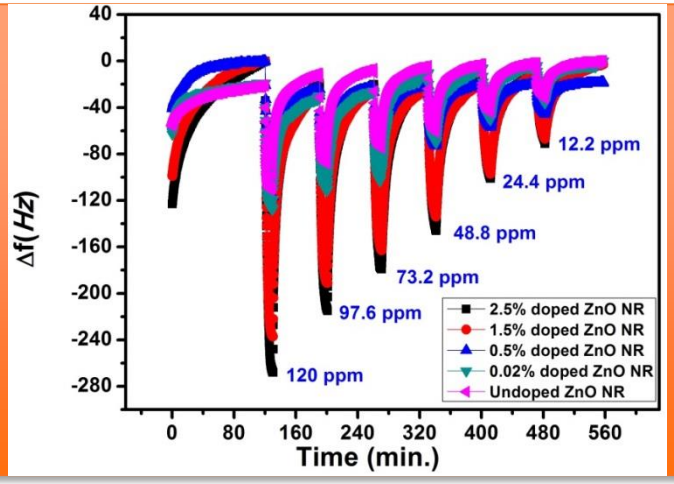
Test Conditions

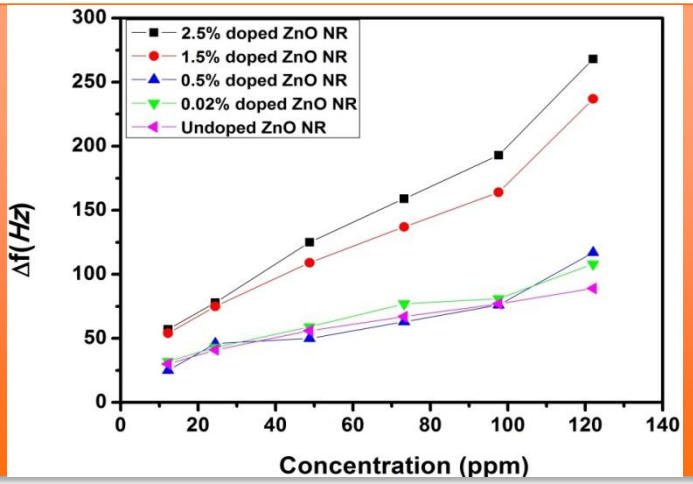
- **Test Ambient:** Dry Air
- **Total Flow:** 1000 ml/min
- **Test Temperature:** 25°C

Analyte	TLV* (ppm)	Density (gr/ml)	Test Concentrations (ppm)
Ethanol	1000	0.8115	122-12.2
Methanol	200	0.7919	242-24.2
Isopropyl Alcohol	400	0.783	97-9.7
EthylAcetate	400	0.90	508-50.8
m-Xylene	100	0.864	29-2.9
Toluene	50	0.862	116-11.6
Acetone	500	0.786	720-72
Chloroform	10	1.481	760 -76

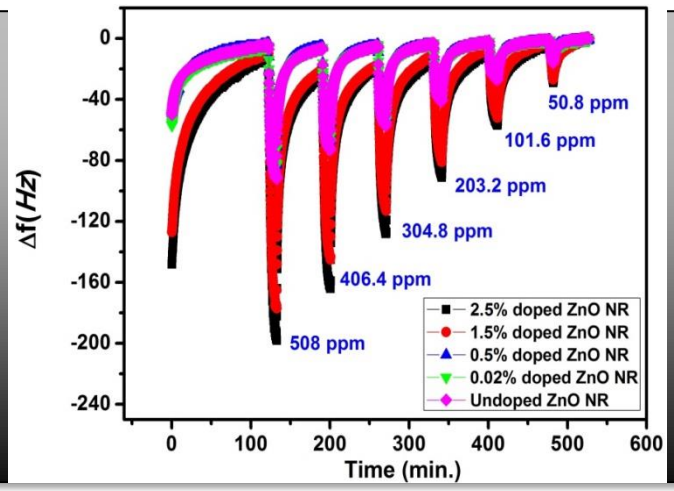
*: *Threshold Limit Values*

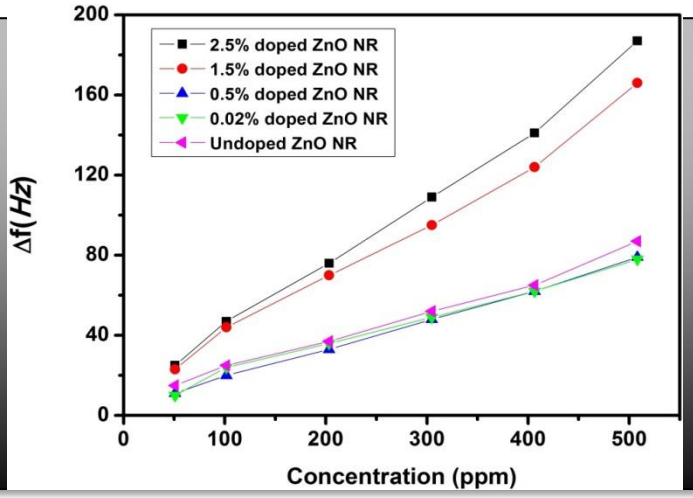
Result and Discussions





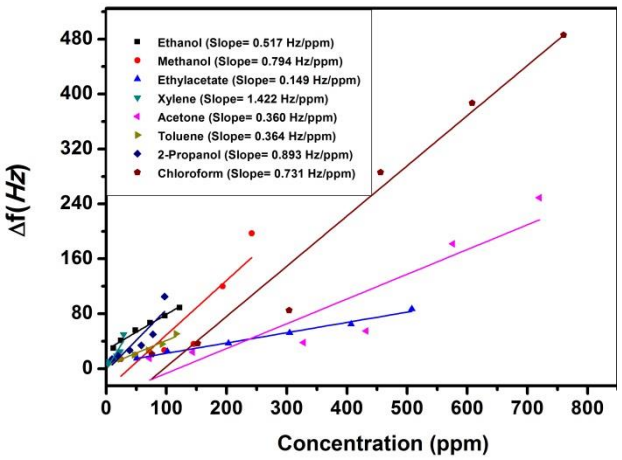
Ethanol



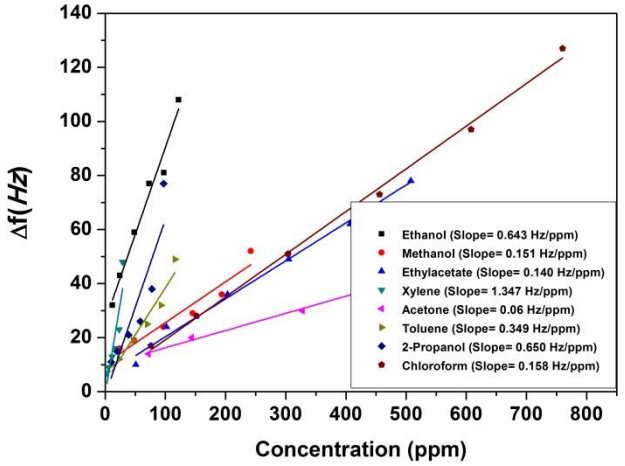


Ethyl Acetate

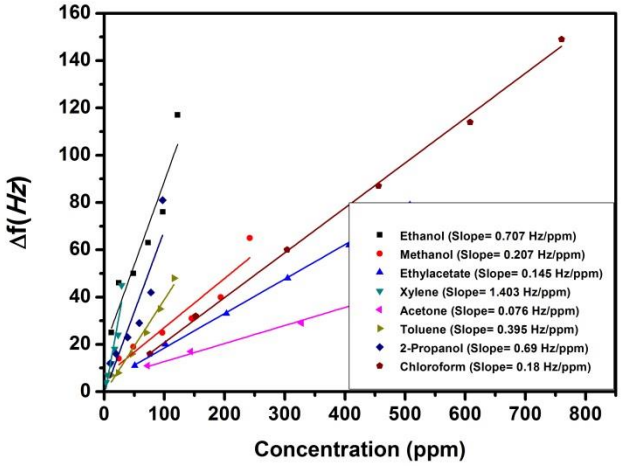
Undoped ZnO NRs



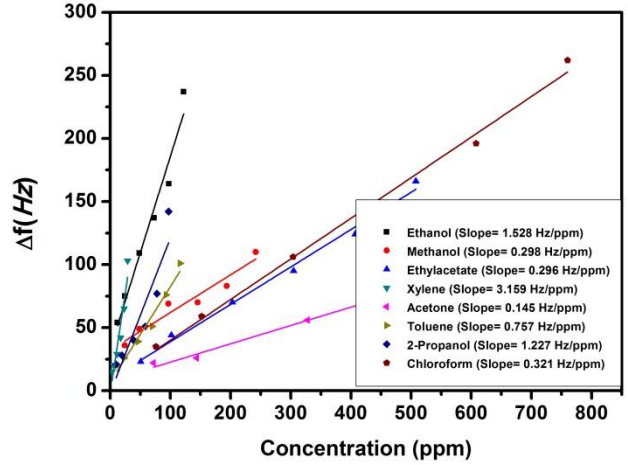
0.02% doped ZnO NRs



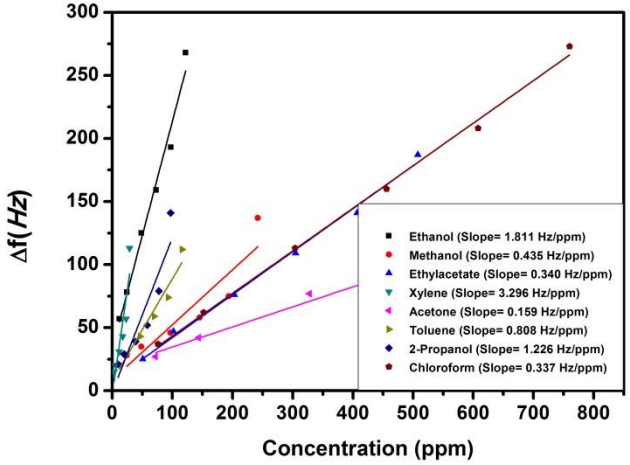
0.05% doped ZnO NRs

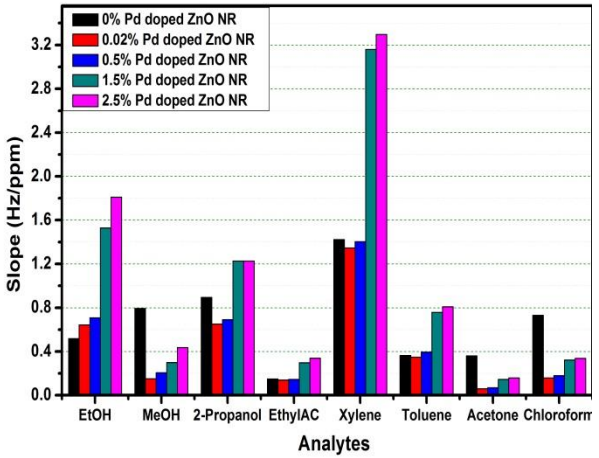


1.5% doped ZnO NRs



2.5% doped ZnO NRs





CONCLUSIONS

- ***NRs on QCM Transducers,***
- ***Metal doping of metal oxide NRs,***
- ***VOCs sensing,***
- ***Responses inreased with doping concentrations,***
- ***Low operation temperature;***
- ***Low selectivity,***

ACKNOWLEDGEMENT

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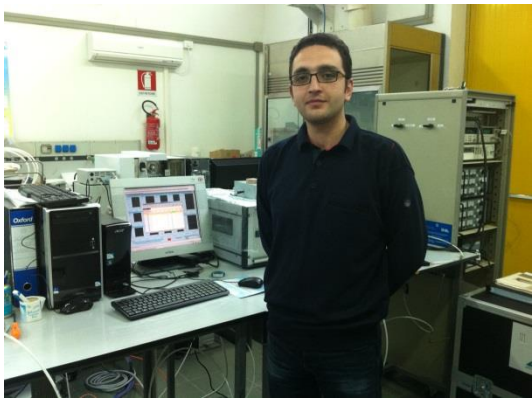

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thank you
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hvala
gracias
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